LICENSE RENEWAL APPLICATION

Byron and Braidwood Stations, Units 1 and 2

Byron Unit 1, Facility Operating License
No. NPF-37

Byron Unit 2, Facility Operating License
No. NPF-66

Braidwood Unit 1, Facility Operating License
No. NPF-72

Braidwood Unit 2, Facility Operating License
No. NPF-77

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1.0 ADMINISTRATIVE INFORMATION

1.1 GENERAL INFORMATION - 10 CFR 54.19

1.1.1 NAME OF APPLICANT

Exelon Generation Company, LLC (Exelon), hereby applies for renewed operating licenses for Byron Station, Units 1 and 2 and Braidwood Station, Units 1 and 2 (Byron and Braidwood Stations, Units 1 and 2).

1.1.2 ADDRESS OF APPLICANT

Exelon Generation Company, LLC
200 Exelon Way
Kennett Square, PA 19348

1.1.3 DESCRIPTIONS OF BUSINESS OR OCCUPATION OF APPLICANT

Exelon Generation Company, LLC is a Delaware limited liability company which is wholly owned by Exelon Ventures Company, a Delaware limited liability company, which in turn is wholly owned by Exelon Corporation, a corporation formed under the laws of the Commonwealth of Pennsylvania. Exelon Generation Company, LLC is the licensed operator of Byron and Braidwood Stations, Units 1 and 2, which are the subject of this application. The current Byron and Braidwood Station operating licenses will expire as follows:

- At midnight on October 31, 2024 for Byron Station, Unit 1 (Facility Operating License No. NPF-37)
- At midnight on November 6, 2026 for Byron Station, Unit 2 (Facility Operating License No. NPF-66)
- At midnight on October 17, 2026 for Braidwood Station, Unit 1 (Facility Operating License No. NPF-72)
- At midnight on December 18, 2027 for Braidwood Station, Unit 2 (Facility Operating License No. NPF-77

Exelon Generation Company, LLC will continue as the licensed operator on the renewed operating licenses.

1.1.4 DESCRIPTIONS OF ORGANIZATION AND MANAGEMENT OF APPLICANT

Exelon Generation Company, LLC, is organized under the laws of the State of Delaware. Exelon Corporation is a corporation organized under the laws of the Commonwealth of Pennsylvania with its headquarters and principal place of business in Chicago, Illinois.

Exelon Corporation is a publicly traded corporation whose shares are widely traded on the New York Stock Exchange. Exelon Ventures Company, LLC (Exelon Ventures) is a wholly owned subsidiary of Exelon Corporation. The directors and principal officers of Exelon Generation Company, LLC, Exelon Ventures, and Exelon Corporation are U.S. citizens. Neither Exelon Generation Company, LLC, nor its parent, Exelon Ventures, are owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government. The principal officers of Exelon Generation Company, LLC and their addresses are presented below:

Principal Directors and Officers (Exelon Generation Company, LLC)

Name	**Title**	**Address**
Christopher M. Crane	President	10 S. Dearborn Street Chicago, IL 60680
Michael J. Pacilio	Senior Vice President Exelon Generation; President and Chief Nuclear Officer, Exelon Nuclear	4300 Winfield Road Warrenville, IL 60555
Bryan P. Wright	Senior Vice President and Chief Financial Officer	Candler Bldg – 6th Floor – Drop E Baltimore, MD 21202
Kenneth W. Cornew	President, Exelon Power Team	111 Market Place Baltimore, MD 21202
Ronald J. DeGregorio	Senior Vice President Exelon Generation; President, Exelon Power	300 Exelon Way Kennett Square, PA 19348
John F. Barnes	Chief Operating Officer, Exelon Power; Senior Vice President, Exelon Generation	300 Exelon Way Kennett Square, PA 19348
Joseph P. Grimes, Jr.	Senior Vice President, Engineering and Technical Services	200 Exelon Way Kennett Square, PA 19348
Bryan C. Hanson	Senior Vice President, Midwest Operations	4300 Winfield Road Warrenville, IL 60555
Faber A. Kearney	Site Vice President, Byron Station, Units 1 and 2	4450 North German Church Road Byron, Illinois 61010
Daniel J. Enright	Site Vice President, Braidwood Station, Units 1 and 2	35100 South Rt. 53 Braceville, Illinois 60407
Michael P. Gallagher	Vice President, License Renewal Projects	200 Exelon Way Kennett Square, PA 19348

1.1.5 CLASS OF LICENSE, USE OF THE FACILITY, AND PERIOD OF TIME FOR WHICH THE LICENSE IS SOUGHT

Exelon Generation Company, LLC requests renewal of the Class 103 operating licenses for Byron and Braidwood Stations, Units 1 and 2, for a period of 20 years beyond the expiration of the current licenses to allow continued use of the facilities for the commercial generation of electricity. The Byron Station Unit 1 license (NPF-37) expires at midnight on October 31, 2024 and the Byron Station Unit 2 license (NPF-66) expires at midnight on November 6, 2026. The Braidwood Station Unit 1 license (NPF-72) expires at midnight on October 17, 2026 and the Braidwood Station Unit 2 license (NPF-77) expires at midnight on December 18, 2027.

In this application, Exelon Generation Company, LLC also requests the renewal of specific licenses under 10 CFR Parts 30, 40, and 70 that are subsumed in or combined with the current operating licenses.

1.1.6 EARLIEST AND LATEST DATES FOR ALTERATIONS, IF PROPOSED

No physical plant alterations or modifications have been identified as necessary in connection with this application.

1.1.7 RESTRICTED DATA

With regard to the requirements of 10 CFR 54.17(f), this application does not contain any “Restricted Data,” as that term is defined in the Atomic Energy Act of 1954, as amended, or other defense information, and it is not expected that any such information will become involved in these licensed activities.

In accordance with the requirements of 10 CFR 54.17(g), the applicant will not permit any individual to have access to, or any facility to possess, restricted data or classified national security information until the individual and/or facility has been approved for such access under the provisions of 10 CFR Parts 25 and/or 95.

1.1.8 REGULATORY AGENCIES

Exelon Generation Company, LLC recovers its share of the costs incurred from operating Byron and Braidwood Stations, Units 1 and 2, in its own wholesale rates. The rates charged and services provided by Exelon Generation Company, LLC are subject to regulation by the Federal Energy Regulatory Commission under the Federal Power Act. Exelon Generation Company, LLC is also subject to regulation as a public utility company by the Securities and Exchange Commission under the Public Utility Holding Company Act of 1935, as amended.

Securities and Exchange Commission
450 Fifth Street, NW
Washington, DC 20549

Federal Energy Regulatory Commission
888 First St. N.E.
Washington, DC 20426

1.1.9 LOCAL NEWS PUBLICATIONS

News publications in circulation near Byron Station, Units 1 and 2 that are considered appropriate to give reasonable notice of the application are as follows:

Byron Tempo
PO Box 982
418 W. Blackhawk LL3
Byron, IL 61010

Oregon Republican Reporter
121A S. Fourth St.
Oregon, IL 61061

Ogle County Life
311 W. Washington St.
Oregon, IL 61061

Rockford Register Star
99 E. State St.
Rockford, IL 61104

News publications in circulation near Braidwood Station, Units 1 and 2 that are considered appropriate to give reasonable notice of the application are as follows:

Braidwood Journal, Coal City Courant, Wilmington Free Press
111 S. Water Street
Wilmington, IL 60481

Joliet Herald News
300 Caterpillar Drive
Joliet, IL 60436

Morris Daily Herald
1804 N. Division
Morris, IL 60450

The Daily Journal (Kankakee)
8 Dearborn Square
Kankakee, IL 60901

1.1.10 CONFORMING CHANGES TO STANDARD INDEMNITY AGREEMENT

10 CFR 54.19(b) requires that “each application must include conforming changes to the standard indemnity agreement, 10 CFR 140.92, Appendix B, to account for the expiration term of the proposed renewed license.” The current indemnity agreements (Agreement No. B-97 for Byron Station, Units 1 and 2 and Agreement No. B-102 for Braidwood Station, Units 1 and 2) each state in Article VII that the agreement shall terminate at the time of expiration of that license specified in Item 3 of the Attachment to the agreement, which is the last to expire; provided that, except as may otherwise be provided in applicable regulations or orders of the Commission, the term of this agreement shall not terminate until all the radioactive material has been removed from the location and transportation of the radioactive material from the location has ended as defined in subparagraph 5(b), Article I. Item 3 of the Attachment to the respective indemnity agreements, as amended, includes license numbers NPF-37 (Byron Station Unit 1), NPF-66 (Byron Station Unit 2), NPF-72 (Braidwood Station Unit 1) and NPF-77 (Braidwood Station Unit 2). Applicant requests that any necessary conforming changes be made to Article VII and Item 3 of the Attachment for the Byron and Braidwood indemnity agreements, and any other sections of the respective indemnity agreements as

appropriate to ensure that the indemnity agreements continue to apply during both the terms of the current licenses and the terms of the renewed licenses. Applicant understands that no changes may be necessary for this purpose if the current license numbers are retained.

1.2 GENERAL LICENSE INFORMATION

1.2.1 APPLICATION UPDATES, RENEWED LICENSES, AND RENEWAL TERM OPERATION

In accordance with 10 CFR 54.21(b), during NRC review of this application, an annual update to the application to reflect any change to the current licensing basis that materially affects the contents of the license renewal application will be provided.

In accordance with 10 CFR 54.21(d), Exelon Generation Company, LLC will maintain a summary list in the Byron/Braidwood Nuclear Stations Updated Final Safety Analysis Report (UFSAR) of activities that are required to manage the effects of aging for the systems, structures or components in the scope of license renewal during the period of extended operation and summaries of the time-limited aging analyses evaluations.

1.2.2 INCORPORATION BY REFERENCE

There are no documents incorporated by reference as part of the application. Any document references, either in text or in Section 1.7 are listed for information only.

1.2.3 CONTACT INFORMATION

Any notices, questions, or correspondence in connection with this filing should be directed to:

Michael P. Gallagher
Vice President License Renewal Projects
Exelon Generation Company, LLC
200 Exelon Way
Kennett Square, PA 19348

with copies to:

Albert A. Fulvio
Manager License Renewal
Exelon Nuclear
200 Exelon Way
Kennett Square, PA 19348

Donald B. Warfel
License Renewal Project Technical Lead
Exelon Nuclear
200 Exelon Way
Kennett Square, PA 19348

1.3 PURPOSE

This document provides information required by 10 CFR 54 to support the application for renewed licenses for Byron and Braidwood Stations, Units 1 and 2. The application contains technical information required by 10 CFR 54.21 and environmental information required by 10 CFR 54.23. The information contained herein is intended to provide the NRC with an adequate basis to make the finding required by 10 CFR 54.29.

1.4 DESCRIPTION OF THE PLANT

This application is submitted for nuclear power plants at Byron, Illinois and at Braidwood, Illinois. Each power plant consists of two units having nearly identical nuclear steam supply systems (NSSS) and turbine generators. The main exception is that the original Unit 1 steam generators at both Byron and Braidwood Stations were replaced by steam generators of a different design. The power plants at the two sites are as nearly identical as site characteristics permit.

Byron Station is located in north central Illinois, near the town of Byron and near the Rock River. Cooling for the plant is provided by two natural draft cooling towers for nonessential cooling, and by mechanical draft cooling towers for essential cooling. Commercial operation of Byron Units 1 and 2 began in September 1985 and August 1987, respectively.

The Braidwood Station is located in northeastern Illinois, near the town of Braidwood and near the Kankakee River. Nonessential cooling for the plant is provided by a large man-made cooling pond of approximately 2500 acres. Essential cooling is provided by a 99-acre auxiliary cooling pond which is integral with the main pond. Commercial operation of Braidwood Units 1 and 2 began in July 1988 and October 1988, respectively.

Each nuclear power station consists of two nearly identical generating units; each unit consists of a Westinghouse Electric Corporation (Westinghouse) four loop pressurized water reactor (PWR) and a turbine-generator. The turbine-generators were all furnished by Westinghouse. For each station, Babcock & Wilcox supplied the steam generators for Unit 1, while Westinghouse supplied the steam generators for Unit 2. Sargent & Lundy was the architect-engineer for both stations.

Each nuclear steam supply system is designed for a power output of 3600.6 MWt and evaluated for safety analyses at 3658.3 MWt. For each of the four units, the current facility operating licenses authorize a reactor core power level of 3586.6 MWt.

By letter dated June 23, 2011, Exelon requested an increase in licensed power level for Byron and Braidwood Stations, Units 1 and 2 from 3586.6 MWt to 3645 MWt based on Measurement Uncertainty Recapture (MUR). NRC approval of the MUR is anticipated in the 3rd quarter, 2013. It should be noted that any impact of MUR on engineering analyses that involve license renewal TLAAs was taken into account prior to crediting or updating the analyses for this license renewal application. As discussed in Section 1.2.1, any change to the current licensing basis that materially affects the contents of the license renewal application, including any impact due to completion of MUR review activities, will be addressed in an annual update.

1.5 APPLICATION STRUCTURE

This license renewal application is structured in accordance with Regulatory Guide 1.188, “Standard Format and Content for Applications to Renew Nuclear Plant Operating Licenses,” and NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule”, Revision 6. In addition, Section 3, Aging Management Review Results and Appendix B, Aging Management Programs are structured to address the guidance provided in NUREG-1800, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants”, Revision 2. NUREG-1800 references NUREG-1801, “Generic Aging Lessons Learned (GALL) Report”, Revision 2. NUREG-1801 was used to determine the adequacy of existing aging management programs and which existing programs should be augmented for license renewal. The results of the aging management review, using NUREG-1801, have been documented and are illustrated in table format in Section 3, “Aging Management Review Results” of this application.

Note that Table 1.5-1 provides an explanation of how station-specific differences are identified throughout the License Renewal Application.

The application is divided into the following major sections:

Section 1 – Administrative Information

This section provides the administrative information required by 10 CFR 54.17 and 10 CFR 54.19. It describes the plant and states the purpose for this application. Included in this section are the names, addresses, business descriptions, and organization and management descriptions of the applicant, as well as other administrative information. This section also provides an overview of the structure of the application, general references, and a listing of acronyms used throughout the application.

Section 2 – Structures and Components Subject To Aging Management Review

This section describes and justifies the methods used in the integrated plant assessment to identify those structures and components subject to an aging management review in accordance with the requirements of 10 CFR 54.21(a)(2). These methods consist of: 1) scoping, which identifies the systems, structures, and components that are within the scope of 10 CFR 54.4(a) and 2) screening under 10 CFR 54.21(a)(1), which identifies those in-scope structures and components that perform their intended function without moving parts or a change in configuration or properties, and that are not subject to replacement based on a qualified life or specified time period.

Additionally, the results for systems and structures are described in this section. Scoping results are presented in Section 2.2 "Plant Level Scoping Results." Screening results are presented in Sections 2.3, 2.4, and 2.5.

The screening results consist of lists of components or component groups and structures that require aging management review. Brief descriptions of mechanical systems and structures within the scope of license renewal are provided as background information. Mechanical system and structure intended functions are provided for in-scope systems and structures. For each in-scope system and structure, components requiring an aging management review are identified, associated component intended functions are identified, and appropriate reference to the Section 3 Table providing the aging management review results is made.

Selected components, such as equipment supports, structural items (e.g., penetration seals, structural bolting, insulation), and passive electrical components, were more effectively scoped and screened as commodities. Under the commodity approach, these component groups were evaluated based upon common environments and materials. Commodities requiring an aging management review are presented in Sections 2.4 and 2.5. Component intended functions and reference to the applicable Section 3 Table are provided.

Section 3 – Aging Management Review Results

10 CFR 54.21 (a)(3) requires a demonstration that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis throughout the period of extended operation. Section 3 presents the results of the aging management reviews. Section 3 is the link between the scoping and screening results provided in Section 2 and the aging management programs provided in Appendix B.

Aging management review results are presented in tabular form, in a format in accordance with NUREG-1800, "Standard Review Plan for Review of License Renewal Applications." For mechanical systems, aging management review results are provided in Sections 3.1 through 3.4 for the Reactor Vessel, Internals, and Reactor Coolant System, Engineered Safety Features, Auxiliary Systems, and Steam and Power Conversion Systems, respectively. Aging management review results for Structures and Component Supports are provided in Section 3.5. Aging management review results for Electrical Commodities are provided in Section 3.6.

Tables are provided in each of these sections in accordance with NUREG-1800, which provide aging management review results for components, materials, environments, and aging effects which are addressed in NUREG-1801, and information regarding the degree to which the proposed aging management programs are consistent with those recommended in NUREG-1801.

Section 4 – Time-Limited Aging Analyses

Time-limited aging analyses (TLAAs), as defined by 10 CFR 54.3, are listed in this section. This section includes each of the TLAAs identified in NUREG-1800 and in plant-specific analyses. This section includes a summary of the time-dependent aspects of the analyses. A demonstration is provided to show that the analyses remain valid for the period of extended operation, the analyses have been projected to the end of the period of extended operation, or that the effects of aging on the intended function(s) will be adequately managed for the period of extended operation, consistent with 10 CFR 54.21(c)(1)(i)-(iii).

Appendix A – Updated Final Safety Analysis Report Supplement

As required by 10 CFR 54.21(d), the Updated Final Safety Analysis Report (UFSAR) supplement contains a summary of activities credited for managing the effects of aging for the period of extended operation. In addition, summary descriptions of time-limited aging analyses evaluations are provided. Table 3.0-1, "FSAR Supplement for Aging Management of Applicable Systems," from Revision 2 of NUREG-1800 was used as guidance for the content of the applicable aging management program summaries.

Appendix B – Aging Management Programs

Appendix B describes the programs and activities that are credited for managing aging effects for components or structures during the period of extended operation based upon the aging management review results provided in Section 3 and the time-limited aging analyses results provided in Section 4.

Sections B.2 and B.3 discuss those programs that are contained in Chapter XI and Section X, respectively, of NUREG-1801. A description of the aging management program is provided and a conclusion based upon the results of an evaluation against each of the ten elements provided in NUREG-1801 is drawn. In some cases, exceptions and justifications for managing aging are provided for specific NUREG-1801 elements. Additionally, operating experience related to the aging management program is provided.

Appendix C – Response to Applicant/Licensee Action Items for Inspection and Evaluation Guidelines for Pressurized Water Reactor (PWR) Vessel Internals (MRP-227-A)

This Appendix provides the requested responses to applicant/licensee actions items contained in the NRC safety evaluation report associated with the Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A).

Appendix D – Technical Specification Changes

This Appendix satisfies the requirement in 10 CFR 54.22 to identify technical specification changes or additions necessary to manage the effects of aging during the period of extended operation. There were no Technical Specification Changes identified necessary to manage the effects of aging during the period of extended operation.

Appendix E – Environmental Information – Byron Station, Units 1 and 2 and Braidwood Station, Units 1 and 2

This Appendix satisfies the requirements of 10 CFR 54.23 to provide a supplement to the environmental report that complies with the requirements of subpart A of 10 CFR Part 51 for Byron Station, Units 1 and 2 and Braidwood Station, Units 1 and 2. A separate environmental report supplement is provided for each Station.

Table 1.5-1 Conventions for Identifying Station-Specific Information

Station-specific information (i.e., information that is not common to both Byron and Braidwood Stations) has been clearly identified throughout the application to assist the reviewer in quickly identifying station differences. Differences are identified in either explicitly stated discussions or through the use of parenthetical annotations. There are also a few cases of unit-specific information in the LRA (e.g., the Byron Unit 1 and Braidwood Unit 1 Steam Generators have the same design, whereas the Byron Unit 2 and Braidwood Unit 2 Steam Generators share the same design). The LRA identifies these differences using appropriate annotations. More detailed information on the conventions used for identification of station differences within each section of the LRA is explained below.	
Section 1.0	Byron and Braidwood station-specific and unit-specific information has been discussed separately, where applicable.
Section 2.0	Byron and Braidwood station-specific information and differences have been identified using parenthetical annotations [e.g., (Byron only), (Byron), (Byron Unit 1 and Braidwood Unit 1 only)]. Where parenthetical annotations are not used, discussions are explicit regarding the station being discussed (e.g., “At Braidwood Station…”).
Section 3.0	Sections 3.1.2.1, 3.2.2.1, 3.3.2.1, 3.4.2.1, 3.5.2.1, and 3.6.2.1 list and summarize the materials, environments, aging effects requiring management, and aging management programs associated with each license renewal system, structure, or commodity group. Byron and Braidwood station and unit specific differences for materials and environments existing within the system, structure, or commodity group are identified with parenthetical annotations. For example, if the Service Water System were to contain titanium material at Byron only, while considering all components being evaluated at both stations, that material would be annotated as station-specific. Table 1s (i.e., Table 3.x.1), as defined in Section 3.0, do not identify station-specific information or differences. These tables provide a summary of the aging management programs credited by the facility, compared to those recommended in NUREG-1801, for managing the aging effects of components with similar material and environment combinations. Therefore, identification (within Table 1s) of where station differences exist is not necessary in order to evaluate the adequacy of an aging management program to manage the aging effects associated a given component, material, and environment combination. Table 2s (i.e., Table 3.x.2-y), as defined in Section 3.0, contain nine (9) columns, including component type, intended function, material, environment, aging effect requiring management, aging management program, NUREG-1801 item, Table 1 Item, and notes. Differences between Byron and Braidwood Stations occur only at

	the component type, intended function, material, or environment level of the aging management review. Annotations are shown in the first column in which the difference between the stations occurs, when reading the table from left to right. For example, both stations may contain a common component type with similar functions, but constructed of a different material at one station. The difference in the material of construction would be identified within the material column only of that line item combination.
Section 4.0	Byron and Braidwood station-specific or unit-specific information has been discussed separately, where applicable.
Appendix A & Appendix B	Byron and Braidwood station-specific information has been clearly identified. Station-specific system, structure, and component information have been identified with parenthetical annotations [e.g., "Demineralized Water System deep well pumps (Byron only)"]. Aging Management Program enhancements and exceptions that apply to only one station have been identified with parenthetical annotations for the station to which they apply. Aging management enhancements that apply to both stations contain no parenthetical annotation identifiers.
Appendix A, Table A.5 (commitments)	Byron and Braidwood station-specific information has been clearly identified in the same manner in which it was in Appendix A. Footnotes have also been used within the table to provide the basis for station-specific differences. These notes "bin" the differences into three categories, as follows: Note 1 – Enhancement at one Station only; other Station currently performs activity Note 2 – Design difference Note 3 – Enhancement due to operating experience
Appendix C	Byron and Braidwood station-specific or unit-specific information has been discussed separately, where applicable.

1.6 ACRONYMS

Acronym	Meaning
AC	Alternating Current
ACI	American Concrete Institute
AMP	Aging Management Program
AMR	Aging Management Review
ANL	Argonne National Laboratory
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATWS	Anticipated transients without scram
BBS	Byron and Braidwood Stations, Units 1 and 2
BTP	Branch Technical Position
BWR	Boiling Water Reactor
C (ºC)	Degrees Celsius
CASS	Cast austenitic stainless steel
CFR	Code of Federal Regulations
CLB	Current licensing basis
CUF	Cumulative Usage Factor
CUF_{en}	Environmentally Adjusted Cumulative Usage Factor
DBA	Design basis accident
DBD	Design baseline document
DC	Direct Current
DO	Dissolved Oxygen
DORL	Division of Operating Reactor Licensing
DOT	Department of Transportation
EAF	Environmentally-Assisted Fatigue
ECCS	Emergency Core Cooling System
ECT	Eddy Current Testing
EDG	Emergency Diesel Generator
EFPY	Effective full-power years
EPRI	Electric Power Research Institute
EPA	Environmental Protection Agency
EPU	Extended Power Uprate

Acronym	**Meaning**
EQ	Environmental Qualification
ESF	Engineered Safety Features
F (ºF)	Degrees Fahrenheit
FAC	Flow-accelerated corrosion
F_{en}	Environmentally Assisted Fatigue Correction Factor
FPR	Fire Protection Report
FSAR	Final Safety Analysis Report
FSSD	Fire safe shutdown
GALL	Generic Aging Lessons Learned Report NUREG 1801
GL	Generic Letter
GSI	Generic Safety Issue
HELB	High energy line break
HEPA	High efficiency particulate air
HVAC	Heating, ventilation, and air conditioning
HX	Heat exchanger
I&C	Instrumentation and controls
IASCC	Irradiation assisted stress corrosion cracking
IEEE	Institute of Electrical and Electronics Engineers
IGA	Intergranular Attack
IGSCC	Intergranular stress corrosion cracking
IN	Information Notice
INPO	Institute of Nuclear Power Operations
IPA	Integrated plant assessment
ISI	Inservice inspection
ISG	Interim Staff Guidance
IST	Inservice testing
LBB	Leak before break
LER	Licensee event report
LLRT	Local leak rate test
LOCA	Loss-of-coolant accident
LRA	License renewal application
LTOP	Low Temperature Overpressure Protection
MCC	Motor control center
MG	Motor generator
MIC	Microbiologically influenced corrosion
MOV	Motor-operated valve

Acronym	Meaning
MSIV	Main steam isolation valve
MSIP	Mechanical Stress Improvement Process
MSV	Main stop valve
MSRV	Main Steam Relief Valve
MUR	Measurement Uncertainty Recapture (power uprate)
MWt	Megawatts-thermal
MWe	Megawatts-electric
NDE	Nondestructive examination
NDT	Nil Ductility Temperature or Non-Destructive Testing
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NPS	Nominal Pipe Size
NRC	Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
OE	Operating experience
P&ID	Piping and instrumentation diagram
PM	Preventive maintenance
PTS	Pressurized Thermal Shock
P-T curves	Pressure-temperature limit curves
PUA	Plant-unique analyses
PWR	Pressurized Water Reactor
RCPB	Reactor Coolant Pressure Boundary
RCS	Reactor Coolant System
RG	Regulatory guide
RPS	Reactor Protection System
RT_{NDT}	nil-ductility transition reference temperature
RPV	Reactor Pressure Vessel
RW	Radwaste Systems
SBO	Station Blackout
SCC	Stress corrosion cracking
SSC	Systems Structures and Components
SR	Safety-Related
SRV	Safety relief valve
SSE	Safe shutdown earthquake
TLAAs	Time-limited aging analyses
UFSAR	Updated Final Safety Analysis Report

Acronym	Meaning
UHS	Ultimate heat sink
USE	Upper-shelf energy

1.7 GENERAL REFERENCES

1.7.1 10 CFR 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants.”

1.7.2 NEI 95-10, “Industry Guidelines for Implementing the Requirements of 10 CFR Part 54 – The License Renewal Rule,” Revision 6, June 2005.

1.7.3 Regulatory Guide 1.188 “Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses,” Rev 1.

1.7.4 NUREG-1800, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants” United States Nuclear Regulatory Commission, Rev 2.

1.7.5 NUREG-1801, “Generic Aging Lessons Learned (GALL) Report,” United States Nuclear Regulatory Commission, Rev 2.

1.7.6 10 CFR 50.48, “Fire Protection.”

1.7.7 10 CFR 50.49, “Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants.”

1.7.8 10 CFR 50.62, “Requirements for Reduction of Risk From Anticipated Transients Without Scram (ATWS) Events for Light-Water-Cooled Nuclear Power Plants.”

1.7.9 10 CFR 50.63, “Loss of All Alternating Current Power.”

1.7.10 10 CFR 50.65, “Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants.”

1.7.11 10 CFR 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.”

1.7.12 10 CFR 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions.”

1.7.13 NUREG-0800, Section 9.5.1, Appendix B, “Supplemental Fire Protection Review Criteria for License Renewal,” Revision 5, March 2007

1.7.14 NUREG-0933, “Resolution of Generic Safety Issues,” U.S. Nuclear Regulatory Commission, Supplement 34, December 2011.

1.7.15 EPRI Technical Report 1010639, “Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools,” Revision 4.

1.7.16 “Plant Support Engineering: License Renewal Electrical Handbook, Revision 1 to EPRI Report 1003057 (1013475),” Final Report, February 2007.

1.7.17 “Plant Support Engineering: Aging Effects for Structures and Structural Components (Structural Tools),” EPRI, Final Report, December 2007, 1015078.

1.7.18 NEI 05-01, “Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document,” Revision A, November 2005.

1.7.19 NEI 97-06, “Steam Generator Program Guidelines,” Revision 3, January 2011.

1.7.20 EPRI Materials Reliability Program (MRP) Report 1016596, “Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-Rev. 0),” Revision 0, December 2008.

1.7.21 EPRI MRP Report 1022863, “Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A-Rev. 0),” Revision 0, December 2011.

2.0 SCOPING AND SCREENING METHODOLOGY FOR IDENTIFYING STRUCTURES AND COMPONENTS SUBJECT TO AGING MANAGEMENT REVIEW, AND IMPLEMENTATION RESULTS

This section describes the process for identifying structures and components subject to aging management review in the Byron and Braidwood Stations (BBS) license renewal integrated plant assessment. For the systems, structures, and components (SSCs) within the scope of license renewal, 10 CFR 54.21(a)(1) requires the license renewal applicant to identify and list those structures and components subject to Aging Management Review (AMR). 10 CFR 54.21(a)(2) further requires that the methods used to implement the requirements of 10 CFR 54.21(a)(1) be described and justified. Section 2 of this application satisfies these requirements.

The process is performed in two steps. *Scoping* refers to the process of identifying the plant systems and structures that are to be included within the scope of license renewal in accordance with 10 CFR 54.4. The intended functions that are the bases for including the systems and structures within the scope of license renewal are also identified during the scoping process. *Screening* is the process of determining which components associated with the in scope systems and structures are subject to an aging management review in accordance with 10 CFR 54.21(a)(1) requirements. A detailed description of the BBS scoping and screening process is provided in Section 2.1. The scoping and screening process, as described in Section 2.1, was performed independently for both Byron Station and Braidwood Station. The results of these reviews are consolidated in the LRA. Station-specific differences are identified as described in Table 1.5-1.

The scoping and screening methodology is consistent with the guidelines presented in NEI-95-10, Industry Guidelines for Implementing the Requirements of 10 CFR Part 54 – The License Renewal Rule, Revision 6 (reference 1.7.1). The plant level scoping results identify the systems and structures within the scope of license renewal in Section 2.2. The screening results identify components subject to aging management review in the following LRA sections:

- Section 2.3 for mechanical systems
- Section 2.4 for structures
- Section 2.5 for electrical

2.1 SCOPING AND SCREENING METHODOLOGY

2.1.1 INTRODUCTION

This introduction provides an overview of the scoping and screening process used at BBS. Subsequent sections provide details of how the process was implemented. This process was performed independently for both Byron Station and Braidwood Station. The results of these reviews are consolidated in the LRA. Station-specific differences are identified as described in Table 1.5-1.

The initial step in the scoping process was to define the entire plant in terms of systems and structures. Each of these systems and structures were evaluated against the scoping criteria in 10 CFR 54.4(a)(1), (a)(2), and (a)(3), to determine if the system or structure performs or supports a safety-related intended function, if system or structure failure could prevent the satisfactory accomplishment of a safety-related function, or if the system or structure performs functions that demonstrate compliance with the requirement of one (1) of the five (5) license renewal regulated events. The intended function(s) that are the bases for including systems and structures within the scope of license renewal were also identified.

A mechanical system was included within the scope of license renewal if any portion of the system met the scoping criteria of 10 CFR 54.4. Mechanical systems determined to be within the scope of license renewal were then further evaluated to determine those system components that are required to perform or support the identified system intended function(s). The in scope boundaries of mechanical systems were identified and are described in Section 2.3. These boundaries are also depicted on the license renewal boundary drawings (LRBD). A separate set of LRBDs were created for both Byron Station and Braidwood Station. The in scope boundaries of the mechanical systems are highlighted in color. In scope mechanical components are shown highlighted in green or red. Mechanical components that are required to perform or support safety-related functions or are required to demonstrate compliance with one (1) of the five (5) license renewal regulated events are shown highlighted in green. Nonsafety-related mechanical components that are included within the scope of license renewal because component failure could prevent the accomplishment of a safety-related function due to potential physical or spatial interaction with safety-related systems, structures, and components (SSCs) are shown highlighted in red. Additional details on scoping evaluations and boundary drawing development are provided in Section 2.1.5.

A structure was included within the scope of license renewal if any portion of the structure met the scoping criteria of 10 CFR 54.4. Structures were then further evaluated to determine those structural components that are required to perform or support the identified structure intended function(s). The portions of each structure within the scope of license renewal that are required to perform or support the identified structure intended function(s) were identified and are described in Section 2.4. The structures that are within the scope of license renewal are highlighted in green on the site plan. Additional details on scoping evaluations and boundary drawing development are provided in Section 2.1.5.

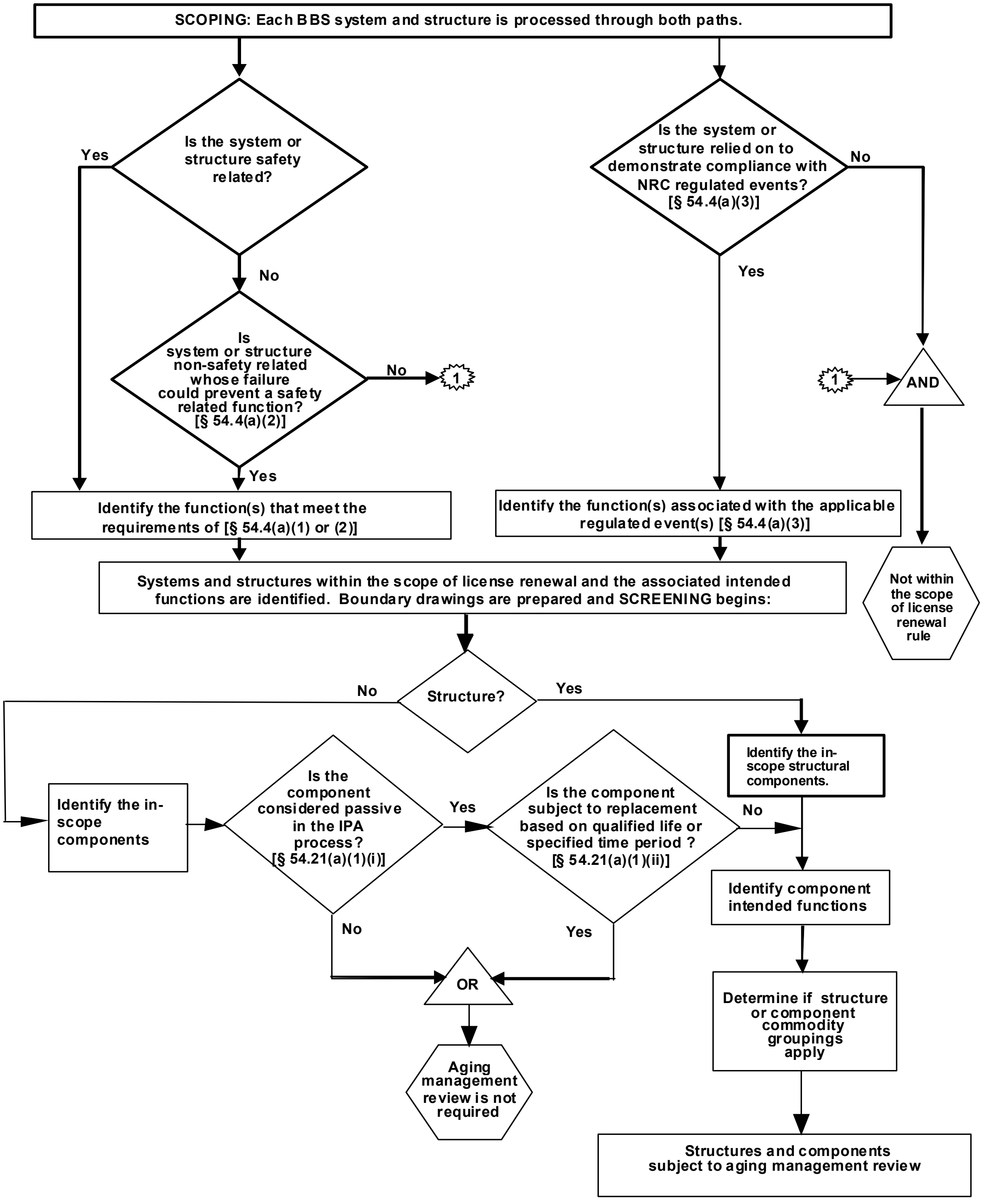
Electrical and Instrumentation and Control (I&C) systems were scoped like mechanical systems and structures per the scoping criteria in 10 CFR 54.4(a)(1), (a)(2), and (a)(3). Electrical and I&C components within the in scope electrical and I&C systems were included within the scope of license renewal. Likewise, electrical and I&C components within in scope mechanical systems were included within the scope of license renewal. Consequently, further system evaluations to determine which electrical components were required to perform or support the system intended functions were not performed during the scoping process. Additional details on electrical and I&C system scoping are provided in Section 2.1.5.

After completion of the scoping and boundary evaluations, the screening process was performed to evaluate the structures and components within the scope of license renewal to identify the long-lived and passive structures and components subject to an Aging Management Review (AMR). In addition, the passive intended functions of structures and components subject to AMR were identified. Additional details on the screening process are provided in Section 2.1.6.

Selected components, such as equipment supports, structural items (e.g., penetration seals, structural bolting, insulation), and passive electrical components, were scoped and screened as commodities. As such, they were not evaluated with the individual system or structure, but were evaluated collectively as a commodity group. Commodity groups are identified in Table 2.2-1. Passive structural commodities are identified in Section 2.4 and passive electrical commodities are identified in Section 2.5. Commodity groups utilized are consistent with NUREG-1800, Table 2.1-5, and previous license renewal applications accepted by the NRC.

Figure 2.1-1 provides a flowchart of the general scoping and screening process for mechanical systems, structures, and electrical systems.

Figure 2.1-1
Byron and Braidwood Stations Scoping and Screening Flowchart



2.1.2 INFORMATION SOURCES USED FOR SCOPING AND SCREENING

A number of different current licensing basis (CLB) and design basis information sources were utilized in the scoping and screening process. The CLB for Byron and Braidwood Stations is consistent with the definition provided in 10 CFR 54.3. The significant source documentation is discussed below.

These source documents are available in hard copy or electronic format. Document records such as licensing correspondence and NRC Safety Evaluation Reports are available in a searchable database, such that applicable documents can be identified and located by searching the appropriate topic.

2.1.2.1 Updated Final Safety Analysis Report

There is a common Updated Final Safety Analysis Report (UFSAR) for BBS. The BBS UFSAR follows the established guidelines published in NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” dated July 1981. The Byron and Braidwood Station UFSAR has since been updated regularly in accordance with the requirements of 10 CFR 50.71(e). The UFSAR provided significant input for system and structure descriptions and functions.

2.1.2.2 Fire Protection Report

There is a common Fire Protection Report (FPR) for BBS. The BBS FPR describes the fire protection configuration for the confinement, detection, and suppression of fires, and demonstrates the capability to achieve and maintain safe shutdown conditions in the event of a fire, in support of the Fire Protection Program functions.

2.1.2.3 Environmental Qualification Master List

The scope of the electrical equipment and components that must be environmentally qualified for use in a harsh environment at Byron and Braidwood Stations is identified in the PassPort equipment database. The PassPort equipment database is discussed in Section 2.1.2.6. The database includes a listing of equipment and components, and includes fields that identify specific equipment information such as manufacturer, plant location, and qualification level. The PassPort equipment database Environmental Qualification (EQ) data field is a mandatory and design basis field, which means that the field must be populated and that the data is controlled and has been verified accurate.

2.1.2.4 Maintenance Rule Database

The Maintenance Rule Database documents the results of Maintenance Rule scoping for Byron and Braidwood Stations systems and structures. The Maintenance Rule Database provided an additional source of information to identify system and structure functions.

2.1.2.5 Engineering Drawings

Engineering drawings at BBS provide system, structure, and component configuration details and safety classification information. These drawings were utilized to determine SSC functional requirements and materials of construction in support of scoping and screening evaluations.

2.1.2.6 Controlled Plant Component Database

BBS maintain a controlled plant component database that contains component level design and maintenance information. The plant component database is called the PassPort equipment database. The PassPort equipment database lists plant components at the level of detail for which discrete maintenance or modification activities typically are performed. At BBS, the PassPort equipment database provides a comprehensive listing of plant components and their quality classifications. Unique equipment component tag numbers identify each component in the database.

2.1.2.7 Other CLB References

NRC Safety Evaluation Reports include NRC staff review of BBS licensing submittals. Some of these documents may contain licensee commitments.

Licensing correspondence includes relief requests, Licensee Event Reports, and responses to NRC communications such as NRC bulletins, generic letters, or enforcement actions. Some of these documents may contain licensee commitments.

Engineering evaluations and calculations can provide additional information about the requirements or characteristics associated with the evaluated systems, structures, or components.

2.1.3 TECHNICAL BASIS DOCUMENTS

Technical basis documents were prepared in support of the license renewal project. Engineers experienced in nuclear plant systems, programs, and operations prepared the basis documents. Basis documents contain technical evaluations and bases for decisions or positions associated with license renewal requirements as described below. Basis documents are prepared, reviewed, and approved in accordance with controlled project procedures, and are based on the CLB source documents described in Section 2.1.2.

The following sections describe the technical basis documents associated with the Byron and Braidwood Stations scoping and screening methodology.

2.1.3.1 License Renewal Systems and Structures List

One of the first steps necessary to begin the license renewal scoping process was to identify a comprehensive list of systems and structures to be evaluated for license renewal scoping. While there exists a variety of document sources that identify and list systems and structures at BBS, no single source provided the comprehensive list in a format appropriate for 10 CFR 54.4 license renewal system and structure scoping. Therefore, a basis document was prepared to establish a comprehensive list of license renewal systems and structures, and to document the basis for the list. Starting with the systems and structures list contained in the PassPort equipment database, the list was evaluated against the BBS UFSAR, plant design drawings, the maintenance rule database, and other plant CLB documents. Plant systems and structures were arranged into logical groupings for scoping reviews, and the groupings were defined as license renewal systems and structures. Components evaluated as commodity groups were also identified. The basis document assures all plant structures and components included in the scoping review are associated with a system, structure, or commodity group.

The basis document grouped license renewal systems and structures into the following categories:

- Reactor Vessel, Internals, and Reactor Coolant System
- Engineered Safety Features
- Auxiliary Systems
- Steam and Power Conversion System
- Electrical Components
- Structures and Component Supports

This grouping of the BBS license renewal systems and structures is based on the BBS UFSAR and the guidance of NUREG-1801 “Generic Aging Lessons Learned (GALL) Report,” Revision 2 (reference 1.7.5). The complete list of systems, structures, and commodity groups evaluated for license renewal is provided in Section 2.2 of this application.

Certain structures and equipment were excluded at the outset because they are not considered to be systems, structures, or components that are part of the CLB and do not have design or functional requirements related to the 10 CFR 54.4(a)(1), (a)(2), or (a)(3) scoping criteria. These include: driveways and parking lots, temporary equipment, health physics equipment, portable measuring and testing equipment, tools, and motor vehicles.

2.1.3.2 Identification of Safety-Related Systems and Structures

Safety-related systems and structures are included within the scope of license renewal in accordance with 10 CFR 54.4(a)(1) scoping criterion. BBS plant components that have been classified as safety-related are identified as “SR” in the controlled safety classification data field in the PassPort equipment database. BBS safety classification procedures were reviewed against the license renewal “Safety-related” scoping criterion in 10 CFR 54.4(a)(1), to confirm that BBS safety-related classifications are consistent with license renewal requirements. This review is included in a technical basis document. The basis document also provides a summary list of the systems and structures that are safety-related at BBS. These systems and structures are included within the scope of license renewal in accordance with the 10 CFR 54.4(a)(1) scoping criterion.

The BBS UFSAR definition of safety-related is as follows:

Safety-related structures, systems, and components are those required to assure:

- *the integrity of reactor coolant boundary,*
- *the capability to shut down the reactor and maintain it in a safe shutdown condition, or*
- *the capability to prevent or mitigate the consequences of accidents which could result in potential off-site exposures comparable to the guideline exposures of 10 CFR 100 for accidents analyzed using TID-14844 and 10 CFR 50.67 for accidents analyzed using Regulatory Guide 1.183 (AST).*

This definition is technically equivalent to 10 CFR 54.4(a)(1) for the purposes of license renewal scoping. The wording differences are addressed as follows:

Design Basis Events

The BBS UFSAR definition of safety-related does not specifically refer to design basis events, while 10 CFR 54.4(a)(1) refers to design basis events as defined in 10 CFR 50.49(b)(1). For BBS license renewal, an additional technical basis document was prepared to confirm that all applicable design basis events were considered. The basis document includes a review of all systems or structures that are relied upon to remain functional during and following design-basis events as defined in 10 CFR 50.49 (b)(1). This includes confirming that conditions of normal operation, internal events, anticipated operational occurrences, design basis accidents, external events, and natural phenomena as described in the current licensing basis (CLB) are considered when scoping for license renewal. Safety-related systems and structures required to support 10 CFR 54.4(a)(1) functions are included within the scope of license renewal in accordance with 10 CFR 54.4(a)(1). Nonsafety-related systems and structures required to support 10 CFR 54.4(a)(1) functions are included within the scope of license renewal in accordance with 10 CFR 54.4(a)(2).

Exposure Limits

The license renewal rule refers to exposure limits as defined in 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2), or 10 CFR 100.11, as applicable. These different exposure limit requirements appear in three different Code sections to address similar accident analyses performed by licensees for different reasons. The exposure limit requirements in 10 CFR 50.34(a)(1) are applicable to facilities seeking a construction permit, and are, therefore, not applicable to BBS license renewal. The exposure limit requirements in 10 CFR 50.67(b)(2) are applicable to facilities seeking to revise the current accident source term used in their design basis radiological analyses.

The original UFSAR Chapter 15 Accident Analyses were performed to address 10 CFR 100 guidelines. In support of a full scope implementation of Alternative Source Term (AST) methodology in accordance with Regulatory Guide 1.183, AST radiological consequence analyses were performed for the six Design Basis Accidents that result in control room and offsite exposure. These six accidents are the Loss of Coolant Accident, Main Steam Line Break Accident, Fuel Handling Accident, Control Rod Ejection Accident, Locked Rotor Accident, and Steam Generator Tube Rupture Accident. The dose consequences for these accidents result in doses that are within the guidelines of 10 CFR 50.67. Although only the six major accidents have been evaluated using the AST methodology, the AST analytical methods described in Regulatory Guide 1.183 and dose limits defined in 10 CFR 50.67 comprise the design basis for BBS for all design basis accidents.

When supplemented with the broad review of CLB design basis events, the BBS UFSAR definition of “safety-related" is consistent with 10 CFR 54.4(a)(1), and results in a comprehensive list of safety-related systems and structures that were included within the scope of license renewal. This is consistent with NUREG-1800 Section 2.1.3.1.1. Additional detail on the application of the 10 CFR 54.4(a)(1) scoping criterion is provided in Section 2.1.5.1.

2.1.3.3 10 CFR 54.4(a)(2) Scoping Criteria

All nonsafety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4 (a)(1), were included within the scope of license renewal in accordance with 10 CFR 54.4(a)(2) requirements. To assure complete and consistent application of this scoping criterion, a technical basis document was prepared.

This license renewal scoping criteria requires consideration of the following:

1. Nonsafety-related SSCs required to support a safety-related 10 CFR 54.4(a)(1) function.
2. Nonsafety-related systems directly connected to and providing structural support for a safety-related SSC.
3. Nonsafety-related systems with a potential for spatial interaction with safety-related SSCs.

The first item is addressed by reviewing the BBS UFSAR and other CLB documents to identify nonsafety-related systems or structures required to support satisfactory accomplishment of a safety-related function. In addition, a supporting system review was performed to identify any nonsafety-related system that supports a safety-related intended function of a system included within the scope of license renewal in accordance with 10 CFR 54.4(a)(1). Any nonsafety-related systems identified during this review are included within the scope of license renewal in accordance with 10 CFR 54.4(a)(2). All SSCs required for the system to perform its support function are included within the scope of license renewal in accordance with 10 CFR 54.4(a)(2).

The remaining two items concern nonsafety-related systems with potential physical or spatial interaction with safety-related systems, structures, and components. Scoping of these systems is the subject of NEI 95-10, Appendix F. To assure complete and consistent application of 10 CFR 54.4(a)(2) requirements and NEI 95-10, a technical basis document was prepared. The basis document includes a review of the CLB references relevant to physical or spatial interactions.

The basis document describes the BBS approach to scoping of nonsafety-related systems with a potential for physical or spatial interaction with safety-related SSCs. BBS chose to implement the preventive option as described in NEI 95-10. The basis document provides appropriate guidance to assure that license renewal scoping for 10 CFR 54.4(a)(2) met the requirements of the license renewal rule and NEI 95-10. Additional detail on the application of the 10 CFR 54.4(a)(2) scoping criterion is provided in Section 2.1.5.2.

2.1.3.4 Scoping for Regulated Events

Technical basis documents were prepared to address license renewal scoping of SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Fire Protection, Environmental Qualification, Anticipated Transients Without Scram, Station Blackout, and Pressurized Thermal Shock. These basis documents are summarized below:

Fire Protection

All systems, structures, and components relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for fire protection (10 CFR 50.48) are included within the scope of license renewal in accordance with 10 CFR 54.4(a)(3) requirements.

The scope of systems and structures required for the fire protection program to comply with the requirements of 10 CFR 50.48 includes:

- Systems and structures required to demonstrate post-fire safe shutdown capabilities
- Systems and structures required for fire detection and suppression
- Systems and structures required to meet commitments made to Appendix A of Branch Technical Position (BTP) CMEB 9.5-1

NRC guidance, including NUREG-0800 Section 9.5.1, Appendix B (reference 1.7.13) states that the scope of 10 CFR 50.48 goes beyond the protection of safety-related equipment, and also includes fire protection systems, structures, and components needed to minimize the effects of a fire and to prevent the release of radioactive material to the environment. Fire protection system and structure scoping for BBS is performed consistent with this guidance, and is documented in the technical basis document.

The fire protection technical basis document summarizes results of a detailed review of the plant’s fire protection program documents that demonstrate compliance with the requirements of 10 CFR 50.48. The basis document provides a list of systems and structures credited in the plant’s fire protection program documents. For the listed systems and structures, the basis document also identifies appropriate CLB references. The identified systems and structures are included within the scope of license renewal in accordance with 10 CFR 54.4(a)(3) scoping criteria.

The fire detection and suppression systems at BBS are plant-wide systems that protect a wide variety of plant equipment. Not all portions of these systems are required to demonstrate compliance with 10 CFR 50.48. Some portions of the fire detection and suppression systems protect plant areas in which a fire would not impact any equipment important to safety or significantly increase the risk of radioactive releases to the environment. Portions of the fire suppression and detection systems are not included within the scope of license renewal if (1) those portions of the system are provided to protect areas that do not contain any SSCs within the scope of license renewal and (2) those portions of the system can be isolated from the in scope portions of the system. The portions of the fire suppression and detection systems that are not included within the scope of license renewal are identified in the technical basis document. Those portions of fire detection and suppression systems that are not included in scope can be isolated from the remaining in scope system by closing the associated isolation valve. The isolation valve is included within the scope of license renewal.

Environmental Qualification

Criterion 10 CFR 54.4(a)(3) requires that all systems, structures, and components relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for environmental qualification (10 CFR 50.49) be included within the scope of license renewal.

The BBS Environmental Qualification (EQ) program includes (1) safety-related electrical and mechanical equipment, (2) nonsafety-related electrical and mechanical equipment whose failure under postulated environmental conditions could prevent satisfactory accomplishment of safety functions of the safety-related equipment, and (3) certain post-accident monitoring equipment, as defined in 10 CFR 50.49(b)(1), 10 CFR 50.49(b)(2), and 10 CFR 50.49(b)(3), respectively. This equipment is included within the scope of license renewal.

The environmental qualification basis document summarizes the results of a review of BBS EQ program documents. The EQ basis document provides a list of systems that include EQ components. The EQ basis document also provides a list of structures that provide the physical boundaries for the postulated harsh environments, and contain environmentally qualified electrical equipment. These systems and structures are included within the scope of license renewal in accordance with 10 CFR 54.4(a)(3) scoping criteria.

Pressurized Thermal Shock

Criterion 10 CFR 54.4(a)(3) requires that all systems, structures, and components relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61) be included within the scope of license renewal.

Pressurized Thermal Shock (PTS) is a potential pressurized water reactor (PWR) event or transient causing vessel failure due to severe overcooling (thermal shock) concurrent with, or followed by, significant pressure in the reactor vessel. The CLB shows that the BBS reactor vessel has been demonstrated to meet the toughness requirements of 10 CFR 50.61 through its current 40-year end-of-license period. Sixty-year end-of-license fluence projections were prepared, and the components that are projected to meet the definition of beltline material after 60 years of neutron exposure were identified.

The PTS basis document summarizes the results of a review of the BBS current licensing basis with respect to pressurized thermal shock. The basis document identifies components within the Reactor Vessel that are credited in BBS PTS evaluations. The Reactor Vessel is included within the scope of license renewal in accordance with 10 CFR 54.4(a)(3) scoping criteria.

Anticipated Transients Without Scram

Criterion 10 CFR 54.4(a)(3) requires that all systems, structures, and components relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for anticipated transients without scram (10 CFR 50.62) be included within the scope of license renewal.

An Anticipated Transient Without Scram (ATWS) is a postulated operational transient that generates an automatic scram signal, accompanied by a failure of the reactor protection system to automatically shutdown the reactor. The ATWS rule (10 CFR 50.62) requires improvements in the design and operation of light-water cooled water reactors to reduce the likelihood of failure to automatically shutdown the reactor following anticipated transients, and to mitigate the consequences of an ATWS event. The specific requirements for the BBS pressurized water reactors are to have equipment from sensor output to final actuation device, which is diverse from the Reactor Protection System, to automatically initiate the auxiliary feedwater system and initiate a turbine trip under conditions indicative of an ATWS.

The ATWS basis document summarizes the results of a review of the BBS current licensing basis with respect to ATWS. BBS has an ATWS Mitigation System (AMS). The AMS consists of a diverse method to mitigate the consequences of an ATWS event by initiating the auxiliary feedwater system and initiating a turbine trip under conditions indicative of an ATWS. The ATWS basis document provides a list of the systems required by 10 CFR 50.62 to reduce the risk from ATWS events. The basis document also provides a list of structures that provide physical support and protection for the ATWS systems.

These systems and structures are included within the scope of license renewal in accordance with 10 CFR 54.4(a)(3) scoping criteria.

Station Blackout

Criterion 10 CFR 54.4(a)(3) requires that all systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for station blackout (10 CFR 50.63) be included within the scope of license renewal.

A station blackout (SBO) event is a complete loss of alternating current (AC) electric power to the essential and nonessential switchgear buses in a nuclear power plant (i.e., loss of the offsite electric power system concurrent with generator trip and unavailability of the onsite emergency AC power sources). SBO does not include the loss of available AC power to buses fed by station batteries through inverters or by alternate AC sources, nor does it assume a concurrent single failure or design basis accident.

BBS satisfies the requirement of 10 CFR 50.63 for a 4-hour coping duration plant. At BBS, SBO is supported by the use of the diesel generators on the non-blacked out unit for each site as an alternate AC (AAC) power source. The AAC power source is required to be available within ten minutes. BBS capabilities, commitments and analyses that demonstrate compliance with 10 CFR 50.63 are documented in NRC safety evaluation reports and correspondence related to the SBO rule.

The NUREG-1800 guidance on scoping of equipment relied on to meet the requirements of the SBO rule (10 CFR 50.63) for license renewal has been incorporated into the BBS scoping methodology. In accordance with the NUREG-1800 requirements, the SSCs required to recover from the SBO event are included within the scope of license renewal. Recovery is defined as the repowering of the plant AC distribution system from offsite sources or onsite emergency AC sources.

For BBS, this includes the portion of the plant electrical system used to connect the in scope AC distribution system equipment to offsite power and by definition recover from an SBO event. For BBS, the boundary between the electrical transmission network and the plant electrical distribution system and equipment has been defined at the circuit breakers between the switchyard bus and the offsite transmission lines. For Byron Station, these connections are at the 5-6, 3-7, 7-10, and 12-13 345kV circuit breakers. For Braidwood Station, these connections are at the 3-4, 4-7, 11-14, and 14-15 345kV circuit breakers. These circuit breakers are the isolation devices between the plant electrical distribution system and the offsite electrical transmission network and are within the scope of license renewal. Included within the scope of license renewal on the plant side of this boundary are: switchyard bus and connections, circuit breakers and associated control circuits, transmission conductors and connections, high voltage insulators, switchyard structures and supports, metal enclosed bus, insulated cables and connections, and cable connections (metallic parts). See Figure 2.1-2 for the Byron Station SBO recovery boundary and Figure 2.1-3 for the Braidwood Station SBO recovery boundary.

The SBO basis document summarizes the results of a review of the BBS current licensing basis with respect to station blackout. The basis document provides lists of systems and structures credited in BBS SBO evaluations. For the listed systems and structures, the basis document also identifies appropriate CLB references. These systems and structures are included within the scope of license renewal in accordance with 10 CFR 54.4(a)(3) scoping criteria.

Figure 2.1-2

BYRON SBO RECOVERY BOUNDARY

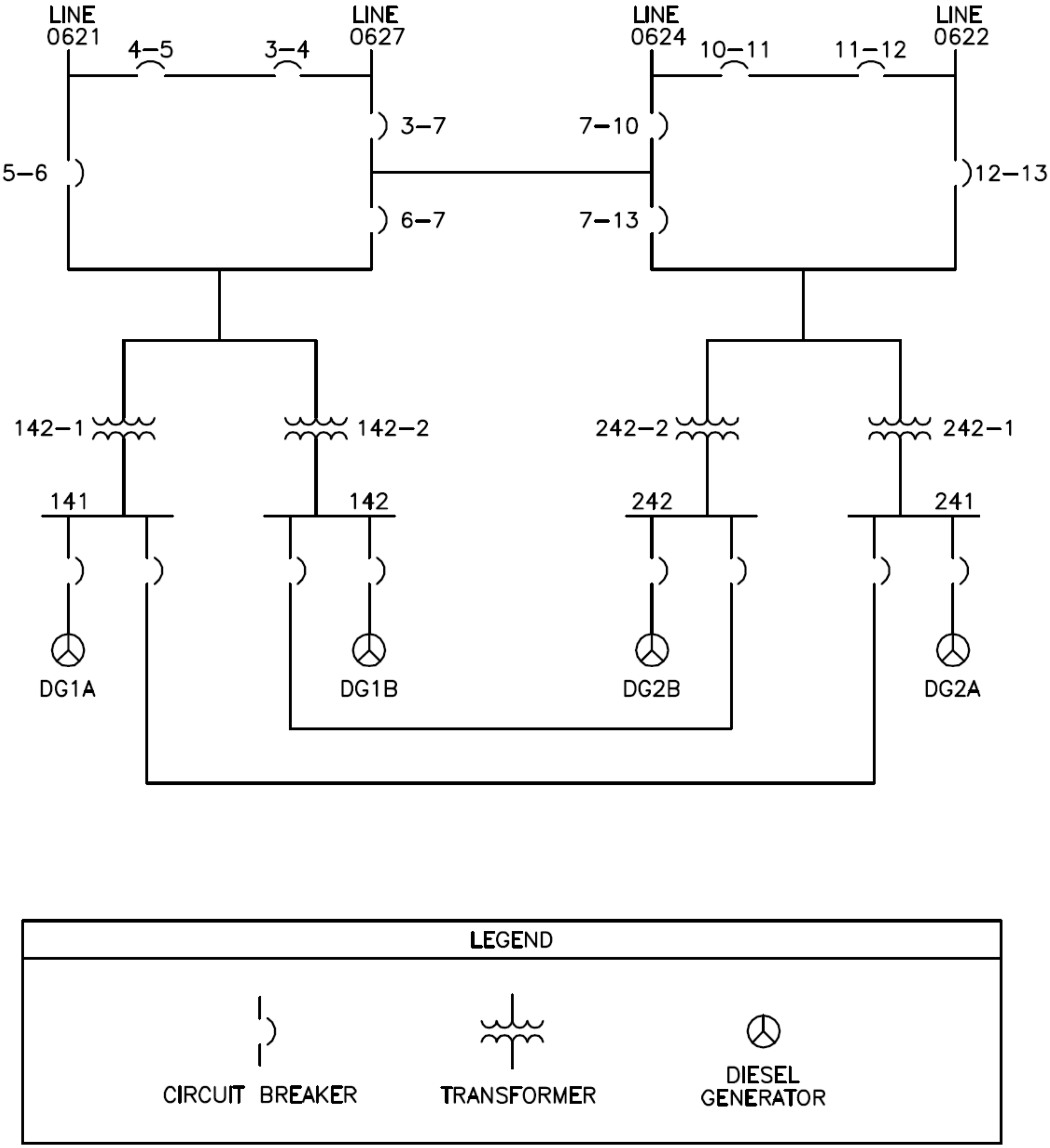
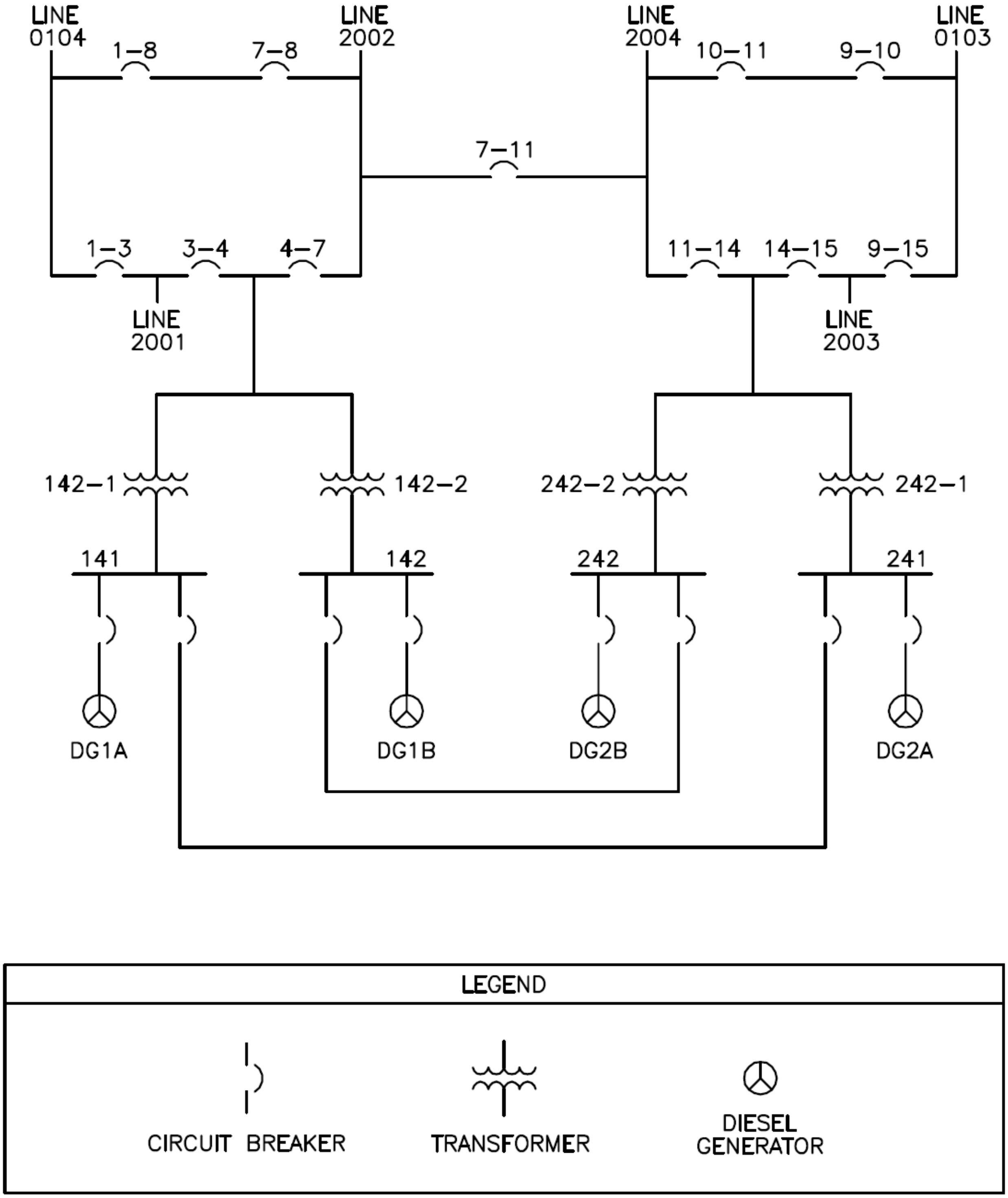


Figure 2.1-3

BRAIDWOOD SBO RECOVERY BOUNDARY



2.1.4 INTERIM STAFF GUIDANCE DISCUSSION

The NRC has encouraged applicants for license renewal to address Interim Staff Guidance (ISG) issues in license renewal applications. The following is a listing of issued ISGs that have not been incorporated in NUREG-1800 or NUREG-1801 as of March 2013.

LR-ISG-2006-03	Staff Guidance for Preparing Severe Accident Mitigation Alternatives Analyses
LR-ISG-2011-01	Aging Management of Stainless Steel Structures and Components in Treated Borated Water, Revision 1
LR-ISG-2011-02	Aging Management Program for Steam Generators
LR-ISG-2011-03	Generic Aging Lessons Learned (GALL) Report Revision 2 AMP XI.M41, “Buried and Underground Piping and Tanks”
LR-ISG-2011-05	Ongoing Review of Operating Experience

The following sections provide summaries of how each of the ISG issues is addressed in the BBS LRA:

2.1.4.1 Staff Guidance for Preparing Severe Accident Mitigation Alternatives Analyses (LR-ISG-2006-03)

This LR-ISG provides interim guidance to applicants for license renewal in which the NRC endorses the guidance of NEI 05-01, “Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document” (reference 1.7.18). The Byron and Braidwood Stations severe accident mitigation alternatives analysis provided as a part of Appendix E to this application is consistent with the guidance of NEI 05-01, as discussed in this LR-ISG.

2.1.4.2 Aging Management of Stainless Steel Structures and Components in Treated Borated Water, Revision 1 (LR-ISG-2011-01)

This LR-ISG provides interim guidance to applicants for license renewal as to one acceptable approach to managing the aging effects of stainless steel structures and components exposed to treated borated water. BBS incorporates the guidance presented in this LR-ISG and utilizes the One-Time Inspection (B.2.1.20) program, when appropriate, to verify the effectiveness of the Water Chemistry (B.2.1.2) program in managing the aging effects of stainless steel structures and components exposed to treated borated water within the scope of license renewal. Results are provided in Section 3, Aging Management Review Results.

2.1.4.3 Aging Management Program for Steam Generators (LR-ISG-2011-02)

This LR-ISG provides interim guidance to applicants for license renewal of pressurized water reactors in which the NRC recommends the adoption of Revision 3 of NEI 97-06, “Steam Generator Program Guidelines” (reference

1.7.19). The Byron and Braidwood Stations Steam Generators (B.2.1.10) program incorporates the guidance presented in this LR-ISG.

2.1.4.4 Generic Aging Lessons Learned (GALL) Report Revision 2 AMP XI.M41, "Buried and Underground Piping and Tanks" (LR-ISG-2011-03)

This LR-ISG provides interim guidance to applicants for license renewal as to one acceptable approach to managing the aging effects of buried and underground piping and tanks within the scope of license renewal. LR-ISG-2011-03 revises the guidance provided in NUREG-1801, Revision 2, XI.M41, "Buried and Underground Piping and Tanks" program. The Byron and Braidwood Stations Buried and Underground Piping (B.2.1.28) program incorporates the guidance presented in this LR-ISG with exceptions as described in Appendix B.

2.1.4.5 Ongoing Review of Operating Experience (LR-ISG-2011-05)

This LR-ISG provides interim guidance to applicants for license renewal revising NUREG-1800 acceptance criteria and review procedure to better address the ongoing review of operating experience with respect to license renewal aging management programs. The Byron and Braidwood Stations license renewal application incorporates the guidance presented in this LR-ISG. Ongoing review of operating experience is addressed in Appendix A, Section A.1.6 and Appendix B, Section B.1.4.

2.1.5 SCOPING PROCEDURE

The scoping process is the systematic process used to identify the BBS systems, structures, and components within the scope of the license renewal rule. The scoping process was initially performed at the system and structure level, in accordance with the scoping criteria identified in 10 CFR 54.4(a). System and structure functions and intended functions were identified from a review of the source CLB documents. In scope boundaries were established and documented in the scoping evaluations, based on the identified intended functions. The in scope boundaries form the basis for identification of the in scope components, which is the first step in the screening process described in Section 2.1.6. System and structure scoping evaluations are documented and have been retained in a license renewal database. The system and structure scoping results are provided in Section 2.2.

The BBS scoping process began with the development of a comprehensive list of plant systems and structures, as described in Section 2.1.3.1. The systems and structures were grouped into one of the following categories:

- Reactor Vessel, Internals, and Reactor Coolant System
- Engineered Safety Features
- Auxiliary Systems
- Steam and Power Conversion System

- Structures and Component Supports
- Electrical Components

Each BBS system and structure was then scoped for license renewal using the criteria of 10 CFR 54.4(a). These criteria are briefly identified as follows:

- Title 10 CFR 54.4(a)(1) – Safety-Related
- Title 10 CFR 54.4(a)(2) – Nonsafety-Related affecting safety-related
- Title 10 CFR 54.4(a)(3) – Regulated Events:
    - Fire Protection (10 CFR 50.48)
    - Environmental Qualification, EQ (10 CFR 50.49)
    - Pressurized Thermal Shock (10 CFR 50.61)
    - Anticipated Transient Without Scram, ATWS (10 CFR 50.62)
    - Station Blackout, SBO (10 CFR 50.63)

The application of each of these criteria is discussed in Section 2.1.5.1, Section 2.1.5.2, and Section 2.1.5.3 below:

2.1.5.1 Safety-Related – 10 CFR 54.4(a)(1)

In accordance with 10 CFR 54.4(a)(1), the systems, structures, and components within the scope of license renewal include:

> *Safety-related systems, structures, and components which are those relied upon to remain functional during and following design-basis events (as defined in 10 CFR 50.49(b)(1)) to ensure the following functions –*
>
> *(i) The integrity of the reactor coolant pressure boundary;*
>
> *(ii) The capability to shutdown the reactor and maintain it in a safe shutdown condition; or*
>
> *(iii) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to those referred to in 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2), or 10 CFR 100.11, as applicable.*

At BBS, the safety-related plant components are identified in controlled engineering drawings and summarized in the PassPort equipment database. The safety-related classifications in the BBS PassPort equipment database were populated using a controlled procedure, with classification criteria consistent with the above 10 CFR 54.4(a)(1) criteria. The classification criteria differences have been evaluated in a license renewal basis document as described in Section 2.1.3.2 and accounted for during the license renewal scoping process.

Safety-related classifications for systems and structures are based on system and structure descriptions and analyses in the UFSAR, or on design basis documents such as engineering drawings, evaluations, or calculations. Safety-related structures are those structures listed in the UFSAR and classified as Safety Category I. Systems and structures that are identified as safety-related in the UFSAR or in design basis documents have been classified as satisfying the criteria of 10 CFR 54.4(a)(1) and have been included within the scope of license renewal. Safety-related components listed in the PassPort equipment database were also reviewed and the system or structure associated with the safety-related component was included within the scope of license renewal in accordance with 10 CFR 54.4(a)(1) criteria. The review also confirmed that all plant conditions, including conditions of normal operation, internal events, anticipated operational occurrences, design basis accidents, external events, and natural phenomena as described in the current licensing basis (CLB), were considered for license renewal scoping.

2.1.5.2 Nonsafety-Related Affecting Safety-Related – 10 CFR 54.4(a)(2)

In accordance with 10 CFR 54.4(a)(2), the systems, structures, and components within the scope of license renewal include:

- All nonsafety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii), or (iii).

This scoping criterion requires an assessment of nonsafety-related SSCs with respect to the following application or configuration categories:

- Functional support for safety-related SSC 10 CFR 54.4(a)(1) functions
- Connected to and provide structural support for safety-related SSCs
- Potential for spatial interactions with safety-related SSCs

Each of these three categories is discussed below:

Functional Support for Safety-Related SSC 10 CFR 54.4(a)(1) Functions

This category addresses nonsafety-related SSCs that are required to function in support of a safety-related SSC intended function. The functional requirement distinguishes this category from the other categories, where the nonsafety-related SSCs are required only to maintain adequate integrity to preclude structural failure or spatial interactions. The nonsafety-related SSCs that were included within the scope of license renewal to support a safety-related SSC in performing a 10 CFR 54.4(a)(1) intended function are identified on the license renewal boundary drawings in green.

The BBS UFSAR and other CLB documents were reviewed to identify nonsafety-related systems or structures required to support satisfactory accomplishment of a safety-related function. Nonsafety-related systems or structures credited in CLB documents to support a safety-related function have been included within the scope of license renewal. BBS classifies systems that are required to perform or support a safety-related function as safety-related, with the following exceptions:

- The normal compressed air supply to the spent fuel pool gate seals is nonsafety-related. Nonsafety-related cylinders provide a back up source of nitrogen that is automatically isolated from the normal air supply by a check valve.

- The nonsafety-related feedwater regulation valves and associated piping and components are credited to preclude certain containment over-pressurization and RCS over-cooling events.
- The nonsafety-related Auxiliary Building floor drains in the Radioactive Drain System provide a flowpath that precludes flooding due to high energy and medium energy line breaks in areas that contain safety-related equipment.
- At Byron Station only, the nonsafety-related deepwell pumps and associated piping and components in the Demineralized Water System that functionally support the safety-related function of the Essential Service Water Cooling Towers by providing a make up water supply to the basins if the safety-related service water make up pumps are unavailable.

These nonsafety-related systems were included within the scope of license renewal in accordance with 10 CFR 54.4(a)(2).

As an additional confirmation of scoping to meet 10 CFR 54.4(a)(2) criteria, a supporting system review was completed as part of the scoping process. The scoping process was performed on a system and structure basis. For systems included within the scope of license renewal in accordance with the requirements of 10 CFR 54.4(a)(1), the scoping evaluation included the identification of any additional systems, including nonsafety-related systems, that are required to support the safety-related system intended functions. It was then confirmed that these identified supporting systems were also included in scope. Except as identified above, the BBS systems required to support 10 CFR 54.4(a)(1) functions are classified safety-related, and as such included within the scope of license renewal in accordance with 10 CFR 54.4(a)(1). The identification of supporting systems was not required for structures since structural intended functions do not rely on supporting systems.

The next three 10 CFR 54.4(a)(2) scoping categories are the subject of NEI 95-10, Appendix F. The guidance requires that, when demonstrating that failures of nonsafety-related systems would not adversely impact the ability to maintain intended functions, a distinction must be made between nonsafety-related systems that are directly connected to safety-related systems and those that are not directly connected to safety-related systems. For a nonsafety-related piping system that is directly connected to and provides structural support for a safety-related piping system; the nonsafety-related piping and supports shall be included within the scope of license renewal up to (1) the analytical boundary defined in the CLB seismic analysis for the safety-related piping or, (2) if the seismic boundary is not clearly defined in the CLB information, up to the point beyond which the failure of the nonsafety-related piping will not render the safety-related portion of the piping system unable to perform its intended function under CLB design conditions. The location of the point beyond which the failure of the nonsafety-related piping will not render the safety-related portion of the piping system unable to perform its intended function under CLB design conditions is identified using the guidance presented in NEI 95-10, Appendix F, Section 4.

For nonsafety-related systems which are not connected to safety-related piping or components, or are outside the structural support boundary for the attached safety-related piping system, but have a spatial relationship such that their failure could adversely impact the performance of a safety-related SSC's intended function, there are two scoping options: a mitigative option or a preventive option. When mitigative features (e.g., pipe whip restraints, jet impingement shields, spray and drip shields, seismic supports, flood barriers) are provided to protect safety-related SSCs from failures of nonsafety-related SSCs, this demonstration should show that mitigating devices are adequate to protect safety-related SSCs from failures of nonsafety-related SSCs regardless of failure location. If this level of protection can be demonstrated, then only the mitigative features need to be included within the scope of license renewal. However, if it cannot be demonstrated that the mitigative features are adequate to protect safety-related SSCs from the consequences of failures of nonsafety-related SSCs, then the preventive option is used, which requires that the nonsafety-related SSC be brought into the scope of license renewal.

The methodology for identification of BBS SSCs that satisfy the 10 CFR 54.4(a)(2) scoping criterion was based on a review of applicable CLB documents, as well as plant specific and industry operating experience. The preventive option is used to demonstrate that safety-related SSCs are adequately protected from failure of nonsafety-related SSCs.

Connected to and Provide Structural Support for Safety-Related SSCs

For nonsafety-related piping connected to safety-related piping, the nonsafety-related piping was assumed to provide structural support to the safety-related piping if the nonsafety-related is within the analytical boundary of the CLB seismic analysis. The analytical boundaries of the CLB seismic analysis are located such that the seismic response of piping outside the boundary will not affect the response of the piping within the analytical boundary. Therefore, nonsafety-related piping outside of the analytical boundary of safety-related piping systems does not need to be included within the scope of license renewal for structural support since failure of this piping will not prevent the accomplishment of the intended function of the safety-related piping due to structural interaction.

Generally the analytical boundaries are located at anchor points. In cases where it is impractical to seismically model a piping system from anchor point to anchor point, the analytical boundary can be truncated by utilizing a series of supports designed such that the effects of the piping truncated from the model would not change the response of the piping within the analysis boundary. In addition, in certain cases a smaller branch line is decoupled from the larger header piping in the CLB seismic analysis if the effects of the smaller piping would not change the response of the attached header piping.

In certain instances the analytical boundaries of the CLB seismic analysis are not clearly defined. In these cases the nonsafety-related piping was included in scope for 10 CFR 54.4(a)(2), up to one of the following:

1. The first seismic anchor. A seismic anchor is defined as a device or structure that ensures that forces and moments are restrained in three (3) orthogonal directions.
2. A combination of restraints or supports that encompasses at least two (2) supports in each of three (3) orthogonal directions.
3. A base-mounted component (e.g., pump, heat exchanger, tank, etc.) that is designed not to impose loads on connecting piping. The anchored component is included within the scope of license renewal as it has a structural support function for the safety-related piping.
4. A flexible connection is considered a pipe stress analysis model end point when the flexible connection effectively decouples the piping system (i.e., does not support loads or transfer loads across it to connecting piping).
5. A free end of nonsafety-related piping, such as a drain pipe that ends at an open floor drain.
6. For nonsafety-related piping runs that are connected at both ends to safety-related piping, the entire run of nonsafety-related piping is included in scope.
7. A branch line off of a header where the moment of inertia of the header is greater than seven (7) times the moment of inertia of the branch. The header is treated as an anchor.

These scoping boundaries are determined from review of the physical installation details, design drawings, or seismic analysis calculations.

Failure in the nonsafety-related piping beyond the above anchor locations would not impact structural support for the safety-related piping. The associated piping and components included within the scope of license renewal are identified on the license renewal boundary drawings in red. Symbols identifying the anchor locations and the CLB seismic analysis boundaries that define the structural support boundary for safety-related piping systems are shown on the license renewal boundary drawings in blue. Note that if the connected nonsafety-related piping system contains water, steam or oil, then the in scope boundary may extend beyond the locations described above due to potential for spatial interaction with safety-related SSCs.

Potential for Spatial Interactions with Safety-Related SSCs

Nonsafety-related systems that are not connected to safety-related piping or components, or are outside the structural support boundary for the attached safety-related piping system, and have a spatial relationship such that their failure could adversely impact the performance of a safety-related SSC intended function, must be evaluated for license renewal scope in accordance with 10 CFR 54.4(a)(2) requirements. As described in NEI 95-10, Appendix F, there are two options when performing this scoping evaluation: a mitigative option and a preventive option.

The mitigative option involves crediting plant mitigative features to protect safety-related SSCs from failures of nonsafety-related SSCs. Examples of plant mitigative features include pipe whip restraints, jet impingement shields, spray and drip shields, seismic supports, flood barriers, and physical barriers (e.g., floors, walls, doors, dampers). This option requires a demonstration that the mitigating features are adequate to protect safety-related SSCs from failures of nonsafety-related SSCs regardless of failure location. If this level of protection can be demonstrated, then only the mitigative features need be included within the scope of license renewal. Mitigative plant design features are used to exclude SSCs from the scope of license renewal at BBS by defining the boundaries for areas where spatial interaction is a concern.

The preventive option involves identifying the nonsafety-related SSCs that have a spatial relationship such that failure could adversely impact the performance of a safety-related SSC intended function, and including the identified nonsafety-related SSC within the scope of license renewal without consideration of plant mitigative features.

BBS applied the preventive option for 10 CFR 54.4(a)(2) scoping. The preventive option as implemented at BBS is based on a “spaces” approach for determining potential for spatial interaction with safety-related SSCs. The boundaries for the “spaces” are defined by mitigative features which act as physical barriers and separate safety-related targets from nonsafety-related hazards.

Nonsafety-related piping and components that contain water, oil, or steam are not excluded from scope unless it can be demonstrated that they are not in proximity to safety-related SSCs. This is demonstrated by confirming that there are no safety-related SSCs located within the same space (e.g., structure or enclosure) as the nonsafety-related piping or component containing water, oil, or steam. This demonstration is based on confirming that there are adequate physical barriers (e.g., floors, walls, doors, dampers) separating the nonsafety-related piping or component from safety-related SSCs, thereby preventing the potential spatial interaction. The structural barrier components are included in scope. No credit is taken for separation by distance alone without a physical barrier capable of preventing the spatial interaction.

Potential spatial interaction is assumed for all nonsafety-related SSCs that contain water, oil, or steam and that are located within structures that contain non-failsafe SSCs that are relied upon to perform safety-related functions. The structures of concern for potential spatial interaction were identified based on a review of the CLB to determine which structures contained active or passive safety-related SSCs. In addition, the location field was reviewed for components listed as safety-related in the PassPort equipment database to confirm that these components are not located in nonsafety-related structures. Finally, walkdowns of not in scope structures were performed to confirm the function of SSCs located in those structures. It is assumed that nonsafety-related SSCs within structures containing safety-related SSCs may be located in proximity to safety-related SSCs.

Nonsafety-related piping and components that contain water, oil, or steam, and are located inside structures that contain safety-related SSCs, are included within the scope of license renewal for potential spatial interaction in accordance with the requirements of criterion 10 CFR 54.4(a)(2). High-energy lines located within structures that contain safety-related equipment are included within the scope of license renewal, in accordance with 10 CFR 54.4 (a)(1) or (a)(2), depending on their safety classification. Safety-related high-energy lines are in scope in accordance with 10 CFR 54.4 (a)(1), and nonsafety-related high-energy lines are in scope in accordance with 10 CFR 54.4 (a)(2). Potential spatial interaction due to leakage or spray is assumed for system pressure as low as atmospheric. Supports for all nonsafety-related SSCs within these structures are included in scope.

The BBS turbine building contains a limited number of SSCs that are classified as safety-related. The components located within the turbine building that perform a safety-related function are either fail-safe or anticipatory and, therefore, are not targets for potential spatial interaction. However, there is the potential for communication between nonsafety-related SSCs located in the turbine building and safety-related SSCs located in the adjacent Auxiliary Building due to ventilation openings in the wall that separates these two structures. Therefore, water, oil, or steam filled SSCs located within the vicinity of these ventilation openings are included within the scope of license renewal due to potential for spatial interaction. A license renewal basis document has been prepared to evaluate the scoping of water, oil, or steam filled nonsafety-related SSCs located within the turbine building.

Air and gas systems (non-liquid) are not a hazard to other plant equipment, and have, therefore, been determined not to have potential for spatial interactions with safety-related SSCs. SSCs containing air or gas cannot adversely affect safety-related SSCs due to leakage or spray, since gas systems contain no liquids that could spray or leak onto safety-related systems to cause shorts or other malfunctions. BBS operating experience was reviewed and confirmed that there have been no failures due to aging in systems containing air or gas that have adversely impacted the accomplishment of a safety function. Additionally, air and gas systems at BBS are classified as moderate energy systems. As described in NEI 95-10, Appendix F, paragraph 5.2.2.2.2, physical impact from pipe whip or jet impingement from moderate energy systems do not occur and need not be considered. Thus, the nonsafety-related systems containing air or gas are not included within the scope of license renewal for spatial interaction. The supports are included in scope to prevent the nonsafety-related piping from becoming gravitational missiles and potentially impacting safety-related SSCs.

The piping systems included within the scope of license renewal in accordance with 10 CFR 54.4(a)(2) for potential spatial interaction with safety-related SSCs are identified on the license renewal boundary drawings in red.

2.1.5.3 Regulated Events – 10 CFR 54.4(a)(3)

In accordance with 10 CFR 54.4(a)(3), the systems, structures, and components within the scope of license renewal include:

> *All systems, structures and components relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for fire protection (10 CFR 50.48), environmental qualification (10 CFR 50.49), pressurized thermal shock (10 CFR 50.61), anticipated transients without scram (10 CFR 50.61), and station blackout (10 CFR 50.63).*

For each of the five regulations, a technical basis document was prepared to provide input into the scoping process. Each of the regulated event basis documents (described in Section 2.1.3.4) identify the systems and structures that are relied upon to demonstrate compliance with the applicable regulation. The basis documents also identify the source documentation used to determine the scope of components within the system that are credited to demonstrate compliance with each of the applicable regulated events. Guidance provided by the technical basis documents was incorporated into the system and structure scoping evaluations, to determine the SSCs credited for each of the regulated events. SSCs credited in the regulated events have been classified as satisfying criteria of 10 CFR 54.4(a)(3) and have been included within the scope of license renewal.

2.1.5.4 System and Structure Intended Functions

For the systems and structures within the scope of license renewal, the intended functions that are the bases for including them within the scope of license renewal are identified and documented in the scoping evaluation. The system or structure intended functions are based on the applicable CLB reference documents. For systems, the system level intended function descriptions associated with 10 CFR 54.4(a)(1) were standardized based on nuclear safety criteria for pressurized water reactors as documented in industry standard ANSI/ANS-51.1-1983. The use of standardized 10 CFR 54.4(a)(1) functions provided for consistent function application and appropriate level of detail for system level intended function descriptions. The component level intended functions are the passive component functions that are necessary to support the system or structure intended function(s). The structure and component intended functions are further described in Section 2.1.6.2.

2.1.5.5 Scoping Boundary Determination

Systems and structures that are included within the scope of license renewal are then further evaluated to determine the population of in scope structures and components. This part of the scoping process is also a transition from the scoping process to the screening process. The process for evaluating mechanical systems is different from the process for structures, primarily because the plant design document formats are different. Mechanical systems are depicted primarily on the system piping and instrumentation diagrams (P&ID) that show the system components and their functional relationships, while structures are depicted on physical drawings. Electrical and I&C components of in scope electrical and in scope mechanical systems are placed into commodity groups and are screened as commodities. Scoping boundaries for mechanical systems, structures, and electrical are, therefore, described separately.

Mechanical Systems

For mechanical systems, the mechanical components that support the system intended functions are included within the scope of license renewal and are depicted on the applicable system piping and instrumentation diagram. Mechanical system piping and instrumentation diagrams are marked up to create license renewal boundary drawings showing the in scope components. Components that are required to support a safety-related function, or a function that demonstrates compliance with one of the license renewal regulated events, are identified on the system piping and instrumentation diagrams by green highlighting. Nonsafety-related components that are connected to safety-related components and are required to provide structural support at the safety/nonsafety interface, or components whose failure could prevent satisfactory accomplishment of a safety-related function due to spatial interaction with safety-related SSCs, are identified by red highlighting. A computer sort and download of associated system components from the PassPort equipment database confirms the scope of components in the system. Plant walkdowns were performed when required for additional confirmation.

Structures

For structures, the structural components that are required to support the intended function(s) of the structure, as described in the CLB, are included within the scope of license renewal. The structural components are identified from a review of applicable plant design drawings of the structure. Plant walkdowns were performed when required for additional confirmation. Component listings from the PassPort equipment database were reviewed to verify structure level intended functions. Structural bolting required to support the structure proper is evaluated with the structure. Structural bolting supporting the intended function of a component support or a structural commodity component is evaluated with the component support or structural commodity component. A site plan layout drawing is marked up for both Byron Station and Braidwood Station to create a license renewal boundary drawing showing the structures within the scope of license renewal highlighted in green. Additionally, the structural scoping results were benchmarked against previous license renewal applications.

Electrical

Electrical and I&C systems, and electrical components within mechanical systems, did not require further system evaluations to determine which components were required to perform or support the identified intended functions. A bounding scoping approach is used for electrical equipment. All electrical components within in scope systems were included within the scope of license renewal. In scope electrical components were placed into commodity groups and were evaluated as commodities during the screening process as described in Section 2.1.6.

2.1.6 SCREENING PROCEDURE

Once the SSCs within the scope of license renewal have been determined, the next step is to determine which structures and components are subject to an aging management review.

2.1.6.1 Identification of Structures and Components Subject to AMR

The requirement to identify structures and components subject to an aging management review is specified in 10 CFR 54.21(a)(1), which states:

Each license renewal application must contain the following information:

> *(a) An integrated plant assessment (IPA). The IPA must –*
>
> *(1) For those systems, structures, and components within the scope of this part, as delineated in §54.4, identify and list those structures and components subject to an aging management review. Structures and components subject to an aging management review shall encompass those structures and components—*
>
> (i) *That perform an intended function, as described in §54.4, without moving parts or without a change in configuration or properties. These structures and components include, but are not limited to, the reactor vessel, the reactor coolant system pressure boundary, steam generators, the pressurizer, piping, pump casings, valve bodies, the core shroud, component supports, pressure retaining boundaries, heat exchangers, ventilation ducts, the containment, the containment liner, electrical and mechanical penetrations, equipment hatches, seismic Category I structures, electrical cables and connections, cable trays, and electrical cabinets, excluding, but not limited to, pumps (except casing), valves (except body), motors, diesel generators, air compressors, snubbers, the control rod drive, ventilation dampers, pressure transmitters, pressure indicators, water level indicators, switchgears, cooling fans, transistors, batteries, breakers, relays, switches, power inverters, circuit boards, battery chargers, and power supplies; and*
>
> *(ii) That are not subject to replacement based on a qualified life or specified time period.*

Structures and components that perform an intended function without moving parts or without a change in configuration or properties are defined as passive for license renewal. Passive structures and components that are not subject to replacement based on a qualified life or specified time period are defined as long-lived for license renewal. The screening procedure is the process used to identify the passive, long-lived structures and components within the scope of license renewal that are subject to aging management review.

NUREG-1800, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants” and NEI 95-10, Appendix B, were used as the basis for the identification of passive structures and components. Most passive structures and components are long-lived. In the few cases where a passive component is determined not to be long-lived, such determination is documented in the screening evaluation and, if applicable, on the associated license renewal boundary drawing.

The BBS structures and components subject to aging management review have been identified in accordance with the requirements of 10 CFR 54.21(a)(1) described above. The process implemented to meet these requirements for mechanical systems, structures, and electrical commodities is described as follows:

Mechanical Systems

The mechanical system screening process began with the results from the scoping process. For in scope mechanical systems, the completed scoping packages include written descriptions and marked up system piping and instrumentation diagrams that clearly identify the in scope system boundary for license renewal. The marked up system piping and instrumentation diagrams are called license renewal boundary drawings. These system boundary drawings were reviewed to identify the passive, long-lived components, and the identified components were then entered into the license renewal database. Component listings from the PassPort equipment database were also reviewed to confirm that all system components were considered. In cases where the system piping and instrumentation diagram did not provide sufficient detail, such as for some large vendor supplied components (e.g., compressors, emergency diesel generators), the associated component drawings or vendor manuals were also reviewed. Plant walkdowns were performed when required for confirmation. Finally, the identified list of passive, long-lived system components was benchmarked against previous license renewal applications containing a similar system.

Some mechanical components, when combined, are considered a complex assembly. A complex assembly is a predominantly active assembly where the performance of its components is closely linked to that of the intended function of the entire assembly, such that testing and monitoring of the assembly is sufficient to identify degradation of these components. Examples of complex assemblies include diesel generators and chiller units. Complex assemblies are considered active and can be excluded from the requirements of AMR. However, to the extent that complex assemblies include piping or components that interface with external equipment, or components that cannot be adequately tested or monitored as part of the complex assembly, those components are identified and subject to aging management review. This follows the screening methodology for complex assemblies as described in Table 2.1-2 of NUREG-1800, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants,” Revision 2 (reference 1.7.4).

Mechanical components are screened with the system in which they were scoped. For heat exchangers, the process side of the heat exchanger is evaluated with the process side system for aging management review. Likewise, the cooling water side of the heat exchanger is evaluated with the cooling water side system for aging management review.

Structures

The structure screening process also began with the results from the scoping process. For in scope structures, the completed scoping packages include written descriptions of the structure. If only selected portions of the structure are in scope, the in scope portions are described in the scoping evaluation. The associated structure drawings were reviewed to identify the passive, long-lived structures and components, and the identified structures and components were then entered into the license renewal database. Plant walkdowns were performed when required for confirmation. Finally, the identified list of passive, long-lived structures and components was benchmarked against previous license renewal applications.

Electrical Commodities

Screening of electrical and I&C components within the in scope electrical, I&C, and mechanical systems used a bounding approach as described in NEI 95-10. Electrical and I&C components for the in scope systems were assigned to commodity groups. The commodities subject to an aging management review are identified by applying the criteria of 10 CFR 54.21(a)(1). This method provides the most efficient means for determining the electrical commodities subject to an aging management review since many electrical and I&C components and commodities are active.

The sequence of steps and special considerations for identification of electrical commodities that require an aging management review is as follows:

1. Electrical and I&C components and commodities in systems within the scope of license renewal at BBS were identified and listed. The listing provided by NEI 95-10, Appendix B, is the basis for this list. Electrical and I&C components and commodities were organized into groups such as circuit breakers, switches, and cables. Individual specific components were not identified. The electrical commodities were identified from a review of plant documents, controlled drawings, the PassPort equipment database, and interface with the parallel mechanical screening efforts.

2. Following the identification of the electrical commodities, the criterion of 10 CFR 54.21(a)(1)(i) was applied to identify commodities that perform their functions without moving parts or without a change in configuration or properties (referred to as “passive” components). These commodities were identified utilizing the guidance of NEI 95-10.

3. Electrical and I&C components and commodities were not evaluated to determine if they perform a license renewal intended function during the scoping of systems. At this point in the screening process, the remaining

passive electrical commodities are reviewed to determine if the commodity performs a license renewal intended function. If an electrical commodity does not perform a license renewal intended function, it is not considered further and, therefore, is not subject to an aging management review.

4. The screening criterion found in 10 CFR 54.21(a)(1)(ii) excludes those commodities that are subject to replacement based on a qualified life or specific time period from the requirements of an aging management review. The 10 CFR 54.21(a)(1)(ii) screening criterion was applied to those commodities that were not previously eliminated by the application of the 10 CFR 54.21(a)(1)(i) screening criterion. Components and commodities included in the plant environmental qualification (EQ) program are replaced on a specified interval based on a qualified life. Components and commodities in the EQ program do not meet the “long-lived” criterion of 10 CFR 54.21(a)(1)(ii) and are considered “short-lived” per the regulatory definition and are, therefore, not subject to an aging management review.

5. Components and commodities which support or interface with electrical components and commodities, for example, cable trays, conduits, instrument racks, panels and enclosures, are evaluated as structural components in Section 2.4.

The electrical commodities that require an aging management review are the separate electrical commodities that are not part of a larger active component.

The passive commodities that are not subject to replacement based on a qualified life or specified time period are subject to an aging management review. For BBS, the electrical commodities that require an aging management review are identified in Section 2.5.

2.1.6.2 Intended Function Definitions

The intended functions that the components and structures must fulfill are those functions that are the bases for including them within the scope of license renewal. A component intended function is defined as a passive component function that must be performed in order for the system or structure to be able to perform the system or structure intended function(s). For example, pressure boundary failure of a component would cause loss of inventory from the system, and the system would subsequently be unable to perform its intended function(s). Structures and components may have multiple intended functions. BBS has considered multiple intended functions where applicable, consistent with the staff guidance provided in Table 2.1-3 of NUREG-1800, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants” (reference 1.7.4).

Table 2.1-1 provides expanded definitions of structure and component passive intended functions identified in this application.

Table 2.1-1   Passive Structure and Component Intended Function Definitions

Intended Function	Definition
Absorb Neutrons	Absorb neutrons.
Direct Flow	Provide spray shield or curbs for directing flow, which may include protective features for medium energy line breaks (MELB). This function is also utilized for selected mechanical components where the pressure boundary intended function is not applicable (e.g., HVAC diffusers, steam generator impingement plates and baffles).
Electrical Continuity	Provide electrical connections to specified sections of an electrical circuit to deliver voltage, current, or signals.
Expansion/Separation	Provide for thermal expansion and/or seismic separation.
Filter	Provide filtration or foreign material exclusion.
Fire Barrier	Provide rated fire barrier to confine or retard fire from spreading to or from adjacent areas of the plant.
Flood Barrier	Provide flood protection barrier (internal and external flood event). This may include protective features for medium energy line breaks (MELB).
Gaseous Release Path	Provide path for release of filtered and unfiltered gaseous discharge.
Heat Sink	Provide heat sink during SBO or design basis accidents.
Heat Transfer	Provide heat transfer.
HELB Shielding	Provide shielding against high energy line breaks (HELB).
Insulate (Electrical)	Insulate and support an electric conductor.
Leakage Boundary	Nonsafety-related component that maintains mechanical and structural integrity to prevent spatial interactions that could cause failure of safety-related SSCs. This function includes the required structural integrity when the nonsafety-related leakage boundary piping is also attached to safety-related piping.
Maintain Adhesion	Provides adhesion to the substrate.
Mechanical Closure	Provide closure of components. Typically used with bolting.
Missile Barrier	Provide missile barrier (internal or external missiles).

Table 2.1-1 Passive Structure and Component Intended Function Definitions

Intended Function	Definition
Pipe Whip Restraint	Provide pipe whip restraint.
Pressure Boundary	Provide pressure-retaining boundary so that sufficient flow at adequate pressure is delivered, or provide fission product barrier for containment pressure boundary, or provide containment isolation for fission product retention. This function includes the required leakage boundary function to prevent spatial interactions that could cause failure of safety related SSCs.
Pressure Relief	Provide overpressure protection.
Shelter, Protection	Provide shelter/protection for structures and components.
Shielding	Provide shielding against radiation.
Spray	Convert fluid into spray.
Structural Pressure Boundary	Provide pressure boundary or essentially leak tight barrier to protect public health and safety in the event of any postulated design basis events.
Structural Support	Provide structural support for structures and components within the scope for 10 CFR 54.4(a)(1), (a)(2), or (a)(3) or provide structural integrity to preclude nonsafety-related component interactions that could prevent satisfactory accomplishment of a safety-related function.
Structural Support to maintain core configuration and flow distribution	Provide structural support of fuel assemblies, control rods, and incore instrumentation, to maintain core configuration and flow distribution.
Thermal Insulation	Control of heat loss to preclude overheating of nearby safety-related SSCs.
Thermal Insulation Jacket Integrity	Prevent moisture absorption and provide physical support of thermal insulation.
Throttle	Provide flow restriction.
Vibration Isolation	Provide flexible support to minimize the impact of vibration.
Water retaining boundary	Provide an essentially leak-tight boundary.

2.1.6.3 Stored Equipment

For many of the fire zones, credit is taken for making repairs to equipment in order to perform one or more of the safe shutdown functions. In all cases, such credit is taken only to accomplish a function required for cold shutdown. Equipment that is stored on site for installation or use in response to a fire event is considered to be within the scope of license renewal. Specific repairs credited for individual fire zones are discussed in the BBS Fire Protection Report (FPR) subsection 2.4.2 and summarized in 2.4-3 of the BBS FPR. Most repairs identified consist of installing temporary cable to replace cables that are assumed to be damaged by a fire. For each repair credited in FPR subsection 2.4.2, a procedure has been written and is available to cover the repair. The procedure is general for each type of repair. For example, a repair procedure covers the temporary repair of cables and is applicable for all zones where such repairs are referenced. For each repair credited in FPR subsection 2.4.2, the quantity and specific type of materials required by the analysis and the procedure are reserved onsite. Tools and supplies used to place the stored equipment in service are not within the scope of license renewal.

2.1.6.4 Consumables

The evaluation process for consumables is consistent with the guidance provided in NUREG-1800, Table 2.1-3. Consumables have been divided into the following four (4) groups for the purpose of license renewal: (a) packing, gaskets, component seals, and O-rings; (b) structural sealants; (c) oil, grease, and component filters; and (d) system filters, fire extinguishers, fire hoses, and air packs.

- Group (a) subcomponents (packing, gaskets, seals, and O-rings): Based on ANSI B31.1 and the ASME B&PV Code Section III, the subcomponents of pressure retaining components as shown above are not pressure-retaining parts. Therefore, these subcomponents are not relied on to form a pressure-retaining function and are not subject to an AMR.
- Group (b) structural sealants: AMRs were required for structural sealants in structures within the scope of license renewal. A summary of the AMR results is presented in Section 3.5.
- Group (c) subcomponents (oil, grease, and component filters): These subcomponents are short-lived and are periodically replaced. Various plant procedures are used in the replacement of oil, grease, and filters in components that are in scope for license renewal. Therefore, these subcomponents are not subject to an AMR.
- Group (d) consumables (system filters, fire extinguishers, fire hoses, and air packs): System Ventilation filters are replaced in accordance with plant procedures based on vendor manufacturers' requirements and system testing. Fire extinguishers, self-contained breathing air packs, and fire hoses are within the scope of license renewal, but are not subject to aging management because they are replaced based on condition. These components are periodically inspected in accordance with National

Fire Protection Association (NFPA) standards. These standards require replacement of equipment based on their condition or performance during testing and inspection. Other equipment such as portable fans and smoke exhausters are periodically inspected for condition and replaced if warranted. These components are not long-lived and are subject to replacement based on NFPA standards; therefore an aging management review is not required.

2.1.7 GENERIC SAFETY ISSUES

In accordance with the guidance in NEI 95-10 and Appendix A.3 of NUREG-1800, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants,” review of NRC generic safety issues (GSIs) as part of the license renewal process is required to satisfy 10 CFR 54.29. This guidance suggests that GSIs involving issues related to license renewal aging management reviews or TLAAs should be addressed in the license renewal application. Based on Nuclear Energy Institute (NEI) and NRC guidance, NUREG-0933 “Resolution of Generic Safety Issues,” Supplement 34 (reference 1.7.14) and previous license renewal applicants, the following GSIs are addressed for BBS license renewal:

- GSI 190, Fatigue Evaluation of Metal Components for 60-year Plant Life – This GSI addresses fatigue life of metal components and was closed by the NRC. In the closure letter, however, the NRC concluded that licensees should address the effects of reactor coolant environment on component fatigue life as aging management programs are formulated in support of license renewal. Accordingly, the issue of environmental effects on component fatigue life is addressed in Section 4.3.

- GSI-191, Assessment of Debris Accumulation on PWR Sump Performance – This GSI addresses the potential for blockage of containment sump strainers that filter debris from cooling water supplied to the safety injection and containment spray pumps following a postulated LOCA. The issue is based on the identification of new potential sources of debris, including failed containment coatings, which may block the sump strainers. The containment sump strainers are evaluated with the Residual Heat Removal System as described in Section 2.3.2.3. The protective coatings inside containment and the containment sumps are evaluated with the Containment Structure as described in Section 2.4.4. The Protective Coating Monitoring and Maintenance Program, B.2.1.36, manages the aging of the coatings inside containment. BBS does not credit coatings to manage aging of SSCs inside the containment. Coatings inside containment are credited to maintain adhesion to protect against failure of the coating, which may block the sump strainers. Also, the issue is not related to the 40-year term of the current operating license; and, therefore, it is not a TLAA.

NUREG-0933 was reviewed and there are no new generic issues that involve issues related to license renewal aging management reviews or TLAAs.

2.1.8 CONCLUSION

The scoping and screening methodology described above was used for the Byron and Braidwood Stations IPA to identify the systems, structures, and components that are within the scope of license renewal and that are subject to an aging management review. The methodology is consistent with and satisfies the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1).

2.2 PLANT LEVEL SCOPING RESULTS

Table 2.2-1 lists the Byron and Braidwood Stations, Units 1 and 2 systems, structures, and commodity groups that were evaluated to determine if they were within the scope of license renewal, using the methodology described in Section 2.1. A reference to the section of the application that contains the scoping and screening results is provided for each in-scope mechanical system, structure, and commodity group in the Table. A reference to the applicable Byron and Braidwood UFSAR Section is provided for electrical systems and not in scope mechanical systems.

Table 2.2-1 Plant Level Scoping Results

System, Structure, or Commodity Group	In Scope for License Renewal?	Reference
Reactor Vessel, Internals, and Reactor Coolant System		
Reactor Coolant System	Yes	2.3.1.1
Reactor Vessel	Yes	2.3.1.2
Reactor Vessel Internals	Yes	2.3.1.3
Steam Generators	Yes	2.3.1.4
Engineered Safety Features		
Combustible Gas Control System	Yes	2.3.2.1
Containment Spray System	Yes	2.3.2.2
Residual Heat Removal System	Yes	2.3.2.3
Safety Injection System	Yes	2.3.2.4
Auxiliary Systems		
Auxiliary Building Ventilation System	Yes	2.3.3.1
Chemical & Volume Control System	Yes	2.3.3.2
Chilled Water System	Yes	2.3.3.3
Circulating Water System	Yes	2.3.3.4
Circulating Water Ventilation System	No	UFSAR Section 9.4.6
Component Cooling System	Yes	2.3.3.5
Compressed Air System	Yes	2.3.3.6
Containment Ventilation System	Yes	2.3.3.7
Control Area Ventilation System	Yes	2.3.3.8
Cranes and Hoists	Yes	2.3.3.9
Demineralized Water System	Yes	2.3.3.10
Emergency Diesel Generator & Auxiliaries Systems	Yes	2.3.3.11
Fire Protection System	Yes	2.3.3.12
Fresh Water System	Yes	2.3.3.13
Fuel Handling & Fuel Storage System	Yes	2.3.3.14
Fuel Oil System	Yes	2.3.3.15
Heating Water and Heating Steam System	Yes	2.3.3.16
Miscellaneous Ventilation Systems	No	UFSAR Section 9.4.10
Non-Radioactive Drain System	Yes	2.3.3.17

Table 2.2-1 Plant Level Scoping Results

System, Structure, or Commodity Group	In Scope for License Renewal?	Reference
Radiation Monitoring System	Yes	2.3.3.18
Radioactive Drain System	Yes	2.3.3.19
Radwaste Storage System	No	UFSAR Section 9.1.2.3.11
Radwaste System	Yes	2.3.3.20
Sampling System	Yes	2.3.3.21
Service Water System	Yes	2.3.3.22
Sewage Treatment System	No	UFSAR Section 9.2.4
Spent Fuel Cooling System	Yes	2.3.3.23
Steam and Power Conversion System		
Auxiliary Feedwater System	Yes	2.3.4.1
Condensate and Feedwater Auxiliaries System	Yes	2.3.4.2
Main Condensate and Feedwater System	Yes	2.3.4.3
Main Condenser and Air Removal System	No	UFSAR Section 10.4.1, 10.4.2
Main Generator and Auxiliaries System	No	UFSAR Section 10.2.2
Main Steam System	Yes	2.3.4.4
Main Turbine and Auxiliaries System	Yes	2.3.4.5
Containments, Structures, and Component Supports		
Auxiliary Building	Yes	2.4.1
Circulating Water Pump House (Byron)	Yes	2.4.2
Component Supports Commodity Group	Yes	2.4.3
Containment Structure	Yes	2.4.4
Deep Well Enclosures (Byron)	Yes	2.4.5
Essential Service Cooling Pond (Braidwood)	Yes	2.4.6
Essential Service Water Cooling Towers (Byron)	Yes	2.4.7
Fuel Handling Building	Yes	2.4.8
Lake Screen Structures (Braidwood)	Yes	2.4.9
Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms	Yes	2.4.10
Miscellaneous Not In-Scope Structures	No	Comment 1
Natural Draft Cooling Towers (Byron)	Yes	2.4.11

Table 2.2-1 Plant Level Scoping Results

System, Structure, or Commodity Group	In Scope for License Renewal?	Reference
RWST Foundation and Tunnel	Yes	2.4.12
Radwaste and Service Building Complex	Yes	2.4.13
River Screen House (Braidwood)	No	Comment 2
River Screen House (Byron)	Yes	2.4.14
Structural Commodity Group	Yes	2.4.15
Switchyard Structures	Yes	2.4.16
Turbine Building Complex	Yes	2.4.17
Yard Structures	Yes	2.4.18
Electrical and Instrumentation and Control (I&C) Systems		
Cathodic Protection System	No	UFSAR Table 3.2-1
Communication System	Yes	UFSAR Section 9.5.2
DC Power System	Yes	UFSAR Section 8.3.2
Electrical Commodities	Yes	2.5.2.5
Heat Trace System	Yes	UFSAR Table 3.2-1
Instrument Power System	Yes	UFSAR Section 7.1.2.1.3
Lighting System	Yes	UFSAR Section 9.5.3
Low Voltage Auxiliary Power System	Yes	UFSAR Section 8.3.1.1
Medium Voltage Auxiliary Power System	Yes	UFSAR Section 8.3.1.1
Miscellaneous Instrumentation Systems	No	UFSAR Section 2.3.3, 3.7.4, 3.9.2.7, 7.7.1.12
Offsite Power System	Yes	UFSAR Section 8.2
Plant Alarm and Annunciator System	Yes	UFSAR Section 7.3.1
Reactor Control System	Yes	UFSAR Section 7.7.1.1
Reactor Protection System	Yes	UFSAR Section 7.2
Security System	No	UFSAR Section 13.6

Comments:

1. The Miscellaneous Not In-Scope Structures are nonsafety-related and provide support, shelter, and protection for nonsafety-related systems, structures, and components (SSC's) that do not perform an intended function for license renewal. These nonsafety-related structures are also separated from safety-related SSC's such that the structures' failure would not impact a safety-related

function. Therefore, the following structures are not within the scope of license renewal: Acid Pump House, Bottle Gas Storage Area, Construction Offices (Braidwood), Containment Access Facilities, Contractors Facility (Byron), Decontamination Facility (Braidwood), Dry Cask Storage Structures, Electrical/Instrument Maintenance Building, Environmental Protection Facility (Byron), FIN Team/Records Management Vault Building (Braidwood), Generator Stator Water Cooling Equipment Building (Byron), Illinois Emergency Management Agency Monitoring Facility, Level B Storage Building, Meteorological Tower, Miscellaneous Oil Handling Structures, Old Steam Generator Facility, Security Structures, Sewage Treatment Plant, Spare Building (Braidwood), Training Facilities, Warehouse Buildings, and Waste Treatment Facilities.

2. The purpose of the Braidwood River Screen House is to provide structural support, shelter, and protection for the nonsafety-related equipment located at the structure. The equipment provides circulating water makeup from the Kankakee River to the Braidwood cooling pond. The Essential Service Cooling Pond (safety-related portion of the cooling pond) is designed to provide sufficient volume for a minimum of 30 (thirty) days without requiring any makeup in accordance with Regulatory Guide 1.27. Therefore, all of the systems, structures, and components associated with the Braidwood River Screen House are nonsafety-related and do not perform any intended functions for license renewal. Included with the Braidwood River Screen House is the Braidwood Circulating Water Blowdown Structure. The purpose of the Braidwood Circulating Water Blowdown Structure is to provide structural support, shelter, and protection for the nonsafety-related equipment necessary to transfer water from the circulating water blowdown line to the Kankakee River. All of the systems, structures, and components associated with the Braidwood Circulating Water Blowdown Structure are nonsafety-related and do not perform any intended functions for license renewal.

2.3 SCOPING AND SCREENING RESULTS: MECHANICAL

2.3.1 REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

The following systems are addressed in this section:

- Reactor Coolant System (2.3.1.1)
- Reactor Vessel (2.3.1.2)
- Reactor Vessel Internals (2.3.1.3)
- Steam Generators (2.3.1.4)

2.3.1.1 Reactor Coolant System

Description

The Reactor Coolant System is a normally operating, mechanical system designed to circulate sub-cooled reactor coolant to transfer heat from the reactor core to the secondary fluid in four (4) steam generators during normal operation, or anticipated operational occurrences. The system is capable of transferring this heat using forced circulation with the reactor coolant pumps during normal operation, or using natural circulation when necessary during emergency operations.

The Reactor Coolant System consists of the following plant systems: reactor coolant system, reactor coolant pressurizer system, reactor vessel level instrumentation system (a plant subsystem of the reactor coolant system), incore thermocouple system, and incore flux mapping system. The Reactor Coolant System is in scope for license renewal.

The purpose of the reactor coolant system is to circulate reactor coolant either by forced circulation with the four (4) reactor coolant pumps or by natural circulation to transfer sufficient heat from the reactor core to the secondary fluid in the four (4) steam generators during normal operation and anticipated operational occurrences so that reactor pressure and reactor core thermal limits are not exceeded. The reactor coolant system provides a reactor coolant pressure boundary to separate fission products from the environment. The reactor coolant system provides a core cooling flow path for decay heat removal during cold shutdown and refueling conditions to the residual heat removal system. The reactor coolant system provides a flow path for emergency core cooling from the safety injection system. Included in the Reactor Coolant System is the ASME Class 1 piping and components in the interconnecting plant systems such as the residual heat removal system, the chemical and volume control system, and the safety injection system.

The reactor coolant system accomplishes the specified function by establishing part of the reactor coolant pressure boundary and circulating reactor coolant through the reactor core to transfer sufficient heat from the reactor core to the steam generators during normal operations and anticipated operational occurrences by means of the reactor coolant pumps and piping. The reactor coolant system consists of four (4) heat transfer loops that are connected in parallel to the reactor pressure vessel. Each loop consists of a reactor coolant pump and a steam generator. During normal power operation the reactor coolant pumps circulate pressurized coolant through the reactor pressure vessel and reactor coolant system piping. The coolant is heated as it passes through the core and flows from the reactor pressure vessel through the hot leg. The coolant then flows into the steam generator where the heat is transferred to the main steam system for the production of electricity. From the steam generator the fluid flows to the reactor coolant pump suction through the intermediate leg and is then pumped into the reactor pressure vessel through the cold leg. The installed elevation of the reactor pressure vessel, steam generators, and reactor coolant system piping provide the thermal driving head required for natural circulation. Piping connections on the reactor coolant system cold legs and hot legs with the Safety Injection System, the Chemical and Volume Control System, and the Residual Heat Removal System are provided to support the injection of borated water from the refueling water storage tank or containment sumps during accident conditions. The reactor coolant system piping connections with the Residual Heat Removal System are also used to support decay heat removal during normal plant shutdown and refueling operations. Reactor coolant make-up borated water and reactor coolant pump seal water is provided by the Chemical and Volume Control System.

The purpose of the reactor coolant pressurizer system is to establish and maintain the reactor coolant system pressure within prescribed limits through use of the pressurizer heaters and the pressurizer spray line. The pressurizer also provides a steam surge chamber and a water reserve to accommodate reactor coolant density changes during operation via the pressurizer surge line. Over-pressure protection is provided by power-operated relief valves and code safety valves that discharge into the pressurizer relief tank to ensure that the code safety limits are not exceeded. Components of the reactor coolant pressurizer system are part of the reactor coolant pressure boundary. Included in the reactor coolant pressurizer system is a pressurizer relief tank. The purpose of the pressurizer relief tank is to accept fluid from the pressurizer, relief valves, valves and stem leak-off, and then discharge the accumulated fluid to the Radioactive Drain System.

The reactor coolant pressurizer system accomplishes the specified function by establishing part of the reactor coolant pressure boundary and providing a method of controlling the reactor coolant system pressure. The pressurizer is connected to the hot leg piping of one loop via the pressurizer surge line. The pressurizer surge line permits unrestricted flow between the reactor coolant system and the pressurizer to maintain the reactor coolant system pressure and accommodate system volume changes. The pressurizer controls the reactor coolant system pressure by means of the pressurizer heaters and the spray line. The pressurizer heaters are designed to replace heat lost during normal operation and to raise the saturation temperature, which raises the pressure. The pressurizer spray line provides a path for the relatively cooler cold leg reactor coolant to spray into the steam space at the top of the pressurizer to condense steam to reduce the system pressure. The pressurizer has two (2) power-operated relief valves and three (3) code safety valves for over-pressure protection. Two (2) safety-related compressed air accumulators and associated piping and valves are provided to supply to the motive force for operating the power-operated relief valves. The pressurizer relief tank receives vented reactor coolant from the pressurizer, relief valves, and valve stem leak-offs, and discharges accumulated fluid to the Radioactive Drain System. Nitrogen from the Radwaste System is added to the pressurizer relief tank to maintain low concentrations of hydrogen and oxygen. The atmosphere of the pressurizer relief tank is vented to the Radwaste System header, and includes a separate branch for gas sampling. Sampling lines off of the pressurizer steam and liquid spaces forwards samples to the Sampling System.

The purpose of the reactor vessel level instrumentation system is to provide indication of inadequate core cooling during emergency situations and to monitor water level during refueling operations. Components of the reactor vessel level instrumentation system are part of the reactor coolant pressure boundary.

The reactor vessel level instrumentation system accomplishes the specified purpose by establishing part of the reactor coolant pressure boundary and providing a method of measuring reactor vessel water level during normal, accident, and refueling operations. The reactor vessel level instrumentation system consists of two (2) removable heated junction thermocouple (HJTC) instruments with sensors at several axial locations in the reactor pressure vessel head region, two (2) differential pressure level indicators used during normal operation, and two (2) differential pressure level indicators used during refueling operation. The HJTC instruments are inserted into the reactor pressure vessel through two (2) penetrations in the reactor pressure vessel closure head and establish part of the reactor coolant pressure boundary. The differential pressure level detectors that are used during normal operation are connected to the pressurizer. The refueling differential pressure level detectors which are isolated during power operation are connected to two (2) incore flux mapping fixed conduits, which connect to the bottom of the reactor pressure vessel, and the pressurizer.

The purpose of the incore thermocouple system is to continuously monitor reactor coolant temperature exiting the core during normal operation and provide input to core power distribution monitoring. It also provides indication of inadequate core cooling during emergency situations. Components of the incore thermocouple system are part of the reactor coolant pressure boundary.

The incore thermocouple system accomplishes the specified purpose by establishing part of the reactor coolant pressure boundary and providing a method of measuring the temperature of the coolant leaving selected fuel assemblies in the reactor core. The incore thermocouple system consists of sixty-five (65) replaceable stainless steel sheathed thermocouples routed to the upper core plate at the point where the reactor coolant exits the selected fuel assemblies. The stainless steel sheathed cabling for the incore thermocouples are routed through five (5) penetrations in the reactor pressure vessel closure head and establish part of the reactor coolant pressure boundary.

The purpose of the incore flux mapping system is to periodically measure the radial and axial neutron flux distribution in the reactor core. The incore flux mapping system also provides an instrumentation tap for the reactor vessel level instrumentation system during refueling outages. Components of the incore flux mapping system are part of the reactor coolant pressure boundary.

The incore flux mapping system accomplishes the specified function by establishing part of the reactor coolant pressure boundary and providing a method of periodically measuring the axial and radial neutron flux. The incore flux mapping system consists of fifty-eight (58) fixed conduits welded to the reactor pressure vessel bottom mounted instrument nozzles, fifty-eight (58) retractable flux thimbles, a seal table, isolation valves, movable gamma detectors, and associated drive and transfer equipment. The fixed conduits, flux thimbles, seal table, and isolation valves establish part of the reactor coolant pressure boundary.

The Reactor Coolant System is required for all plant conditions when fuel is in the reactor pressure vessel (RPV).

For more information, refer to UFSAR Sections 3.9.3, 5.1, 5.2, 5.4, 7.7.1.9, and E.31.

Boundary

The Reactor Coolant System scoping boundary includes the reactor coolant pressure boundary components (hot leg piping, intermediate leg piping (between the steam generator outlet nozzle and the reactor coolant pump suction), and cold leg piping), reactor coolant pumps, pressurizer, pressurizer relief tank, pressurizer heaters, pressurizer surge piping, and pressurizer spray piping, including auxiliary spray piping.

The Reactor Coolant System scoping boundary begins at the Reactor Vessel outlet nozzle safe end to pipe welds and continues through the hot leg piping to the Steam Generator inlet nozzle safe end to pipe welds. The Steam Generators are evaluated as a separate license renewal system. The Reactor Coolant System boundary continues from the Steam Generator outlet safe ends to pipe welds through the intermediate leg piping through the reactor coolant pump and continues from the reactor coolant pump discharge through the cold leg piping to the Reactor Vessel inlet nozzle pipe to safe end welds. The Reactor Vessel is evaluated as a separate license renewal system. The pressurizer surge line that is connected from the hot leg to the pressurizer lower head is included in the Reactor Coolant System scoping boundary, as well as the pressurizer spray lines that are connected from the cold leg piping to the spray nozzle internal to the pressurizer.

The Reactor Coolant System scoping boundary includes the pressurizer attached piping, code safety valves, and power-operated relief valves (PORVs). The PORV accumulators, piping, and tubing from the accumulators to the air actuator of the power-operated relief valves, check valves, and solenoid valves are also included in the Reactor Coolant System. The instrument air supply piping and components upstream of the dual check valves on Byron and Braidwood (Unit 2 only) are evaluated with the Compressed Air System.

The Reactor Coolant System boundaries with the Reactor Vessel are at the reactor pressure vessel inlet and outlet nozzle safe ends. The reactor vessel level instrumentation system and the incore thermocouple system have boundaries with the Reactor Vessel at the associated RPV head penetrations. The incore flux mapping system has a boundary with the Reactor Vessel at the weld between the bottom mounted instrument nozzles and the fixed conduits.

The Reactor Coolant System boundary with the Steam Generators is at the steam generator inlet and outlet nozzle safe ends.

The Reactor Coolant System boundary with the Chemical and Volume Control System is at the upstream side of the dual ASME Class 1 check valves in the charging pump discharge to reactor coolant cold leg lines, at the upstream side of the air operated isolation valve in the charging pump discharge to pressurizer auxiliary spray line, at the downstream side of the air operated valve in the reactor coolant cold leg to letdown regenerative heat exchanger line, at the downstream side of the loop drain header isolation valve to the excess letdown heat exchanger, and at the piping class break of various chemical and volume control system valve and valve stem leak offs to pressurizer relief tank lines. The Reactor Coolant System boundary with the Chemical and Volume Control System is also at the upstream side of the dual ASME Class 1 check valves in the reactor coolant pump seal supply lines, and at the downstream side of the reactor coolant pump seal bypass orifices, and at the connection between the reactor coolant pump seal and the seal water return lines.

The Reactor Coolant System boundary with the Safety Injection System is at the upstream side of the dual ASME Class 1 check valves located on the safety injection discharge piping attached to each of the reactor coolant hot and cold legs. The branch lines connected between the dual ASME Class 1 valves located on the safety injection discharge piping attached to the reactor coolant hot legs are evaluated as part of the Safety Injection System. In addition to the boundary with the safety injection pump discharge piping, the Reactor Coolant System has a boundary with the Safety Injection System at the upstream side of the four (4) safety injection accumulator motor operated isolation valves, a boundary at the upstream side of the air operated isolation valves located on the safety injection accumulator injection lines, a boundary at the upstream side of the charging pump discharge line common ASME Class 1 check valve located inside of containment, and a boundary at the upstream side of the residual heat removal (RHR) heat exchanger discharge to reactor coolant hot leg ASME Class 1 check valves located inside containment.

The Reactor Coolant System boundary with the Residual Heat Removal System is at the downstream side of the second motor operated valve (containment isolation valve) in the RHR pump suction from the reactor coolant hot leg lines and at the piping class break of the residual heat removal system valve stem leakoffs to the pressurizer relief tank lines.

The Reactor Coolant System boundary with the Component Cooling System is at the flex hose connections to the reactor coolant pump thermal barrier, the upper reactor coolant pump motor bearing cooler, and the lower reactor coolant pump motor bearing cooler. The flex hoses are included in the Component Cooling System.

The Reactor Coolant System boundary with the Sampling System is at the downstream side of the two (2) reactor coolant hot leg and four (4) reactor coolant cold leg sample line air operated isolation valves located inside of containment and at the downstream side of the pressurizer steam and liquid sample line air operated isolation valves located inside of containment.

The Reactor Coolant System boundary with the Radioactive Drain System is at the downstream side of the air operated isolation valve in the pressurizer relief tank vent to waste gas compressor line, the downstream side of the air operated isolation valve in the pressurizer relief tank to reactor coolant drain tank line, and the downstream side of the normally closed manual isolation valve in the reactor coolant hot and cold leg drain header to reactor coolant drain tank line.

All associated piping, components, and instrumentation contained within the flow path described above are included in the system evaluation boundary.

Also included in the license renewal scoping boundary of the Reactor Coolant System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in the proximity to equipment performing a safety-related function, whichever extends furthest. This includes the nonsafety-related portions of the system located within the Containment Structure. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawings for identification of this boundary, shown in red.

Also included in the license renewal scoping boundary of the Reactor Coolant System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor. Included in this boundary are components relied upon to preserve the structural support intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Reason for Scope Determination

The Reactor Coolant System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Reactor Coolant System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Reactor Coolant System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Anticipated Transient Without Scram (10 CFR 50.62), and Station Blackout (10 CFR 50.63). The Reactor Coolant System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61).

Intended Functions

1. Provide reactor coolant pressure boundary. The Reactor Coolant System provides a boundary for containing the reactor coolant under normal operating temperature and pressure conditions. The power operated relief valves (PORVs) and safety valves prevent an overpressure condition during plant transients. 10 CFR 54.4(a)(1)

2. Sense process conditions and generate signals for reactor trip or engineered safety features actuation. The Reactor Coolant System instrumentation provides system pressure, temperature, pressurizer water level, and reactor coolant flow inputs to reactor trip and engineered safety feature actuation systems. 10 CFR 54.4(a)(1)

3. Remove residual heat from the reactor coolant system. The Reactor Coolant System provides connections with the residual heat removal system and provides a portion of the flow path to support decay heat removal. 10 CFR 54.4(a)(1)

4. Provide and maintain sufficient reactor coolant inventory for core cooling. The Reactor Coolant System transfers the heat generated in the reactor core to the steam generators. Coolant is circulated at the flow and temperature required for achieving the reactor core thermal-hydraulic performance. The Reactor Coolant System circulates reactor coolant either by forced circulation with the reactor coolant pumps or by natural circulation to transfer sufficient heat from the reactor core to the steam generator secondary fluid during normal operation and anticipated operational occurrences so that reactor core thermal limits are not exceeded. 10 CFR 54.4(a)(1)

5. Provide primary containment boundary. The Reactor Coolant System process lines that penetrate primary containment are provided with the required primary containment isolation valves. 10 CFR 54.4(a)(1)

6. Maintain the dose consequences within the guidelines of 10 CFR 50.67 or 10 CFR 100. The Reactor Coolant System provides sufficient core cooling to ensure that the nuclear fuel and the reactor coolant design limits are not exceeded. 10 CFR 54.4(a)(1)

7. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Reactor Coolant System contains nonsafety-related components that have the potential for spatial interaction with safety-related components. Also included are sections of nonsafety-related piping that provide structural support to safety-related components. 10 CFR 54.4(a)(2)

8. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The Reactor Coolant System is credited with providing reactor coolant inventory and pressure control and process monitoring including incore thermocouples during fire events. 10 CFR 54.4(a)(3)

9. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Reactor Coolant System contains environmental qualification components that are safety-related and in a harsh environment. 10 CFR 54.4(a)(3)

10. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Anticipated Transients Without Scram (10 CFR 50.62). The Reactor Coolant System is credited with maintaining reactor coolant pressure boundary integrity during an ATWS event. 10 CFR 54.4(a)(3)

11. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). The Reactor Coolant System is credited with maintaining reactor coolant pressure boundary integrity, natural reactor coolant natural circulation for decay heat removal, and process monitoring during a SBO event. 10 CFR 54.4(a)(3)

UFSAR References

3.9.3
5.1
5.2
5.4
7.7.1.9
E.31

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-60, Sheet 1A, 1B, 2, 3, 4, 5, 6, 7A, 7B, 8
LR-BYR-M-61, Sheet 2, 3, 4, 5, 6
LR-BYR-M-62, Sheet 1
LR-BYR-M-64, Sheet 1, 2, 5
LR-BYR-M-66, Sheet 1B
LR-BYR-M-68, Sheet 1A, 1B

Byron Unit 2:
LR-BYR-M-55, Sheet 5
LR-BYR-M-135, Sheet 1A, 1B, 2, 3, 4, 5, 6, 7, 8
LR-BYR-M-136, Sheet 2, 3, 4, 5, 6
LR-BYR-M-137, Sheet 1
LR-BYR-M-138, Sheet 1, 2, 5A, 5B
LR-BYR-M-139, Sheet 1
LR-BYR-M-140, Sheet 1

Byron Common:
None.

Braidwood Unit 1:
LR-BRW-M-60, Sheet 1A, 1B, 2, 3, 4, 5, 6, 7A, 7B, 8
LR-BRW-M-61, Sheet 2, 3, 4, 5, 6
LR-BRW-M-62, Sheet 1

LR-BRW-M-64, Sheet 1, 2, 5
LR-BRW-M-66, Sheet 1B
LR-BRW-M-68, Sheet 1A, 1B

Braidwood Unit 2:
LR-BRW-M-55, Sheet 15
LR-BRW-M-135, Sheet 1A, 1B, 2, 3, 4, 5, 6, 7, 8
LR-BRW-M-136, Sheet 2, 3, 4, 5, 6
LR-BRW-M-137, Sheet 1
LR-BRW-M-138, Sheet 1, 2, 5A, 5C
LR-BRW-M-139, Sheet 1
LR-BRW-M-140, Sheet 1A , 1B

Braidwood Common:
None.

Table 2.3.1-1 Reactor Coolant System Components Subject to Aging Management Review

Component Type	Intended Function
Accumulator	Pressure Boundary
Bolting	Mechanical Closure
Bolting (Class 1)	Mechanical Closure
Bottom mounted instrument system: flux thimble tubes	Pressure Boundary
Bottom-mounted instrument guide tube (external to bottom head)	Pressure Boundary
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary
Equipment supports and foundations (RCP Motor Stand)	Structural Support
Filter Housing (PORV Air Filter – Byron Unit 1, Byron Unit 2, and Braidwood Unit 2 only)	Structural Support
Filter Housing (Reactor Coolant Pump Motor Oil Lift Component)	Leakage Boundary
Heat Exchanger - (Reactor Coolant Pump Motor Lower Bearing Cooling Coil) Tubes	Pressure Boundary
Heat Exchanger - (Reactor Coolant Pump Motor Upper Bearing Oil Cooler) Shell Side Components	Leakage Boundary
Heat Exchanger - (Reactor Coolant Pump Motor Upper Bearing Oil Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (Reactor Coolant Pump Motor Upper Bearing Oil Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (Reactor Coolant Pump Motor Upper Bearing Oil Cooler) Tubes	Pressure Boundary
Heat Exchanger - (Reactor Coolant Pump Thermal Barrier, Class 1) Tubes	Pressure Boundary
Nozzle Thermal Sleeves (Pressurizer)	Direct Flow
Nozzle Thermal Sleeves (Reactor Vessel Level Instrumentation System)	Direct Flow
Piping Element	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
	Structural Support
Pressure Housings (Class 1)	Pressure Boundary
Pressurizer (Class 1)	Pressure Boundary
Pressurizer (integral support - skirt)	Structural Support
Pressurizer instrumentation penetrations, heater sheaths and sleeves, heater bundle diaphragm plate, and manways and flanges (Class 1)	Pressure Boundary

Component Type	Intended Function
Pressurizer surge and steam space nozzles, and welds (Class 1)	Pressure Boundary
Pump Casing (Reactor Coolant Pump Class 1)	Pressure Boundary
Pump Casing (Reactor Coolant Pump Motor Oil Lift Pump)	Leakage Boundary
Reactor Coolant Pressure Boundary Components (Hot Leg, Intermediate Leg, Cold Leg, and Class 1 Piping >4" NPS)	Pressure Boundary
Restricting Orifice	Pressure Boundary
	Throttle
Restricting Orifice (Class 1)	Pressure Boundary
	Throttle
Rupture Disks	Leakage Boundary
Strainer Body (Reactor Coolant Pump Motor Oil Lift Component)	Leakage Boundary
Tanks (Pressurizer Relief Tank)	Leakage Boundary
Tanks (Reactor Coolant Pump Motor Upper and Lower Oil Reservoirs, integral to motor)	Leakage Boundary
Valve Body	Leakage Boundary
	Pressure Boundary
	Structural Support
Valve Body (Class 1)	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.1.2-1	Reactor Coolant System Summary of Aging Management Evaluation

2.3.1.2 Reactor Vessel

Description

The Reactor Vessel is a normally operating, mechanical system designed to contain the pressure and heat generated by the nuclear core and transfer this heat to the Reactor Coolant System. The Reactor Vessel consists of the reactor pressure vessel (RPV), control rod drive mechanisms (CRDMs), integral reactor vessel head assembly, and the valves and piping associated with the RPV head vent and reactor vessel flange leakage monitoring. The Reactor Vessel is in scope for license renewal.

The purpose of the Reactor Vessel is to maintain the reactor coolant pressure boundary and provide structural support for the reactor vessel internals, nuclear fuel, incore instrumentation, and CRDMs. The Reactor Vessel provides a boundary to prevent fission product release to the environment. The CRDMs maintain the reactor coolant pressure boundary and provide a means of reactivity control in the reactor by monitoring and controlling the motion and position of the rod cluster control assemblies. The integral reactor vessel head assembly provides seismic support of the CRDMs and missile protection. The RPV head vent maintains the reactor coolant pressure boundary and provides a method of venting non-condensable gases from the reactor vessel and the reactor coolant system. The reactor vessel flange leakage monitoring provides a method of detecting reactor vessel flange o-ring seal leakage.

The RPV accomplishes the specified purpose by providing a reactor coolant pressure boundary for the circulation of fluid from the reactor coolant system and by providing structural support for the reactor vessel internals, incore instrumentation, and CRDMs during normal operations and design basis events. Forced reactor coolant flow from the Reactor Coolant System piping enters the reactor vessel through four (4) primary inlet nozzles, flows downward through the annulus between the core barrel and the vessel wall and enters the bottom head region. The reactor coolant flow then travels upwards through the core support and lower core plate, up through the nuclear core, absorbing heat from the fuel assemblies, and exits the reactor vessel through the four (4) primary outlet nozzles where the reactor coolant continues through the Reactor Coolant System piping to the respective steam generator. A small portion of the coolant flows between the baffle plates and the core barrel to provide additional cooling of the core barrel. Similarly, a small amount of the entering flow is directed into the vessel head plenum and exits through the vessel outlet nozzles.

The CRDMs accomplish the specified purpose by establishing part of the reactor coolant pressure boundary and providing a method to position the rod cluster control assemblies during normal operation and design basis events. The CRDMs are mounted on the RPV head CRDM penetrations and the pressure-retaining components are an extension of the reactor coolant pressure boundary. Rod cluster control assembly position for reactivity control is controlled by energizing and de-energizing a series of DC powered electrical coils. These DC electrical coils are part of the CRDM and received power through the control rod drive system. Rod cluster control assembly position is manually controlled during plant start-up and automatically controlled once a defined power level has been obtained. The CRDMs provide a rapid insertion of negative reactivity into the core by removing power to all CRDMs. Once power is removed from the CRDMs, the rod cluster control assemblies are inserted into the nuclear core by the force of gravity. Power is removed from the CRDMs when the reactor trip breakers are opened from the engineered safety features plant system.

The integral reactor vessel head assembly, which is externally attached to the RPV head, accomplishes the specified purpose by providing seismic support for the CRDMs and missile protection in the event of a CRDM ejection. The integral reactor vessel head assembly combines the head lifting rig, seismic platform, lift columns, reactor vessel missile shield, CRDM forced air cooling system, and electrical and instrumentation cable routing into an efficient, one package reactor vessel head design.

The RPV head vent piping and valves provide a method of venting non-condensable gases during reactor vessel filling operations post refueling. Venting of the reactor vessel is accomplished by manually opening solenoid valves and venting the non-condensable gases directly to the containment while the reactor vessel is being filled. The RPV head vent solenoid valves are required to be closed during power operation. Surface mounted temperature elements are installed to detect leakage past the normally closed solenoid valves.

The RPV head to reactor vessel flange joint is sealed by two (2) concentric metallic o-rings. Reactor vessel flange o-ring seal leakage is monitored by two (2) leakoff connections: one (1) between the inner and outer o-ring, and one (1) outside the outer o-ring. Normally the flow path between the inner o-ring and outer o-ring is open and the flow path outside of the outer o-ring is isolated. Leakage is directed to the reactor coolant drain tank and detected by a surface mounted temperature element. A normally open remotely operated air valve is provided for isolation if leakage is detected.

For more information, refer to UFSAR Sections 4.6, 5.1, 5.2, 5.3, 9.1.4, E.19, and E.31.

Boundary

The Reactor Vessel scoping boundary begins at the four (4) RPV inlet nozzle safe ends and terminates at the four (4) RPV outlet nozzle safe ends. There are a series of plates and baffles assisting in flow distribution through the core. These plates and baffles are evaluated separately with the Reactor Vessel Internals. The boundary with the Reactor Coolant System is at the four (4) RPV primary inlet nozzle safe ends and the four (4) RPV primary outlet nozzle safe ends, the two (2) reactor vessel closure head penetration housing adapters used for the reactor vessel level indication system, the five (5) reactor vessel closure head penetration housing adapters used for the incore thermocouple system, and the fifty-eight (58) reactor vessel lower head bottom mounted instrument nozzles used for the incore flux mapping system.

The Reactor Vessel scoping boundary with the Reactor Vessel Internals is at the vessel flange on which the removable reactor vessel internals rest, the core support pads attached to the inside of the reactor pressure vessel and the removable reactor vessel internals clevis support keys, and the rod cluster control assembly couplers which connect the rod cluster assemblies to the control rod drive mechanisms.

The scoping boundary includes the normally isolated RPV head vent piping and valves and the normally open reactor vessel flange leakage monitoring piping and valves. The RPV head vent begins at the RPV head vent nozzle and terminates inside of the containment structure. The reactor vessel flange leakage monitoring piping begins at the RPV flange and terminates at the downstream side of the remotely operated air valve. Downstream of the remotely operated air valve is evaluated with the Radioactive Drain System.

A summary of the RPV nozzles and penetrations is provided. The RPV nozzles include four (4) inlet nozzles, four (4) outlet nozzles, and two (2) reactor vessel flange leakage monitoring nozzles. The RPV head has a total of seventy-nine (79) penetrations which include seventy-one (71) CRDM penetrations (53 active, 18 spare), two (2) reactor vessel level indication system penetrations, five (5) core exit thermocouple penetrations, and one (1) head vent penetration. The fifty-three (53) CRDM active penetrations and two (2) reactor vessel level indication system penetrations have thermal sleeves installed. The eighteen (18) spare CRDM penetrations are sealed with a stainless steel plug. The reactor vessel lower head has fifty-eight (58) penetrations (bottom mounted instrumentation nozzles) for the incore flux mapping system.

Also included in the Reactor Vessel boundary is the integral reactor vessel head assembly which is externally attached to the RPV head. The four (4) CRDM exhaust fans and plenums attached to the integral reactor vessel head assembly are evaluated separately with the Containment Ventilation System.

Not included in the Reactor Vessel scoping boundary are the Reactor Coolant System piping and components connected to the RPV nozzles and penetrations described above, which are evaluated with the Reactor Coolant System; the nuclear fuel, rod cluster control assemblies, and the removable reactor vessel internals which are evaluated with the Reactor Vessel Internals; the Radioactive Drain System piping downstream of the reactor vessel flange leakage monitoring remotely operated air valve, which is evaluated with the Radioactive Drain System; and the four (4) CRDM exhaust fans and plenums attached to the integral reactor vessel head assembly, which are evaluated with the Containment Ventilation System.

All associated piping, components, and instrumentation contained within the flow path described above are included in the system evaluation boundary.

Also included in the license renewal scoping boundary of the Reactor Vessel are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the system located within the Containment Structure. Included in the boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Reason for Scope Determination

The Reactor Vessel meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Reactor Vessel meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Reactor Vessel also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), and Station Blackout (10 CFR 50.63).

Intended Functions

1. Provide reactor coolant pressure boundary. The Reactor Vessel provides a barrier against the release of reactor coolant and radioactive material to the Containment Structure. 10 CFR 54.4(a)(1)

2. Maintain reactor core assembly geometry. The Reactor Vessel houses the core and reactor vessel internals. 10 CFR 54.4(a)(1)

3. Achieve and maintain the reactor core subcritical for any mode of normal operation or event. The control rod drive mechanisms portion of the Reactor Vessel provides automatic and manual means of positioning rod cluster control assemblies in the core. 10 CFR 54.4(a)(1)

4. Introduce emergency negative reactivity to make the reactor subcritical. The CRDMs permit rapid insertion of the rod cluster control assemblies following a reactor trip. 10 CFR 54.4(a)(1)

5. Provide physical support, shelter, and protection for safety-related systems, structures, and components. The integral reactor vessel head assembly provides seismic support for the CRDMs and missile protection in the event of a CRDM ejection event. 10 CFR 54.4(a)(1)

6. Resist nonsafety-related system, structure, or component failure that could prevent satisfactory accomplishment of a safety-related function. The Reactor Vessel contains nonsafety-related water-filled lines in the Containment Structure that have the potential for spatial interactions (spray or leakage) with safety-related SSCs. The nonsafety-related RPV head vent piping downstream of the isolation valves is positioned to minimize possible impingement on equipment. 10 CFR 54.4(a)(2)

7. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The Reactor Vessel is integral to the reactor coolant pressure boundary and provides a heat removal flow path for hot and cold shutdown. The CRDMs are used to control movement of the rod cluster control assemblies to achieve and maintain the reactor core sub-critical following a reactor trip. 10 CFR 54.4(a)(3)

8. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Reactor Vessel consists of components such as, the RPV head vent solenoid valves, which are in the Environmental Qualification program. 10 CFR 54.4(a)(3)

9. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61). The reactor vessel beltline shell, including plates, forgings, and welds are subject to Pressurized Thermal Shock (PTS) analyses. 10 CFR 54.4(a)(3)

10. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Anticipated Transients Without Scram (ATWS) (10 CFR 50.62). The Reactor Vessel maintains the pressure boundary to assure that the specified design limits are not exceeded as a result of an ATWS. 10 CFR 54.4(a)(3)

11. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout. Reactor coolant pressure boundary and rod cluster control assembly control are functions credited for Station Blackout analysis (10 CFR 50.63). 10 CFR 54.4(a)(3)

UFSAR References

4.6
5.1
5.2
5.3
9.1.4
E.19
E.31

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-60, Sheet 1B, 5

Byron Unit 2:
LR-BYR-M-135, Sheet 1B, 5

Byron Common:
None.

Braidwood Unit 1:
LR-BRW-M-60, Sheet 1B, 5

Braidwood Unit 2:
LR-BRW-M-135, Sheet 1B, 5

Braidwood Common:
None.

Table 2.3.1-2 Reactor Vessel Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Bolting (Class 1)	Mechanical Closure
Bolting (Structural)	Structural Support
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary
Control Rod Assembly (Pressure Boundary Components including; latch housing, rod travel housing, cap, and CRDM adapter)	Pressure Boundary
Equipment supports and foundations (Integral Reactor Vessel Head Assembly)	Missile Barrier
	Structural Support
Nozzle (Bottom Mounted Instrumentation and Welds)	Pressure Boundary
Nozzle (RPV Head Nozzles; CRDM Housing, Instrumentation, and Welds)	Pressure Boundary
Nozzle (RPV Head Vent, Flange Leakage Monitoring Tubes, and Welds)	Pressure Boundary
Nozzle Safe Ends and Welds	Pressure Boundary
Nozzle Thermal Sleeves	Direct Flow
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
Reactor Vessel (Beltline components; primary inlet and outlet nozzles, nozzle shell forging, intermediate shell forging, lower shell forging, and welds)	Pressure Boundary
Reactor Vessel (Core Support Pads)	Structural Support
Reactor Vessel (RPV Head and Flange)	Pressure Boundary
Reactor Vessel (Reactor Vessel Flange, Lower Head Dutchman, Lower Head Center Disc, and Welds)	Pressure Boundary
Valve Body	Pressure Boundary
Valve Body (Class 1)	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.1.2-2 Reactor Vessel
Summary of Aging Management Evaluation

2.3.1.3 Reactor Vessel Internals

Description

The Reactor Vessel Internals is a normally operating, mechanical system designed to maintain reactor core assembly geometry, to achieve and maintain the reactor core subcritical for any mode of operation or design basis event, and to introduce negative reactivity to make the reactor subcritical.

The Reactor Vessel Internals consist of the upper core support structure, the lower core support structure, and the incore instrumentation support structure, where each of these major components has distinct purposes. The Reactor Vessel Internals also include the fuel assemblies and the rod cluster control assemblies that are supported by all three structures. The Reactor Vessel Internals is in scope for License Renewal.

The overall purpose of the Reactor Vessel Internals is to direct reactor coolant flow through the fuel assemblies and other components to meet heat transfer performance requirements for all modes of operation, maintain alignment between fuel assemblies and rod cluster control assemblies to achieve and maintain the reactor core subcritical for any mode of operation or design basis event, and introduce negative reactivity to make the reactor subcritical. The Reactor Internals also provides support for and guides incore instrumentation.

The purpose of the upper core support structure is to contain the guide tube assemblies that shield and guide the control rod drive shafts and rod cluster control assemblies. This structure engages the top of the fuel assemblies and provides structural support experienced by transverse loadings from coolant cross flow and other design conditions. The upper core support structure also provides structural support for vertical loads from the fuel, hydraulic forces, control rod dynamics, and other design loadings. The upper core support structure consists of the upper support assembly, the upper core plate, support columns, and the control rod guide assemblies. The support columns establish the spacing between the upper support assembly and the upper core plate and provide the supplementary function of supporting the thermocouple guide tube. The upper core plate consists of openings for the control rod guide tubes, and for the distribution of reactor coolant flow via orifice plates, integral flow mixers, and open holes. The control rod guide tubes are fastened to the upper support assembly and are restrained by pins into the upper core plate for proper orientation and support. A large circumferential hold down spring restrains axial movements. The entire upper core support structure is removed as a unit during refueling operations to permit access to the fuel assemblies.

The purpose of the lower core support structure is to form a periphery enclosure of the core including core baffles and a lower core plate for efficient flow distribution, provide neutron shielding by means of the neutron pads, and to provide structural support experienced by transverse loadings from coolant cross flow and other design conditions. The lower core support structure also provides structural support for vertical loads from the fuel, hydraulic forces, control rod dynamics, and other design loadings. The lower core support structure consists of the core barrel, the core baffles, the lower core plate, the manway cover, the support columns, the neutron pads, the upper and lower tie plates, the core support and the secondary core support. The core support is welded to the core barrel. The core barrel supports and contains the fuel assemblies. The core barrel directs coolant flow downward and then upwards through the fuel assemblies by means of the core baffles and the lower core plate. The lower core plate is sized to provide the desired inlet flow distribution to the core, support for the support columns, and support and orientation of the fuel assemblies. Four (4) strategically placed stainless steel neutron pads provide neutron shielding when fuel is present in the core. The neutron pads are fixed to the core barrel by a combination of pins and bolts. Each neutron pad has two sections to reduce the effects of vertical relative thermal expansion. The secondary core support is contoured to the bottom of the reactor vessel and receives the weight, hydraulic, and control rod dynamic loadings. The lower core support structure remains in place in the reactor vessel during most refueling operations and is only removed to perform scheduled inspections. The lower core support structure is supported at its upper flange from a ledge in the reactor vessel and its lower end is restrained from transverse motion by a radial support system attached to the reactor vessel wall.

The purpose of the incore instrumentation support structure is to provide structural support for the Reactor Coolant System incore thermocouple system instrumentation and incore flux mapping system instrumentation. The incore instrumentation support structure consists of an upper structure to convey and support the incore thermocouple system instruments penetrating the reactor pressure vessel through the reactor pressure vessel head and a lower structure to convey and support the incore flux mapping system instruments penetrating the reactor pressure vessel lower head. The incore instrumentation upper support structure is a series of columns that route and support the incore thermocouple system’s sixty-five (65) thermocouples to five (5) instrumentation ports that penetrate the reactor pressure vessel head. The incore instrumentation lower support structure is a series of instrumentation guide columns (cruciforms) and tubing assemblies that align and support the fifty-eight (58) flux thimbles. The flux thimbles penetrate through the reactor pressure vessel lower head via penetration nozzles. Fixed conduits connect the reactor pressure vessel lower head penetrations to the seal table.

The purpose of the fuel assemblies is to generate heat from the fuel rods, maintain coolable fuel rod geometry, and promote efficient heat transfer from the nuclear fuel to the reactor coolant by means of directing flow upwards from the bottom nozzle through the assembly and out the top nozzle. The top and bottom nozzles with the guide thimbles provide dimensional stability of the fuel rods, permit insertion of rod cluster control assembly rodlets for control of reactivity, and permit insertion of incore flux mapping system instrumentation. The reactor core consists of one hundred and ninety-three (193) square fuel assemblies arranged to approximate the shape of a cylinder.

The purpose of the rod cluster control assemblies is to provide reactivity control for shutdown, reactivity changes due to reactor coolant temperature changes within the power range, the power coefficient of reactivity, and reactor coolant void formation. The reactivity of the core is controlled by fifty-three (53) rod cluster control assemblies. Each rod cluster control assembly consists of twenty-four (24) rodlets arranged on a spider assembly so that the rodlets can be inserted and withdrawn within the fuel assembly guide thimbles.

The reactor coolant flow path begins at the reactor vessel inlet nozzles where reactor coolant flow enters the reactor vessel and impinges against the upper core barrel. Flow continues down the annulus between the core barrel and neutron pads and the reactor vessel wall, with some flow going between the neutron pads and the core barrel. Flow continues between the core barrel radial support members to the lower head plenum. The coolant flow is redirected upwards by means of the annular orientation of the Reactor Vessel Internals from the lower head plenum through the core support the lower core plate, and through the fuel assemblies where it absorbs heat from the fuel rods. The core baffles contain the coolant flow at the core periphery as it travels upwards through the fuel assemblies. Flow exits the reactor core and continues into the upper vessel internals through the upper core plate, passing through and across the support columns and guide tube assemblies, exiting through the upper core barrel, and exiting the reactor vessel through the outlet nozzles.

The Reactor Vessel Internals is required for all modes of power operation.

The Reactor Vessel Internals accomplishes its purposes by providing the necessary support structures for the circulation of reactor coolant through the reactor core to remove heat from the reactor core.

For more information, refer to UFSAR Sections 3.9.5, 4.2, 4.5.2, and 5.2.

Boundary

The Reactor Vessel Internals scoping boundary includes the upper core support structure, lower core support structure, and incore instrumentation support structure. The upper core support structure consists of the guide tube assemblies, the upper core plate, upper support assembly, fuel assembly guide pins, a large circumferential hold down spring, and support columns. The lower core support structure consists of the core barrel, the core baffles, the lower core plate, the manway cover, the support columns, the neutron pads, the upper and lower tie plates, the core support and the secondary core support. The incore instrumentation support structure consists of the upper structure containing the instrumentation guide columns and the lower structure containing instrumentation guide tube assemblies. Also included in the Reactor Vessel Internals are the fuel assemblies and the rod cluster control assemblies, including the spider assembly and rodlets. The boundary between the rod cluster control assembly and the control rod drive mechanism which is part of the Reactor Vessel is at the rod cluster control assembly spider assembly coupler.

Not included in the Reactor Vessel Internals license renewal scoping boundary are the reactor pressure vessel and control rod drive housings and mechanisms which are evaluated with the Reactor Vessel. Also not included in the scoping boundary are the incore flux mapping system flux thimbles, fixed conduits and seal table, the incore thermocouple system core exit thermocouples and the reactor vessel level indication system thermocouples which are evaluated with the Reactor Coolant System.

The fuel assemblies and rod cluster control assemblies are in scope for license renewal, however these components are short-lived components, and therefore not subject to aging management review.

Reason for Scope Determination

The Reactor Vessel Internals meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Reactor Vessel Internals is not in scope under 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system would not prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Reactor Vessel Internals also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The Reactor Vessel Internals is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Maintain reactor core assembly geometry. The Reactor Vessel Internals maintains core assembly geometry within the reactor to ensure core cooling, core reactivity control, and the integrity of the fuel cladding as a radioactive material barrier. 10 CFR 54.4(a)(1)

2. Achieve and maintain the reactor core subcritical for any mode of normal operation or event. The rod cluster control assemblies adjust the concentration of the neutron absorber in the core. 10 CFR 54.4(a)(1)

3. Introduce emergency negative reactivity to make the reactor subcritical. Following a reactor trip signal, all rod cluster control assemblies are released into the core to initiate a complete reactor trip. 10 CFR 54.4(a)(1)

4. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The Reactor Vessel Internals are an integral part of the reactor vessel, which are all credited in the fire safe shutdown analysis. 10 CFR 54.4(a)(3)

UFSAR References

3.9.5
4.2
4.5.2
5.2

License Renewal Boundary Drawings

None.

Table 2.3.1-3 Reactor Vessel Internals Components Subject to Aging Management Review

Component Type	Intended Function
Alignment and Interfacing Components: Internals Hold Down Spring	Structural Support to maintain core configuration and flow distribution
Alignment and Interfacing Components: Upper Core Plate Alignment Pins	Structural Support to maintain core configuration and flow distribution
Baffle-to-Former Assembly: Accessible Baffle-to-Former Bolts	Structural Support to maintain core configuration and flow distribution
Baffle-to-Former Assembly: Baffle and Former Plates	Structural Support to maintain core configuration and flow distribution
Baffle-to-Former Assembly: Barrel-to-Former Bolts	Structural Support to maintain core configuration and flow distribution
Bottom-Mounted Instrumentation System: Bottom-Mounted Instrumentation (BMI) Column Bodies	Structural Support
Control Rod (Short-lived)	None - Short Lived
Control Rod Guide Tube (CRGT) Assemblies: C-tubes, Sheaths, and Flanges	Structural Support to maintain core configuration and flow distribution
Control Rod Guide Tube (CRGT) Assemblies: CRGT Guide Plates (cards)	Structural Support to maintain core configuration and flow distribution
Control Rod Guide Tube (CRGT) Assemblies: CRGT Lower Flange Welds (accessible)	Structural Support to maintain core configuration and flow distribution
Control Rod Guide Tube Assemblies: Guide Tube Support Pins	Structural Support to maintain core configuration and flow distribution
Core Barrel Assembly (Barrel Plates and Nozzles)	Structural Support to maintain core configuration and flow distribution
Core Barrel Assembly: Core Barrel Axial Welds	Structural Support to maintain core configuration and flow distribution
Core Barrel Assembly: Core Barrel Flange	Structural Support to maintain core configuration and flow distribution
Core Barrel Assembly: Core Barrel Outlet Nozzle Welds	Structural Support to maintain core configuration and flow distribution
Core Barrel Assembly: Lower Core Barrel Flange Weld	Structural Support to maintain core configuration and flow distribution
Core Barrel Assembly: Upper Core Barrel Flange Weld	Structural Support to maintain core configuration and flow distribution
Fuel Assembly (Short-lived)	None - Short Lived
Lower Internals Assembly: Clevis Insert Bolts	Structural Support to maintain core configuration and flow distribution
Lower Internals Assembly: Lower Core Plate and Extra-Long (XL) Lower Core Plate	Structural Support to maintain core configuration and flow distribution
Lower Support Assembly: Lower Support Column Bodies (non-cast)	Structural Support to maintain core configuration and flow distribution

Component Type	Intended Function
Lower Support Assembly: Lower Support Column Bolts	Structural Support to maintain core configuration and flow distribution
Reactor Vessel Internals Components (Manway Cover, Nuts, and Pins)	Structural Support to maintain core configuration and flow distribution
Reactor Vessel Internals Components (Neutron Pads, Bolting, and Pins)	Absorb Neutrons
	Structural Support
Reactor Vessel Internals Components (Primary, Expansion, or Existing program - inaccessible locations)	Structural Support to maintain core configuration and flow distribution
Upper Internals Assembly (Thermocouple Columns)	Structural Support
Upper Internals Assembly (Upper Core Plate)	Structural Support to maintain core configuration and flow distribution
Upper Internals Assembly: Upper Support Ring or Skirt	Structural Support to maintain core configuration and flow distribution

The aging management review results for these components are provided in:

Table 3.1.2-3	Reactor Vessel Internals Summary of Aging Management Evaluation

2.3.1.4 Steam Generators

Description

The Steam Generators is a normally operating, mechanical system designed to serve as a heat sink for the reactor coolant, to supply dry saturated steam to the turbine, and to provide a barrier to prevent fission products and activated corrosion products in the reactor coolant from entering the steam system or environment.

The Steam Generators consists of the following components and plant systems: steam generators (part of the reactor coolant system) and the steam generator blowdown system. The Steam Generators are in scope for License Renewal.

The major components of the Steam Generators are the four (4) steam generators per unit. Byron and Braidwood Unit 1 have Babcock and Wilcox recirculating vertical inverted u-tube steam generators. Byron and Braidwood Unit 2 have Westinghouse D-5 recirculating vertical inverted u-tube steam generators. The steam generator blowdown system consists of the blowdown condensers, hotwell tanks, blowdown condenser hotwell pumps, piping, and valves.

The Steam Generators have interfaces with several other systems and components that are not within the license renewal boundary of the Steam Generators, and are evaluated separately. These include the Auxiliary Feedwater System, Main Condensate and Feedwater System, Main Steam System, Reactor Coolant System, Radwaste System, Sampling System, Service Water System, and Radioactive Drain System.

The purpose of the steam generators is to transfer heat from the reactor coolant to the main feedwater through the four steam generators during normal operation and anticipated operational occurrences so that reactor core thermal limits are not exceeded and to produce dry saturated steam for the main turbine.

Additionally, the steam generators provide a portion of the reactor coolant pressure boundary which prevents fission products and activated corrosion products in the reactor coolant from entering the steam system or being released to the environment. The reactor coolant pressure boundary portion of the steam generators consist of the primary inlet and outlet chambers, primary inlet and outlet nozzles, tube sheet, u-tubes, and manways.

The steam generators also provide indication of steam generator water level to the main control room. The level instrumentation actuates a reactor trip signal, starts the auxiliary feedwater pumps, and isolates the steam generator blowdown lines upon a low steam generator water level condition. If above a specified power, on a high steam generator water level condition, the level instrumentation actuates a turbine trip and a trip of all feedwater pumps. The level instrumentation also provides inputs into the ATWS mitigation system.

The steam generators accomplish the specified functions by establishing part of the reactor coolant pressure boundary, providing a heat sink to remove heat from the reactor core through the reactor coolant system, transferring the heat from the reactor coolant system to the secondary fluid (feedwater) to produce high quality steam, and providing instrumentation to monitor and control steam generator water level based on steam flow and feedwater flow.

The Steam Generators consist of four (4) steam generators per unit that are large shell and tube heat exchangers. Byron and Braidwood Unit 1 have Babcock and Wilcox recirculating vertical inverted u-tube steam generators. The Babcock and Wilcox steam generators were installed in 1998 and replaced the original Westinghouse D-4 steam generators. Unit 2 has the original plant equipment Westinghouse D-5 recirculating vertical inverted u-tube steam generators. The steam generators are located at a higher elevation than the reactor core, thus, natural circulation is assured for removal of decay heat if forced primary flow is lost.

The primary side (reactor coolant) flow path of both types of steam generators is similar. Reactor coolant from the reactor coolant system hot leg enters the primary inlet chamber through the primary inlet nozzle. The reactor coolant continues through the vertical inverted u-tubes during which heat is transferred from the reactor coolant to the secondary fluid (feedwater). The vertical inverted u-tubes and tube sheet provide a pressure boundary between the primary side fluid (reactor coolant) and the secondary side fluid (feedwater/steam). The cooled reactor coolant exits the vertical u-tubes, enters the primary outlet chamber and exits to the reactor coolant system intermediate leg through the primary outlet nozzle. The primary inlet chamber and primary outlet chamber are separated by a divider plate sometimes referred to as a channel head partition plate. The primary inlet and outlet nozzles, the primary inlet and outlet chambers, and the divider plate are also referred to as the primary channel head. There are no instrumentation taps on the primary side of the steam generators. Provisions to manually drain the primary side for maintenance are provided.

The secondary side (feedwater and steam) flow path is different between the two types of steam generators.

The secondary side flow path for the Byron and Braidwood Unit 1 steam generators is as follows. Feedwater enters the steam generator through the feedwater nozzle, into a gooseneck, ring header, and out j-tubes which direct the feedwater flow downward outside of the shroud into the downcomer region. The feedwater passes through the downcomer region and into the tube bundle region. In the tube bundle region the feedwater absorbs heat from the primary side (reactor coolant) and forms steam bubbles. The heated water and steam bubbles rise and travel through the primary moisture separators and then through the secondary moisture separators. The separated water drains to the downcomer region. The dry steam exits the steam generator to the main steam system through the steam outlet nozzle. A continuous blowdown flow near the top of the tube sheet removes impurities and helps to maintain secondary side chemistry. Instrument taps are provided for water level and steam flow indication. In addition to the main feedwater nozzle, an auxiliary feedwater nozzle is provided. On Unit 1 the chemical feed and handling system injects through the auxiliary feedwater nozzles and the auxiliary feedwater is injected through the main feedwater water piping.

The secondary side flow path for the Byron and Braidwood Unit 2 steam generators is as follows. Feedwater enters the steam generator through the feedwater nozzle and is directed by an impingement plate into the preheater section. A flow limiting device is installed in the feedwater inlet nozzle to limit flow in the event of a feedwater line break. In the preheater section the feedwater flows around the preheater baffles mixing the cooler feedwater with the hotter water in the steam generator. From the preheater section the water enters the tube bundle region. In the tube bundle region, the feedwater absorbs heat from the primary side (reactor coolant) and forms steam bubbles. The heated water and steam bubbles rise and travel into the steam drum and then through the swirl vane moisture separators. The steam then travels through the second stage chevron moisture separators. The separated moisture is returned to the downcomer region. The dry steam exits the steam generator to the main steam system through the steam outlet nozzles. In addition to the main feedwater nozzle, an auxiliary feedwater nozzle is provided in the upper shell of the steam generator. The auxiliary feedwater nozzle reduces the thermal shock on the tubes in the preheater section when at low power and the feedwater temperature is cold or when the auxiliary feedwater system is in operation by bypassing the preheater section. A continuous blowdown flow near the top of the tube sheet and the mid-section of the tube bundle removes impurities and helps to maintain secondary side chemistry. Instrument taps are provided for water level and steam flow indication.

The purpose of the steam generator blowdown system is to provide a means of removing impurities from the steam generators to maintain secondary feedwater chemistry within prescribed limits. The steam generator blowdown system accomplishes this specified function by permitting a continuous blowdown from all four (4) steam generators through the blowdown condensers (one per unit), hotwell tanks (one per unit), blowdown condenser hotwell pumps (two per unit), piping, and valves. The continuous blowdown flow from all four (4) steam generators, which flashes to steam, enters the blowdown condenser which is cooled by the Service Water System. The condensed liquid enters the blowdown condenser hotwell tank. The level in the blowdown condenser hotwell tank is automatically controlled by one (1) of two (2) blowdown condenser hotwell tank pumps. The blowdown condensate is pumped to the Radwaste System for processing. The steam generator blowdown system can be cross connected allowing one (1) steam generator blowdown condenser to receive fluid from both units.

A wet layup system is provided for the Byron and Braidwood Unit 1 steam generators. The wet layup system is used to provide chemical treatment and recirculate the steam generator secondary side fluid for chemistry monitoring and adjustment during refueling outages. Each steam generator has a dedicated wet layup system that consists of piping, manual valves, one (1) wet layup pump, and temperature indication on the pump inlet. During normal operation, manual valves, and spectacle flanges isolate the layup pumps and instrumentation from the safety-related portion of the steam generator blowdown system. A wet layup system is not provided for the Byron and Braidwood Unit 2 steam generators.

The Steam Generators also provide containment isolation. The steam generator blowdown system outboard air-operated containment isolation valves automatically close upon either a low-low steam generator water level signal or a Phase A isolation signal. The steam generator blowdown lines are also automatically isolated if a high energy line break is detected.

For more information, refer to UFSAR Sections 5.2.3, 5.4.2, 7.2.2.3.5, 7.7.1.21, and 10.4.8.

Boundary

The Steam Generators scoping boundary includes those portions of the four (4) steam generators associated with maintaining the reactor coolant pressure boundary, maintaining the secondary side pressure boundary, and the steam generator blowdown system.

The Steam Generators scoping boundary associated with maintaining the reactor coolant pressure boundary begins at the steam generator primary inlet nozzle safe end connected to the Reactor Coolant System hot leg piping and ends at the steam generator primary outlet nozzle safe end connected to the Reactor Coolant System cold leg piping.

The Steam Generators scoping boundary associated with maintaining the secondary side pressure boundary begins at the steam generator feedwater inlet nozzle connected to the Main Condensate and Feedwater System feedwater piping and ends at the steam generator steam outlet nozzle connected to the Main Steam System steam piping. The integral steam flow restrictor and steam flow instrumentation are evaluated as part of the Main Steam System. The Unit 2 steam generators have an additional boundary with the Main Condensate and Feedwater System at the auxiliary feedwater inlet nozzle.

The Steam Generators scoping boundary associated with the steam generator blowdown system begins at the steam generator, passes through containment, the blowdown flow from the four (4) steam generators is combined into a single header, continues to the steam generator blowdown condenser, to the steam generator blowdown condenser hotwell tank, to one of two steam generator blowdown condenser hotwell pumps, and ends at the upstream side of the normally open, manual plug valve which is part of the Radwaste System. Boundaries with the Radwaste System are also at the upstream side of the nitrogen supply normally closed, manual globe valve connected to the blowdown piping for each steam generator. Braidwood has an additional boundary with the Radwaste System at a branch connection in a gaseous radwaste drain line, which connects into the Braidwood Unit 2A steam generator condenser blowdown condenser hotwell pump drain line.

The Steam Generators scoping boundary with the Sampling System is at the downstream side of the normally open, fail close air operated isolation valve connected to the blowdown piping for each steam generator.

The Steam Generators scoping boundary with the Radioactive Drain System is at the downstream side of the normally open, manual gate valve in the auxiliary building equipment drain radwaste system piping connected to the Unit 1 steam generator blowdown condenser hotwell tank. Byron Unit 1 has an additional boundary at the downstream side of the normally open ball valve in blowdown sample collection tank pump discharge line to the Unit 1 steam generator blowdown condenser.

The Steam Generators scoping boundary with the Service Water System is at the non-essential service water piping connected to the inlet and outlet of the steam generator blowdown condenser.

All associated piping, components, and instrumentation contained within the flow paths described above are included in the system evaluation boundary.

The Steam Generators have interfaces with several other systems and components that are not within the license renewal scoping boundary of the Steam Generators and are evaluated separately. These include the Auxiliary Feedwater System, Main Condensate and Feedwater System, Main Steam System, Reactor Coolant System, Radwaste System, Sampling System, Service Water System, and Radioactive Drain System.

Also included in the license renewal scoping boundary of the Steam Generators are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the systems located within the Auxiliary Building and the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Also included in the license renewal scoping boundary of the Steam Generators are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor. Included in this boundary are components relied upon to preserve the structural support intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included in the scope of license renewal is the portion of the Steam Generators located in the Unit 1 turbine building, upstream of the Unit 1 steam generator chemical feed branch connections, as this portion of the system is not located within an area in proximity to components performing a safety-related function. Components that are not required to support the system's leakage boundary intended function and do not perform or support system intended functions are not included in the scope of license renewal. The Unit 2 steam generator chemical feed and handling system connections are evaluated with the Condensate and Feedwater Auxiliaries System.

Reason for Scope Determination

The Steam Generators meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Steam Generators meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Steam Generators also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Anticipated Transient Without Scram (10 CFR 50.62), and Station Blackout (10 CFR 50.63). The Steam Generators is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61).

Intended Functions

1. Provide reactor coolant pressure boundary. The steam generator primary channel head, manways, nozzles, tube sheet, tubes, drain lines, and valves form a barrier against the release of reactor coolant and radioactive material to the Containment Structure or the Main Steam System. 10 CFR 54.4(a)(1)

2. Sense process conditions and generate signals for reactor trip or engineered safety features actuation. The Steam Generators System monitors the level of water in the Steam Generators and actuates a reactor trip upon a low steam generator water level signal and a turbine trip and feedwater isolation on a high steam generator water level signal. 10 CFR 54.4(a)(1)

3. Provide primary containment boundary. The Steam Generators have containment isolation valves on the steam generator blowdown system piping that close upon a safety injection actuation signal or manual isolation. The steam generator blowdown system also isolates if a high energy line break is detected. 10 CFR 54.4(a)(1)

4. Remove residual heat from the reactor coolant system. The Steam Generators in conjunction with the Main Steam System, Main Condensate and Feedwater System, and Auxiliary Feedwater System provides a method of removing residual decay heat from the reactor coolant system during normal plant shutdown and design basis events by providing steam generator secondary integrity and controlled steam release. 10 CFR 54.4(a)(1)

5. Provide secondary heat sink. The Steam Generators in conjunction with the Auxiliary Feedwater System provides an alternate heat sink for removing heat (including reactor coolant pump energy, decay and sensible heat) from the Reactor Coolant System to allow safe shutdown of the reactor for events where the main feedwater system is unavailable. 10 CFR 54.4(a)(1)

6. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The nonsafety-related portions of the steam generator blowdown system have the potential for spatial interaction with safety-related components. The nonsafety-related nitrogen supply piping to the steam generator blowdown system provides structural support of steam generator blowdown system safety-related piping and components. 10 CFR 54.4(a)(2)

7. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The steam generators are an integral part of the reactor coolant system, main feedwater system, and main steam system, which are all credited in the fire safe shutdown analysis. 10 CFR 54.4(a)(3)

8. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Steam Generators contain Environmental Qualification components that are safety-related, and are in a harsh environment. 10 CFR 54.4(a)(3)

9. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for ATWS (10 CFR 50.62). The Steam Generators provide indication (steam generator water level) to determine if a loss of heat sink has occurred and sends a signal to the ATWS mitigation system.) 10 CFR 54.4(a)(3)

10. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). The Steam Generators provide a heat sink for decay heat removal and containment isolation during the required Station Blackout coping period. 10 CFR 54.4(a)(3)

UFSAR References

5.2.3
5.4.2
7.2.2.3.5
7.7.1.21
10.4.8

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-35, Sheet 1, 2
LR-BYR-M-36, Sheet 1A, 1B, 1C, 1D
LR-BYR-M-60, Sheet 1A, 2, 3, 4
LR-BYR-M-68, Sheet 8

Byron Unit 2:
LR-BYR-M-120, Sheet 1, 2A, 2B
LR-BYR-M-121, Sheet 1A, 1B, 1C, 1D
LR-BYR-M-135, Sheet 1A, 2, 3, 4

Byron Common:
LR-BYR-M-48, Sheet 2, 5A, 5B, 29

Braidwood Unit 1:
LR-BRW-M-35, Sheet 1, 2
LR-BRW-M-36, Sheet 1A, 1B, 1C, 1D
LR-BRW-M-60, Sheet 1A, 2, 3, 4
LR-BRW-M-68, Sheet 8

Braidwood Unit 2:
LR-BRW-M-120, Sheet 1, 2A, 2B
LR-BRW-M-121, Sheet 1A, 1B, 1C, 1D
LR-BRW-M-135, Sheet 1A, 2, 3, 4

Braidwood Common:
LR-BRW-M-48, Sheet 2, 5A, 5B
LR-BRW-M-69, Sheet 1

Table 2.3.1-4 Steam Generators
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Bolting (Class 1)	Mechanical Closure
Class 1 Piping, Fittings and Branch Connections < NPS 4" (Steam Generator Drain - Byron Unit 1 and Braidwood Unit 1 only)	Pressure Boundary
Condensing Chamber	Pressure Boundary
Flow Device (Feedwater Flow Limiter - Byron Unit 2 and Braidwood Unit 2 only)	Throttle
Heat Exchanger - (Steam Generator Blowdown Condenser) Shell Side Components	Leakage Boundary
Nozzle Thermal Sleeves (Aux Feedwater)	Direct Flow
Nozzle Thermal Sleeves (Feedwater)	Direct Flow
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
	Structural Support
Pump Casing (Steam Generator Blowdown Condenser Hotwell Pump)	Leakage Boundary
Pump Casing (Wet Layup Pump - Byron Unit 1 and Braidwood Unit 1 only)	Leakage Boundary
Steam Generators (Feedwater Ring and J-Tubes - Byron Unit 1 and Braidwood Unit 1 only)	Direct Flow
Steam Generators (Impingement Plate and Preheater Baffles - Byron Unit 2 and Braidwood Unit 2 only)	Direct Flow
Steam Generators (Internal Supports and Structures)	Structural Support
Steam Generators (Moisture Separators)	Direct Flow
Steam Generators (Primary Head Drain Penetration and Weld)	Pressure Boundary
Steam Generators (Primary Head, Integral Inlet and Outlet Nozzles, Nozzle Closure Ring, Manway Nozzle, Safe Ends, and Welds)	Pressure Boundary
Steam Generators (Primary Manway Cover and Insert)	Pressure Boundary
Steam Generators (Primary Side Components: Divider Plate)	Direct Flow
Steam Generators (Secondary Side Instrument Nozzles (Bosses))	Pressure Boundary

Component Type	Intended Function
Steam Generators (Secondary Side Manway and Handhole Covers)	Pressure Boundary
Steam Generators (Secondary Side Nozzles, Steam Outlet, Feedwater Inlet, Safe Ends, and Welds)	Pressure Boundary
Steam Generators (Secondary Side Shell and Head)	Pressure Boundary
Steam Generators (Supports - Pads, Lugs, and Trunnions)	Structural Support
Steam Generators (Tube Bundle Wrapper (Shroud))	Direct Flow
Steam Generators (Tube Plugs)	Pressure Boundary
Steam Generators (Tube Sheet)	Pressure Boundary
Steam Generators (Tube Support Plates and U-Bend Supports)	Structural Support
Steam Generators (Tube-to-Tube Sheet Weld - Byron Unit 1 and Braidwood Unit 1 only)	Pressure Boundary
Steam Generators (Tubes)	Heat Transfer
	Pressure Boundary
Tanks (Steam Generator Blowdown Condenser Hotwell Tank)	Leakage Boundary
Valve Body	Leakage Boundary
	Pressure Boundary
Valve Body (Class 1 Steam Generator Drain - Byron Unit 1 and Braidwood Unit 1 only)	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.1.2-4 Steam Generators
Summary of Aging Management Evaluation

2.3.2 ENGINEERED SAFETY FEATURES

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

The following systems are addressed in this section:

- Combustible Gas Control System (2.3.2.1)
- Containment Spray System (2.3.2.2)
- Residual Heat Removal System (2.3.2.3)
- Safety Injection System (2.3.2.4)

2.3.2.1 Combustible Gas Control System

Description

The Combustible Gas Control System is a system designed to limit the concentrations of hydrogen in containment following a loss of coolant accident. The Combustible Gas Control System consists of the hydrogen recombiner plant system. The Combustible Gas Control System is in scope for license renewal. However, portions of the Combustible Gas Control System associated with hydrogen monitoring are not required to perform intended functions and are not in scope. The design functions of containment atmosphere mixing and post-LOCA purge of the containment atmosphere are performed by the Containment Spray and Containment Ventilation Systems.

The purpose of the Combustible Gas Control System is to monitor and control hydrogen concentrations in containment postulated to be generated following a loss of coolant accident. Buildup of hydrogen concentrations in containment could result in hydrogen burns or hydrogen detonations that could jeopardize containment integrity.

The Combustible Gas Control System accomplishes this purpose by employing hydrogen recombiners, which process the primary containment atmosphere and recombine available oxygen with available hydrogen by thermal recombination and by employing hydrogen analyzers, which measure and record hydrogen concentrations in containment. The hydrogen monitors are independent of the hydrogen recombiners, and are evaluated with the Sampling System.

The Combustible Gas Control System is a common system between both nuclear units at each station and is comprised of two separate and redundant trains, each capable of monitoring hydrogen concentrations and recombining hydrogen and oxygen at a rate in excess of their expected production following a loss of coolant accident. Cross connection piping and redundant flow paths are furnished such that either system train is available for either nuclear unit. Each containment hydrogen recombiner train has a blower assembly, which provides the motive force to transport the primary containment atmosphere to the reaction (recombiner) chamber for processing and then provides a return flow path to the primary containment. The main heater in each containment hydrogen recombiner train is used to raise the operating temperature to the reaction temperature required to allow spontaneous recombination of hydrogen and oxygen. A single blower creates the pressure differential necessary to cause the gas flow from the Containment to the recombiner system and back to the primary containment. Each hydrogen recombiner is furnished with a hydrogen analyzer, which samples the blower outlet or the recombiner outlet and provides an indication of the hydrogen concentration. The interface between the nonsafety-related hydrogen analyzers and the safety-related hydrogen recombiners is at three sampling valves connected between the hydrogen recombiner tubing and hydrogen analyzer tubing.

The power sources for each containment hydrogen recombiner skid and the associated containment hydrogen recombiner inboard and outboard containment isolation valves are from separate Class 1E Auxiliary Power System sources.

The inboard and outboard containment isolation valves for each Combustible Gas Control System are normally closed. The system is started and removed from service manually and will automatically isolate on a containment isolation signal. The isolation signal can be reset to re-open the isolation valves when necessary.

The portion of the Combustible Gas Control System that recombines available hydrogen and oxygen to form water is safety-related and is in scope for license renewal. However, the portion of the Combustible Gas Control System that measures and records hydrogen concentrations (hydrogen analyzers) is nonsafety-related and does not perform any license renewal intended functions and, therefore, is not in scope for license renewal.

For more detailed information, see UFSAR Section 6.2.5.

Boundary

The Combustible Gas Control System scoping boundary for each train begins at the two (2) parallel suction points inside containment and continues through two (2) in-series containment isolation valves, one (1) inboard and one (1) outboard, on each parallel suction path. From the parallel suction lines, the Combustible Gas Control System flow path continues to a hydrogen recombiner skid, which includes a motor operated valve on the intake, blower, spiral heater pipe, reaction chamber, air blast heat exchanger and another motor operated valve of the discharge. The system scoping boundary continues from the hydrogen recombiner skid and terminates at two (2) parallel discharge attachment points inside containment. Each parallel attachment point contains two (2) in-series containment isolation valves, one (1) inboard and one (1) outboard.

Also included in the Combustible Gas Control System scoping boundary is the cross connection piping and valves, which allows either system train to be available for either nuclear unit.

Also included in the Combustible Gas Control System scoping boundary is the hydrogen analyzer and the connected hydrogen analyzer calibration subsystem.

All associated piping, components, and instrumentation contained within the flow path described above are included in the system evaluation boundary.

Also included in the license renewal scoping boundary of the Combustible Gas Control System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor. Included in this boundary are components relied upon to preserve the structural support intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included in the scope of license renewal are the hydrogen analyzer and the connected hydrogen analyzer calibration subsystem as this portion of the system is not relied upon for structural support of in-scope portions of the system. Also not included is a portion of the post-LOCA containment purge supply line from the radioactive waste gas system upstream of the hydrogen recombiner nitrogen supply isolation valves, since it does not perform or support system intended functions.

Reason for Scope Determination

The Combustible Gas Control System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Combustible Gas Control System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Combustible Gas Control System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Combustible Gas Control System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provide primary containment boundary. The Combustible Gas Control System includes containment isolation valves that close on a containment isolation signal. 10 CFR 54.4(a)(1)

2. Control combustible gas mixtures in the primary containment atmosphere. The Combustible Gas Control System is used to control and reduce hydrogen concentrations following a loss of coolant accident. 10 CFR 54.4 (a)(1)

3. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The seismic anchor upstream of the hydrogen recombiner nitrogen supply isolation valve, which is part of the nonsafety-related post-LOCA containment purge system piping, is credited for structural support of the safety-related Combustible Gas Control System piping. 10 CFR 54.4 (a)(2)

4. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The limit switches associated with the containment isolation valves within the Combustible Gas Control System are environmentally qualified. 10 CFR 54.4(a)(3)

UFSAR References

6.2.5
9.4.9.3

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-47, Sheet 2

Byron Unit 2:
LR-BYR-M-150, Sheet 2

Byron Common:
LR-BYR-M-152, Sheet 6

Braidwood Unit 1:
LR-BRW-M-47, Sheet 2

Braidwood Unit 2:
LR-BRW-M-150, Sheet 2

Braidwood Common:
LR-BRW-M-152, Sheet 6

Table 2.3.2-1 Combustible Gas Control System Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Fan Housing	Pressure Boundary
Flow Device	Pressure Boundary
Heat Exchanger - (Recombiner Air Blast Heat Exchanger) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Recombiner Preheater) Tubes	Heat Transfer
	Pressure Boundary
Piping, piping components, and piping elements	Pressure Boundary
	Structural Support
Recombiners	Pressure Boundary
Valve Body	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.2.2-1 Combustible Gas Control System
Summary of Aging Management Evaluation

2.3.2.2 Containment Spray System

Description

The Containment Spray System is a standby, mechanical emergency core cooling system (ECCS) designed to reduce containment pressure to nearly atmospheric pressure, remove airborne fission products from the containment atmosphere, and minimize corrosion of equipment following a large break loss of cooling accident (LOCA). This system also functions with the reactor containment fan coolers (evaluated with Containment Ventilation System) to limit containment pressure following a Main Steam Line Break (MSLB) inside the Containment Structure. The Containment Spray System consists of the containment spray plant system. The Containment Spray System is in scope for license renewal.

The purpose of the Containment Spray System is to remove energy from the environment by transferring heat from the higher temperature atmosphere to the lower temperature spray droplets discharged from spray nozzles. Heat transfer continues until the spray droplets reach the liquid saturation temperature associated with the pressure in the containment, transferring energy from the containment atmosphere to the fluid in the containment sump. Sodium hydroxide is added to the spray to control the sump pH, which maintains the iodine in solution and minimizes corrosive attack on safety-related components following a LOCA.

The Containment Spray System accomplishes this purpose following a design basis event by automatically starting the containment spray pumps and opening several motor-operated valves to align the sodium hydroxide tank to both containment spray trains, and then delivering flow to the spray nozzles. These spray nozzles are arranged on six concentric spray headers located on the inside dome of the Containment Structure.

The Containment Spray System is designed with two redundant trains. Each train consists of one containment spray pump, one eductor, three sets of nozzle headers, and the necessary piping, valves, instrumentation, and controls. The two redundant trains are required so that a single active failure during the injection phase in the Containment Spray System will not prevent operation of the system or reduce its capacity below that required to reduce and maintain containment pressure at or near atmospheric pressure following a design basis accident. In addition, there is piping on each train which allows the eductor to draw the sodium hydroxide out of the spray additive tank and inject it into each pump suction line. There are also manual isolation valves that allow a recirculation path back to the refueling water storage tank for the periodic testing of the pumps. There are two additional piping connections in the Containment Structure that were used for the full flow testing of the containment spray pumps during refueling outages. These connections are no longer used and have blank flanges installed in the piping during normal operation.

The Containment Spray System is automatically initiated on a high-high-high containment pressure signal from two out of four pressure transmitters. This system can also be actuated manually from the control room. Two other instrument loops provide input to the wide range containment pressure indication in the control room following a design basis accident. These signals for actuation and indication are provided from the containment pressure transmitters, which sense the containment pressure through the instrument tubing and bellows assembly. The bellows assemblies are located inside the Containment Structure, while the transmitters are located outside the Containment Structure in the Auxiliary Building electrical penetration (curved wall) area. When the containment pressure reaches the high-high-high setpoint following a design basis accident, the engineered safety features plant system initiates operation of the Containment Spray System. The containment spray pumps are sequenced onto the diesel generators, if needed, and the system valves on the containment spray pump discharge and spray additive tank outlet valves are aligned for injection to the spray nozzles. At this point, the two containment spray pumps take suction from the refueling water storage tank (RWST) (evaluated in the Safety Injection System) and pump the sodium hydroxide/treated borated water mixture through the Containment Spray System into the containment atmosphere. The chemical spray solution is injected into the containment atmosphere through the containment spray nozzle headers. As the water level rises in the containment recirculation sump and water is depleted from the RWST, the control room operator manually realigns the system at the low-low-low RWST level to provide containment spray from the containment recirculation sump to the spray nozzles. Sodium hydroxide is drawn into the eductor line and back to the suction of the containment spray pumps during the injection phase and continues during the recirculation phase until the spray additive tank is isolated by operator action.

The spray additive tank has a nitrogen overpressure cover gas to prevent carbon dioxide in the atmosphere from entering the tank and being absorbed into sodium hydroxide solution. The absorption of carbon dioxide into sodium hydroxide solution allows the formation of sodium carbonate, which could precipitate out of solution and clog the spray nozzles.

The containment spray pumps have cubicle coolers, which are evaluated with the Auxiliary Building Ventilation System and Service Water System.

For more detailed information, see UFSAR Sections 6.2.2 and 6.5.2.

Boundary

The Containment Spray System scoping boundary begins at the motor-operated suction valves on the outlet piping of the refueling water storage tank and continues through the two containment spray pumps. On the discharge side of the containment spray pumps, the redundant piping trains continue through motor-operated valves into the Containment Structure and divide into three spray headers per train located on the inside dome of the Containment Structure. The system scoping boundary also includes the containment recirculation sump suction lines from the normally-closed, containment recirculation sump motor-operated isolation valves to the suction lines of the containment spray pumps.

The system scoping boundary includes the spray additive tank and piping connecting to the eductors as well as the nitrogen supply piping to the spray additive tank up to and including the nitrogen isolation valves. The system scoping boundary also includes the piping from the discharge of the pump through the eductor back to the suction of the pump. The system scoping boundary includes both the pump suction and the eductor discharge drain piping that ends at the first isolation valves. Downstream of the spray additive tank isolation valves is evaluated with the Radioactive Drain System.

The system scoping boundary also includes the instrument piping that senses containment pressure. There are six penetrations that exit the Containment Structure and provide the containment pressure input to four instrument loops for the Reactor Protection System and two instrument loops for wide range containment pressure indication. The system scoping boundary begins at the location of the bellows assemblies in the Containment Structure where containment pressure is sensed, and continues through the containment penetration instrument tubing and isolation valves in the instrumentation loops. The system scoping boundary ends at the pressure transmitters. The containment spray instrumentation boundary includes all associated piping, isolation valves, and mounted instruments for monitoring the specific parameter.

All associated piping, components, and instrumentation contained in the flow path described above are included in the system evaluation boundary.

Not included in the Containment Spray System scoping boundary are the refueling water storage tank with its associated suction piping upstream of the refueling water storage tank motor-operated suction valves, the piping from the suction isolation valves back to the refueling water storage tank header, and the containment spray train piping and the containment spray pump test lines up to the test line isolation valves, which are evaluated with the Safety Injection System. Also not included in the scoping boundary is the containment recirculation sump with its associated suction piping upstream of the containment recirculation sump motor-operated suction valves, which are evaluated with Residual Heat Removal System.

Also included in the license renewal scoping boundary of the Containment Spray System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related and nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the system located within the Auxiliary Building. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Also included in the license renewal scoping boundary of the Containment Spray System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor. Included in this boundary are components relied upon to preserve the structural support intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Reason for Scope Determination

The Containment Spray System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Containment Spray System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Containment Spray System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48) and Environmental Qualification (10 CFR 50.49). The Containment Spray System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Sense process conditions and generate signals for reactor trip or engineered safety features actuation. The Containment Spray System includes pressure-sensing instrumentation that provides input to initiate the containment spray function. 10 CFR 54.4(a)(1)

2. Provide primary containment boundary. The Containment Spray System includes containment isolation valves to assure that radioactive material is not inadvertently transferred out of the Containment Structure. 10 CFR 54.4(a)(1)

3. Provide heat removal from primary containment and provide primary containment pressure control. The Containment Spray System includes nozzles that spray into the Containment Structure; the spray absorbs the heat energy in the containment and the containment pressure is reduced. 10 CFR 54.4(a)(1)

4. Provide removal of radioactive material from the primary containment atmosphere. Sodium hydroxide sprayed from the containment spray nozzles performs the function of iodine scrubbing from a post-LOCA containment atmosphere. 10 CFR 54.4(a)(1)

5. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Containment Spray System contains nonsafety-related water-filled lines in the Auxiliary Building that have the potential for spatial interactions (spray or leakage) with safety-related SSCs. The Containment Spray System contains nonsafety-related piping that is attached directly to and provides structural support for safety-related piping. 10 CFR 54.4(a)(2)

6. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). Isolation of containment spray on a spurious actuation precludes loss of reactor coolant makeup water from the refueling water storage tank to the containment floor, therefore conserving refueling water storage tank inventory for safe shutdown. 10 CFR 54.4(a)(3)

7. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Containment Spray System contains instrumentation that is used for automatic actuation of its protective functions and monitoring of conditions following a design basis accident. 10 CFR 54.4(a)(3)

UFSAR References

6.2.2
6.5.2
15.6.5
Table A1.183

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-46, Sheet 1A, 1B, 1C
LR-BYR-M-61, Sheet 4

Byron Unit 2:
LR-BYR-M-129, Sheet 1A, 1B, 1C
LR-BYR-M-136, Sheet 4

Byron Common:
None.

Braidwood Unit 1:
LR-BRW-M-46, Sheet 1A, 1B, 1C
LR-BRW-M-61, Sheet 4

Braidwood Unit 2:
LR-BRW-M-129, Sheet 1A, 1B, 1C
LR-BRW-M-136, Sheet 4

Braidwood Common:
None.

Table 2.3.2-2 Containment Spray System
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Eductor	Pressure Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
	Structural Support
Pump Casing (Containment Spray Pump)	Pressure Boundary
Restricting Orifice	Pressure Boundary
	Throttle
Sensor Element (Containment Pressure)	Pressure Boundary
Spray Nozzles (Containment Spray)	Spray
Tanks (Spray Additive Tank)	Pressure Boundary
Valve Body	Pressure Boundary
	Structural Support

The aging management review results for these components are provided in:

Table 3.2.2-2 Containment Spray System
Summary of Aging Management Evaluation

2.3.2.3 Residual Heat Removal System

Description

The Residual Heat Removal System is a standby, mechanical emergency core cooling system (ECCS) designed to provide low pressure injection flow and long-term core cooling following design basis events. The system is designed to maintain core cooling for larger break sizes by providing low-pressure injection independent of and in addition to the high-pressure and intermediate-pressure injection provided by the Chemical & Volume Control System and Safety Injection System, respectively. During normal startup and shutdown operations, the Residual Heat Removal System is designed to remove decay heat from the core and residual heat from the Reactor Coolant System to the Component Cooling System when Reactor Coolant System pressure is low. The Residual Heat Removal System consists of the residual heat removal and portions of the safety injection plant systems. The Residual Heat Removal System is in scope for license renewal.

The purpose of the Residual Heat Removal System is to inject borated water into the core following a loss of cooling accident (LOCA) for long-term emergency core cooling. The Residual Heat Removal System accomplishes this purpose by taking suction from the refueling water storage tank and injecting into the reactor vessel through the Safety Injection System when Reactor Coolant System pressure decreases below residual heat removal pump discharge pressure. The residual heat removal pumps recirculate a minimum cooling flow to their suction, until the Reactor Coolant System pressure decreases below residual heat removal pump discharge pressure. When the refueling water storage tank level reaches the low-low level, suction is manually aligned to the containment sump, permitting recirculation and cooling of the reactor coolant and injection water discharged from the LOCA break. A portion of this transfer to the containment sump is performed by the automatic switchover system (evaluated with the Reactor Protection System), while the remainder of the alignment is performed by the operator. After a small break LOCA, the reactor pressure may remain above the shutoff head of the residual heat removal pumps even when the refueling water storage tank inventory has been reduced to the minimum level. In this event, the Residual Heat Removal System can be aligned to provide flow from the containment sump to the suction of the high-pressure Chemical & Volume Control System pumps and intermediate-pressure Safety Injection System pumps, to allow continued high and intermediate pressure injection.

The Residual Heat Removal System is comprised of two residual heat removal pumps powered from independent safety-related sources, two residual heat removal heat exchangers (evaluated with the Component Cooling System), the containment sump and the associated piping, valves, instrumentation, and controls. The residual heat removal pumps are single stage centrifugal pumps. The pumps are fitted with mechanical seals and seal coolers, and the bearings are oil-lubricated. The pump motors are powered from the safety-related 4160-volt busses. The residual heat removal heat exchangers are shell and tube type heat exchangers with residual heat removal process water on the tube side and component cooling water on the shell side. The Residual Heat Removal System is designed so that a single failure will not result in the loss of the Residual Heat Removal System capability during a LOCA or loss of offsite power.

During normal plant power operation, the Residual Heat Removal System is in standby; aligned for operation in the low-pressure "cold leg injection" mode. The ECCS function is initiated by one of the following automatic signals: (1) low pressurizer pressure, (2) low steamline pressure, or (3) high containment pressure. Additionally, the ECCS function can be manually initiated from the Control Room. Automatic signals from the engineered safety features plant system start the residual heat removal pumps from the normal standby mode to the cold leg injection mode, so that they deliver borated water from the refueling water storage tank into the reactor vessel through all four reactor coolant cold leg lines. All the ECCS pumps (centrifugal charging, safety injection, residual heat removal) are started upon receipt of an ECCS initiation signal. If the containment pressure reaches the high-high-high setpoint, the containment spray pumps are also started and sequenced onto the emergency diesel generators during a design basis event. These ECCS pumps are sequenced into the emergency diesel generators, if there is a coincident loss of off-site power with the initiation of the ECCS function. During a LOCA, the Residual Heat Removal System is transferred from the cold leg injection mode to the cold leg recirculation mode, and finally to the hot leg recirculation mode. This final alignment, in conjunction with the Safety Injection System re-alignment, provides an active means to mitigate boron plateout on the reactor vessel internals.

The Residual Heat Removal System suction isolation valves downstream of the Reactor Coolant System are interlocked to remain closed when reactor coolant pressure is greater than Residual Heat Removal System normal operating pressure. These isolation valves maintain the Reactor Coolant System pressure boundary to prevent high pressure to low pressure system breaks. The Residual Heat Removal System also removes decay heat from the core and residual heat from the Reactor Coolant System during normal shutdown. The Residual Heat Removal System accomplishes this by drawing water from two reactor coolant hot legs and pumping it through the two residual heat removal heat exchangers, cooled by the Component Cooling System, and back to the reactor vessel through the Safety Injection System cold leg injection piping.

The Residual Heat Removal System also maintains the reactor coolant temperature at a suitable level for refueling. The Residual Heat Removal System accomplishes this by removing heat from the reactor coolant, normally using one of two Residual Heat Removal System pumps and heat exchanger trains to maintain reactor coolant temperature below 140 degrees F. This system provides the means for filling and draining the refueling cavity. The Residual Heat Removal System accomplishes filling of the cavity above the level of the reactor vessel flange by aligning suction of one residual heat removal pump to the refueling water storage tank. After refueling, the Residual Heat Removal System accomplishes draining of the cavity to the level of the reactor vessel flange by aligning one of the residual heat removal pumps from the reactor coolant hot leg, discharging back to the refueling water storage tank. During this operation, the remaining residual heat removal pump continues in normal cooling flow path for decay heat removal. The Residual Heat Removal System provides a means of reactor coolant boration and cleanup in preparation for and during refueling operations. The Residual Heat Removal System can be aligned for chemical addition or cleanup while operating in the "letdown booster" mode. In this mode of operation, the letdown booster pump (evaluated with the Chemical & Volume Control System) provides additional flow for chemical addition and cleanup at lower reactor coolant pressures to support refueling operations.

For more detailed information, see UFSAR Sections 5.4.7 and 6.3.2.

Boundary

The Residual Heat Removal System has several piping flow paths that are part of this system scoping boundary. The Residual Heat Removal System scoping boundary for the normal standby alignment begins downstream of the outlet of the refueling water storage tank check valves and continues to the Residual Heat Removal System pump suction. The pump suction lines continue through the residual heat removal pumps and heat exchangers, and end at the downstream side of the heat exchanger outlet valves. Included in this boundary are heat exchanger bypass flow lines on each residual heat removal loop, which connects the piping upstream of each residual heat removal heat exchanger to the downstream side of the residual heat removal heat exchanger bypass valves.

The Residual Heat Removal System scoping boundary emergency water source piping flow path during the cold leg recirculation phase begins at the ECCS sump screen, flows from the containment recirculation sump, through a containment penetration, and continues to the suction of each residual heat removal pump. This scoping boundary also includes the lines to the upstream side of the containment spray pump sump suction isolation valves.

The Residual Heat Removal System scoping boundary includes the cross-connect line on the outlet of the residual heat removal heat exchangers, and ends on the upstream side of the air-operated discharge valve to the piping, which constitutes one of the interfaces with the Chemical & Volume Control System. Included in this boundary are minimum flow recirculation lines on each residual heat removal loop, which connects the piping downstream of each residual heat removal heat exchanger with its associated residual heat removal pump suction line.

The Residual Heat Removal System scoping boundary piping flow path for the normal unit shutdown alignment and refueling alignment begins at the downstream side of the motor-operated valves on the letdown lines from the Reactor Coolant System loop hot legs, through a containment penetration, and continues to the suction piping of each of the residual heat removal pumps. The Residual Heat Removal System reactor coolant isolation valves provide the interface with the Reactor Coolant System. The boundary includes the lines to the pump suction relief valves, and ends at the discharge of the relief valves, which provide an interface with the Chemical and Volume Control System.

All associated piping instrumentation, components, and instrumentation contained within the flow path described above are included in the system evaluation boundary.

The process side of the residual heat removal heat exchangers and pump seal coolers are included in the Residual Heat Removal System scoping boundary. The cooling side of these heat exchangers is evaluated with the Component Cooling System. The drain and vent lines from the tube side of the residual heat exchangers are included in the Residual Heat Removal System boundary up to the downstream side of the manual isolation valves to the Auxiliary Building Ventilation System.

Not included in the Residual Heat Removal System scoping boundary are the residual heat exchanger discharge lines into the Reactor Coolant System cold legs and hot legs, which are evaluated with the Safety Injection System. The suction lines from the refueling water storage tank are also evaluated with the Safety Injection System. Also not included in the Residual Heat Removal System scoping boundary are the cooling side of the residual heat removal heat exchangers and pump seal coolers, which are evaluated with the Component Cooling System. The hot leg letdown lines are not included within the Residual Heat Removal System boundary and are evaluated with the Reactor Coolant System.

Also included in the license renewal scoping boundary of the Residual Heat Removal System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the system located within the Auxiliary Building. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Reason for Scope Determination

The Residual Heat Removal System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Residual Heat Removal System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Residual Heat Removal System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), and Station Blackout (10 CFR 50.63). The Residual Heat Removal System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61) or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provide reactor coolant pressure boundary. The Residual Heat Removal System injects borated water into the reactor coolant cold legs through the Safety Injection System through a series of motor-operated valves and check valves. These check valves provide the reactor coolant pressure boundary during normal and accident conditions. 10 CFR 54.4(a)(1)

2. Achieve and maintain the reactor core subcritical for any mode of normal operation or event. The Residual Heat Removal System injects borated water into the Reactor Coolant System through the Safety Injection System to shutdown the reactor and to maintain it in a shutdown condition. 10 CFR 54.4(a)(1)

3. Introduce emergency negative reactivity to make the reactor subcritical. The Residual Heat Removal System injects borated water into the Reactor Coolant System through the Safety Injection System to shutdown the reactor and to maintain it in a shutdown condition. 10 CFR 54.4(a)(1)

4. Remove residual heat from the reactor coolant system. The Residual Heat Removal System removes decay heat from the core and residual heat from the reactor coolant during latter stages of unit cooldown. 10 CFR 54.4(a)(1)

5. Provide and maintain sufficient reactor coolant inventory for core cooling. The Residual Heat Removal System is designed to maintain core cooling and reactor coolant inventory for larger LOCA break sizes by providing water from the refueling water storage tank or containment sump. The Residual Heat Removal System also prevents boron precipitation in the reactor core during the hot leg recirculation phase. 10 CFR 54.4(a)(1)

6. Introduce negative reactivity. The Residual Heat Removal System is designed to inject borated water into the reactor vessel through the Safety Injection System and maintain core cooling for larger LOCA break sizes. 10 CFR 54.4(a)(1)

7. Provide primary containment boundary. The Residual Heat Removal System includes containment isolation valves for the containment sump to assure that radioactive material is not inadvertently transferred out of the Containment Structure. 10 CFR 54.4(a)(1)

8. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Residual Heat Removal System contains nonsafety-related water filled lines in the Auxiliary Building that have the potential for spatial interactions (spray or leakage) with safety-related SSCs. 10 CFR 54.4 (a)(2)

9. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The Residual Heat Removal System provides the means for cooling down and maintaining the unit in a cold shutdown condition following an Appendix R fire. 10 CFR 54.4(a)(3)

10. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Residual Heat Removal System has several indications and controls that are used for achieving and maintaining cold shutdown following a design basis accident. 10 CFR 54.4(a)(3)

11. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). The Residual Heat Removal System provides the means for cooling down and maintaining the unit in a cold shutdown condition following a Station Blackout event. 10 CFR 54.4(a)(3)

UFSAR References

5.4.7
6.1.3
6.3.2
7.6.4

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-61, Sheet 4
LR-BYR-M-62, Sheet 1
LR-BYR-M-64, Sheet 5
LR-BYR-M-68, Sheet 1A

Byron Unit 2:
LR-BYR-M-136, Sheet 4
LR-BYR-M-137, Sheet 1
LR-BYR-M-138, Sheet 5A
LR-BYR-M-140, Sheet 1

Byron Common:
None.

Braidwood Unit 1:
LR-BRW-M-61, Sheet 4
LR-BRW-M-62, Sheet 1
LR-BRW-M-64, Sheet 5
LR-BRW-M-68, Sheet 1A

Braidwood Unit 2:
LR-BRW-M-136, Sheet 4
LR-BRW-M-137, Sheet 1
LR-BRW-M-138, Sheet 5A
LR-BRW-M-140, Sheet 1A

Braidwood Common:
None.

Table 2.3.2-3 Residual Heat Removal System Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Heat Exchanger - (Residual Heat Removal Pump Seal Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (Residual Heat Removal Pump Seal Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Residual Heat Removal) Tube Sheet	Pressure Boundary
Heat Exchanger - (Residual Heat Removal) Tube Side Components	Pressure Boundary
Heat Exchanger - (Residual Heat Removal) Tubes	Heat Transfer
	Pressure Boundary
Piping Element	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
Pump Casing (Residual Heat Removal)	Pressure Boundary
Restricting Orifice	Pressure Boundary
	Throttle
Strainer Body	Pressure Boundary
Sump Screen	Filter
Valve Body	Leakage Boundary
	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.2.2-3 Residual Heat Removal System
Summary of Aging Management Evaluation

2.3.2.4 Safety Injection System

Description

The Safety Injection System is a standby, mechanical emergency core cooling system (ECCS) designed to provide emergency core cooling following a Loss of Cooling Accident (LOCA) or Main Steam Line Break (MSLB) in the Containment Structure. Borated water from the refueling water storage tank is injected into the Reactor Coolant System in order to remove decay heat from the reactor core and to prevent fuel and clad damage. This capability limits the fuel clad temperature and ensures that the core will remain substantially intact and in place, while preserving its heat transfer geometry. In addition, the Safety Injection System adds shutdown reactivity, when reactor coolant pressure does not drop below the safety injection accumulator pressure for injection to prevent an uncontrolled return to power. The Safety Injection System is in scope for license renewal.

The Safety Injection System consists of the safety injection plant system, portions of the residual heat removal plant system, and portions of the chemical & volume control plant system that perform the emergency core cooling function. The Safety Injection System consists of the following components: high-pressure injection flow paths from the centrifugal charging pumps, low-pressure injection flow paths from the residual heat removal pumps, intermediate-pressure flow paths from the safety injection pumps, safety injection accumulators, refueling water storage tank, and the necessary piping, valves, controls and instrumentation. The centrifugal charging pumps and residual heat removal pumps are evaluated in the Chemical & Volume Control System and the Residual Heat Removal System, respectively, but their ECCS functioning components (piping and major valves) are included in the Safety Injection System.

The major purposes of the Safety Injection System are to provide core cooling by injecting borated water from the refueling water storage tank into the core following a LOCA, limit the positive reactivity addition from the resultant reactor coolant cooldown by injecting borated water from the refueling water storage tank into the core following a MSLB, provide core reflooding during a large break LOCA by injecting borated water from the safety injection accumulators, and provide containment isolation for piping penetrations following a design basis event. This system also provides mitigation of other design basis accidents, such as the control rod ejection accident and the steam generator tube rupture accident.

The Safety Injection System accomplishes these purposes by providing the necessary tanks, pumps, piping systems, gas manifolds, and associated valves and controls to deliver the required borated cooling water to the reactor vessel during design basis accidents. Operation of the Safety Injection System in the emergency injection phase continues until aligned by a combination of automatic and operator actions to the cold leg recirculation configuration or manually terminated.

The ECCS function is initiated from the engineered safety features plant system by the following automatic signals: (1) low pressurizer pressure, (2) low steamline pressure, or (3) high containment pressure. Additionally, the ECCS function can be manually initiated from the control room. Automatic operation of the valves and pumps by the actuation signals from the engineered safety features plant system changes the alignment of the system from its normal standby mode, so that it delivers borated water from the refueling water storage tank into the reactor vessel through all four reactor coolant cold leg lines. All the ECCS pumps (centrifugal charging, safety injection, residual heat removal) are started upon receipt of an emergency safeguards initiation signal. If the containment pressure reaches the high-high-high setpoint, the containment spray pumps are also started during a design basis accident. These ECCS pumps are sequenced onto the emergency diesel generators, if there is a coincident loss of offsite power with the initiation of the ECCS function.

The emergency core cooling system is designed with two redundant trains. The two redundant trains are required so that a single active failure during the injection phase will not prevent operation of the system, reduce its capacity below that required to maintain reactor coolant inventory, and increase fuel clad temperature following a design basis accident. One train of ECCS equipment is capable of delivering the required injection flow assumed for all break sizes in the LOCA analysis. One safety injection pump and one charging pump are sufficient to prevent core damage for those smaller leak sizes which do not allow the Reactor Coolant System pressure to decrease rapidly to the point at which low pressure injection is initiated by the safety injection accumulators and the Residual Heat Removal System. A minimum recirculation line is provided for the ECCS pumps to the refueling water storage tank (safety injection pumps) or to the pump suction lines (residual heat removal pumps) in the event that the pumps are started with Reactor Coolant System pressure above the pump shutoff head.

The Safety Injection System is comprised of a single refueling water storage tank and three injection flow paths: high pressure injection flow path through the centrifugal charging pumps, intermediate pressure flow path through the safety injection pumps, and low pressure injection flow path through the residual heat removal pumps. Each of the three flow paths contains two redundant full capacity pumps. The discharge piping from the centrifugal charging water pumps (high pressure flow path) and the safety injection pumps (intermediate pressure flow path) combine into their own single respective header prior to entering the containment structure. After entering the Containment Structure, the respective single header divides into four lines, which provide flow to each reactor coolant cold leg. The discharge piping from each residual heat removal pump enters the containment structure. Inside the containment structure each discharge line divides into two lines which supply flow to the cold leg of two reactor coolant loops. The four safety injection accumulators, located inside the Containment Structure also provide injection flow to the cold leg lines on each reactor coolant loop. Following the injection mode, the Safety Injection System is transferred to the cold leg recirculation mode, which transfers the suction source of the charging pumps and safety injection pumps from the refueling water storage tank (low-low level) to the containment sump through the discharge of the residual heat removal pumps. Finally, the Safety Injection System is manually re-aligned to the hot leg recirculation mode to prevent boron plateout on the reactor vessel components following a design basis event. During normal operations, there are no required system functions.

The refueling water storage tank provides borated water to the centrifugal charging pumps (Chemical & Volume Control System), safety injection pumps, residual heat removal pumps, and the containment spray pumps during accident conditions, and this tank becomes the source of makeup water for the Chemical & Volume Control System in the event that leakage makeup is required when the volume control tank is empty. The refueling water storage tank also provides a source of makeup water to the Spent Fuel Cooling System for the spent fuel pool. The Safety Injection System also includes a recirculation line for the refueling water storage tank heating pump and heater, which maintains the refueling water storage tank above the freezing temperature. There are also recirculation lines on the Safety Injection System, which provide flow from the discharge of the safety injection pumps and containment spray pumps back to the refueling water storage tank for operational testing.

Check valves exist on each cold leg injection and hot leg recirculation line on the downstream side of the Containment Structure penetration for each train providing the containment isolation function on each reactor coolant loop. These check valves are evaluated with the Reactor Coolant System.

For more detailed information, see UFSAR Sections 6.3.1, 6.3.2, and 15.6.5.

Boundary

The Safety Injection System provides the emergency core cooling flow path for a wide range of design basis accidents. This system includes the emergency core cooling suction and discharge flowpath piping and valves from the high-pressure injection system (Chemical & Volume Control System), the intermediate-pressure injection system (Safety Injection System), and the low-pressure injection system (Residual Heat Removal System).

The high pressure scoping boundary begins at the refueling water storage tank header, continues through the motor-operated suction isolation valves, and ends at the common suction check valve to the centrifugal charging pumps. On the discharge line of the charging pumps, the scoping boundary begins on the upstream side of the charging pump to cold leg injection isolation valves, continues through the Containment Structure, and ends at the single check valve prior to dividing into four separate lines into the Reactor Coolant System. The scoping boundary of the Safety Injection System also includes the crossover piping from the downstream side of the residual heat exchanger outlet valve to the downstream side of the charging pump suction crossover isolation valve.

The intermediate pressure scoping boundary begins at the refueling water storage tank and continues through the safety injection pump suction piping and through the two safety injection pumps. On the discharge side of the safety injection pumps, the redundant piping trains combine into a single cold leg header, which continues into the Containment Structure, and then divides into four cold leg injection lines. These four lines connect to the four safety injection accumulator injection lines, which end at the upstream side of the check valves after the safety injection cold leg throttle valves. Also included is a recirculation line on the discharge of each safety injection pump, which continues back to the refueling water storage tank to provide pump protection for small size breaks and to provide the capability for testing the pumps during normal operation. The scoping boundary of the Safety Injection System also includes the crossover piping from the downstream side of the residual heat exchanger outlet valve to the suction side of the safety injection pump. The Safety Injection System also includes the process side of the safety injection pump bearing oil cooler, which is cooled and evaluated by the Service Water System.

The low pressure scoping boundary begins at the refueling water storage tank header, continues through the suction piping, and ends at the suction check valves to the residual heat removal pumps. The system scoping boundary begins again at the residual heat removal heat exchanger outlet valves and on the downstream side of the heat exchanger bypass valves and ends at the upstream side of the check valves in each of the four cold leg lines after the two residual heat removal cold leg injection lines enter the Containment Structure.

The Safety Injection System scoping boundary includes the piping up to the air-operated isolation valves for each safety injection accumulator, which includes the piping and valves required for filling, draining, and pressurizing these tanks. This scoping boundary also includes the drain lines from the accumulators to the upstream side of manual isolation drain valves of the reactor coolant drain tank. The scoping boundary for the nitrogen gas begins at the automatic outboard containment isolation valve and ends at the accumulators' gas space. Since the accumulator levels are normally maintained with the safety injection pumps, the Safety Injection System scoping boundary includes the piping and valves for filling and draining the accumulators. The safety injection accumulator boundary with the Reactor Coolant System ends at the upstream side of the motor-operated accumulator discharge isolation valves.

The Safety Injection System scoping boundary includes the motor-operated crossover valves and the piping from the Residual Heat Removal System to the suction of the safety injection pumps and charging pumps. The scoping boundary also includes the motor-operated valves on the discharge lines of the Residual Heat Removal System, the flowpath into the cold leg injection lines, and ends at the check valves on the cold leg injection lines prior to the Reactor Coolant System.

The Safety Injection System scoping boundary includes the piping from the motor-operated hot leg injection valves and ends at the upstream side of the check valves after the hot leg throttle valves. Similarly, the Safety Injection System scoping boundary begins at the motor-operated hot leg isolation valve from the Residual Heat Removal System and ends at the upstream side of the check valves on the two lines prior to the four Safety Injection System hot leg recirculation lines.

The Safety Injection System scoping boundary also begins at the refueling water storage tank, continues through the refueling water storage tank heating pump and heater, and ends at the connection to the refueling water storage tank. The Safety Injection System scoping boundary also begins on the downstream of the boric acid blender isolation valve and at the safety injection test line to the refueling water storage tank. The Safety Injection System scoping boundary also begins at the refueling water storage tank and ends at the Spent Fuel Cooling System for the spent fuel pool makeup and return lines. The Safety Injection System also includes drain lines starting at the safety injection accumulators to the reactor coolant drain tank isolation valves (Radioactive Drain System) and the accumulator sampling isolation valves (Sampling System). The Safety Injection System scoping boundary includes the vent piping on the top of the refueling water storage tank until it reaches the Auxiliary Building Ventilation System piping classification change. There are also recirculation lines on the Safety Injection System, which provide flow from the discharge of the safety injection pumps and containment spray pumps back to the refueling water storage tank for operational testing.

All associated piping, components, and instrumentation contained within the flow path described above are included in the system evaluation boundary.

Not included in Safety Injection System scoping boundary are the centrifugal charging pumps, which are evaluated with the Chemical & Volume Control System. Also not included in the Safety Injection System scoping boundary are the residual heat removal pumps and piping flow path from the containment sump, which are evaluated with the Residual Heat Removal System. The Safety Injection System has four flowpaths into the Reactor Coolant System cold legs and four flowpaths into the Reactor Coolant System hot legs; the piping and valves associated with these flowpaths are evaluated in the Reactor Coolant System. Also, not included in the Safety Injection System scoping boundary is the containment sump, which is evaluated with the Containment Structure.

Also included in the license renewal scoping boundary of the Safety Injection System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related and nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the system located within the Auxiliary Building and Containment Structure. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Also included in the license renewal scoping boundary of the Safety Injection System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor. Included in this boundary are components relied upon to preserve the structural support intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Reason for Scope Determination

The Safety Injection System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Safety Injection System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Safety Injection System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), and Station Blackout (10 CFR 50.63). The Safety Injection System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61) or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provide reactor coolant pressure boundary. The Safety Injection System maintains the Reactor Coolant System pressure boundary through a series of motor-operated valves and check valves. 10 CFR 54.4(a)(1)

2. Achieve and maintain the reactor core subcritical for any mode of normal operation or event. The Safety Injection System injects borated water into the Reactor Coolant System to shutdown the reactor and to maintain it in a shutdown condition. 10 CFR 54.4(a)(1)

3. Introduce emergency negative reactivity to make the reactor subcritical. The Safety Injection System injects borated water into the Reactor Coolant System to shutdown the reactor and to maintain it in a shutdown condition. 10 CFR 54.4(a)(1)

4. Sense process conditions and generate signals for reactor trip or engineered safety features actuation. The refueling water storage tank level provides part of the signal to open

certain valves required for the transfer to the recirculation phase following a design basis event. 10 CFR 54.4(a)(1)

5. Provide and maintain sufficient reactor coolant inventory for core cooling. The Safety Injection System provides borated water to the Reactor Coolant System from the refueling water storage tank and containment sump following a design basis event. 10 CFR 54.4(a)(1)

6. Introduce negative reactivity. The Safety Injection System provides borated water to the Reactor Coolant System from the refueling water storage tank and containment sump following a design basis event. The system is realigned during the hot leg recirculation phase to prevent boron plateout on the reactor vessel internal components. 10 CFR 54.4(a)(1)

7. Provide primary containment boundary. The Safety Injection System includes containment isolation valves to assure that radioactive material is not inadvertently transferred out of the Containment Structure. 10 CFR 54.4(a)(1)

8. Maintain the dose consequences within the guidelines of 10 CFR 50.67 or 10 CFR 100. The Safety Injection System maintains adequate reactor coolant inventory in the reactor vessel to limit core damage. The Safety Injection System ensures that there is no significant reduction in shutdown margin when cooling water is introduced into the reactor, which ensures that radioactive releases are satisfied for the offsite dose criteria. 10 CFR 54.4(a)(1)

9. Ensure adequate cooling in the spent fuel pool to maintain stored fuel within acceptable temperature limits. The Safety Injection System provides a safety-related source of borated water to the Spent Fuel Cooling System from the refueling water storage tank. 10 CFR 54.4(a)(1)

10. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Safety Injection System contains nonsafety-related water-filled lines in the Auxiliary Building that have the potential for spatial interactions (spray or leakage) with safety-related SSCs. The Safety Injection System contains nonsafety-related piping that is attached directly to and provides structural support for safety-related piping. 10 CFR 54.4(a)(2)

11. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The refueling water storage tank is used to provide negative reactivity for shutting down the reactor, ensuring adequate reactor coolant inventory, and provide makeup flow to the reactor coolant pump seals. 10 CFR 54.4(a)(3)

12. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Safety Injection System contains several components for accident mitigation and indications for monitoring parameters during and after a design basis accident. 10 CFR 54.4(a)(3)

13. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). The Safety Injection System provides a source of treated borated water to the centrifugal charging pumps from the refueling water storage tank. This system also

provides containment isolation through closure of automatic and manual valves. 10 CFR 54.4(a)(3)

UFSAR References

6.3.1
6.3.2
15.6.5

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-46, Sheet 1C
LR-BYR-M-61, Sheet 1A, 1B, 2, 3, 4, 5, 6
LR-BYR-M-62, Sheet 1
LR-BYR-M-64, Sheet 4A, 4B
LR-BYR-M-68, Sheet 1B
LR-BYR-M-70, Sheet 1

Byron Unit 2:
LR-BYR-M-129, Sheet 1C
LR-BYR-M-136, Sheet 1, 2, 3, 4, 5, 6
LR-BYR-M-137, Sheet 1
LR-BYR-M-138, Sheet 4
LR-BYR-M-140, Sheet 1
LR-BYR-M-141, Sheet 1

Byron Common:
LR-BYR-M-63, Sheet 1A
LR-BYR-M-65, Sheet 2C

Braidwood Unit 1:
LR-BRW-M-46, Sheet 1C
LR-BRW-M-61, Sheet 1A, 1B, 2, 3, 4, 5, 6
LR-BRW-M-62, Sheet 1
LR-BRW-M-64, Sheet 4A, 4B
LR-BRW-M-68, Sheet 1B
LR-BRW-M-70, Sheet 1

Braidwood Unit 2:
LR-BRW-M-129, Sheet 1C
LR-BRW-M-136, Sheet 1, 2, 3, 4, 5, 6
LR-BRW-M-137, Sheet 1
LR-BRW-M-138, Sheet 4A
LR-BRW-M-140, Sheet 1B
LR-BRW-M-141, Sheet 1

Braidwood Common:
LR-BRW-M-63, Sheet 1A
LR-BRW-M-65, Sheet 2C

Table 2.3.2-4 Safety Injection System
Components Subject to Aging Management Review

Component Type	Intended Function
Accumulator	Pressure Boundary
Bolting	Mechanical Closure
Electric Heaters (Refueling Water Storage Tank)	Leakage Boundary
Filter Element	Filter
Filter Housing	Pressure Boundary
Heat Exchanger - (SI Pump Bearing Oil Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (SI Pump Bearing Oil Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (SI Pump Bearing Oil Cooler) Tubes	Heat Transfer
	Pressure Boundary
Piping Element	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
	Structural Support
Pump Casing (Refueling Water Storage Tank Heating)	Leakage Boundary
Pump Casing (Safety Injection)	Pressure Boundary
Restricting Orifice	Pressure Boundary
	Throttle
Strainer Body	Pressure Boundary
Tanks (Refueling Water Storage)	Pressure Boundary
Tanks (Safety Injection Pump Oil Reservoir)	Pressure Boundary
Valve Body	Leakage Boundary
	Pressure Boundary
	Structural Support

The aging management review results for these components are provided in:

Table 3.2.2-4 Safety Injection System
Summary of Aging Management Evaluation

2.3.3 AUXILIARY SYSTEMS

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

The following systems are addressed in this section:

- Auxiliary Building Ventilation System (2.3.3.1)
- Chemical & Volume Control System (2.3.3.2)
- Chilled Water System (2.3.3.3)
- Circulating Water System (2.3.3.4)
- Component Cooling System (2.3.3.5)
- Compressed Air System (2.3.3.6)
- Containment Ventilation System (2.3.3.7)
- Control Area Ventilation System (2.3.3.8)
- Cranes and Hoists (2.3.3.9)
- Demineralized Water System (2.3.3.10)
- Emergency Diesel Generator & Auxiliaries System (2.3.3.11)
- Fire Protection System (2.3.3.12)
- Fresh Water System (2.3.3.13)
- Fuel Handling & Fuel Storage System (2.3.3.14)
- Fuel Oil System (2.3.3.15)
- Heating Water and Heating Steam System (2.3.3.16)
- Non-Radioactive Drain System (2.3.3.17)
- Radiation Monitoring System (2.3.3.18)
- Radioactive Drain System (2.3.3.19)
- Radwaste System (2.3.3.20)
- Sampling System (2.3.3.21)
- Service Water System (2.3.3.22)
- Spent Fuel Cooling System (2.3.3.23)

2.3.3.1 Auxiliary Building Ventilation System

Description

The Auxiliary Building Ventilation System is a normally operating, mechanical system designed to provide environmental conditions conducive to component life and improved habitability in the Auxiliary Building. The Auxiliary Building Ventilation System includes the following plant systems: auxiliary building HVAC, diesel generator room ventilation, miscellaneous electric equipment room ventilation, switchgear heat removal, radwaste / remote shutdown control room HVAC, machine shop ventilation, laboratory HVAC, containment & auxiliary building filtered vents, containment & auxiliary building non-filtered vents, and radwaste facility ventilation. The Auxiliary Building Ventilation System is in scope for license renewal. However, portions of the Auxiliary Building Ventilation System are not required to perform intended functions and are not in scope.

The purpose of the Auxiliary Building Ventilation System is to supply filtered, temperature conditioned outside air to maintain the proper environment for the health and safety of personnel and proper operation of equipment in the Auxiliary Building. Additionally, the purpose of the Auxiliary Building Ventilation System is to ensure that any post design basis accident releases from the Auxiliary Building are filtered by charcoal and HEPA filters to mitigate the consequences of the accident. The Auxiliary Building Ventilation System accomplishes this purpose with a combination of supply fans, exhaust fans, filter trains, isolation valves, cooling coils, and heating coils.

The following is a system description of each of the Auxiliary Building Ventilation System plant systems.

Auxiliary Building HVAC:
The auxiliary building HVAC system serves all plant areas of the Auxiliary Building including engineered safety features (ESF) cubicles and the Fuel Handling Building but excludes the computer rooms, areas within the Control Room Envelope, and separate independent HVAC systems described below. The auxiliary building HVAC system is common for Units 1 and 2.

The auxiliary building HVAC system is designed to operate under all plant operating conditions. The auxiliary building HVAC system controls radioactivity in the areas served by directional air flow paths. The airflow within the Auxiliary Building is from areas with lesser potential for contamination (general areas) to areas with greater potential for contamination (nonaccessible areas). The air is mechanically exhausted through filters and monitored prior to release to the environment. Supply air conditioning and cubicle coolers are used to ensure environmental conditions in the ESF areas and cubicles are controlled within equipment requirements.

All of the components of the auxiliary building HVAC system are safety-related except for the following components: heating coils; cooling coils; chilled water area coolers located in the elevator machine room; wall fans located in the Auxiliary Building refrigeration unit area; supply air filter (Byron only); hot machine shop filter unit (Braidwood only); cubicle coolers located in the spent fuel pit pump room and positive displacement pump rooms; supply and exhaust fan vibration monitoring system; mask cleaning room package air conditioning unit (this unit is at Braidwood only); Unit 2 collection drain sump room (this room is at Braidwood only); and hot tool room (this room is at Braidwood only).

The Auxiliary Building supply subsystem is comprised of two supply air plenums. Each plenum is comprised of the following components: a missile protected outside air intake louver, supply air filters, hot water heating coils, chilled water cooling coils, and direct driven vane axial fans. The supply air is distributed throughout all elevations of the Auxiliary Building via supply ductwork.

The Auxiliary Building ventilation exhaust air subsystem is comprised of two exhaust systems: the Auxiliary Building exhaust subsystem, and the Fuel Handling Building exhaust subsystem. The Auxiliary Building exhaust subsystem is designed to exhaust Auxiliary Building air after filtering through prefilter and HEPA filter banks. Provisions are also made to route the effluents from nonaccessible areas in the Auxiliary Building through charcoal adsorbers and HEPA filters automatically on a safety injection signal from Unit 1 or 2. The Fuel Handling Building exhaust subsystem is designed to filter the exhaust air through prefilter and HEPA filter banks. Provisions are also made to route the effluent from the Fuel Handling Building through charcoal adsorbers and HEPA filters automatically on a high radiation signal from area radiation monitors in the Fuel Handling Building, or on a safety injection signal from Units 1 or 2.

The auxiliary building HVAC system is safety-related and in scope for license renewal, except for the equipment identified previously which is nonsafety-related, does not perform a license renewal intended function and, therefore, is not in scope for license renewal.

Diesel Generator Room Ventilation:
The diesel generator room ventilation systems consist of the following two independent subsystems for each unit: (1) diesel generator room and day tank room ventilation system, and (2) diesel oil storage room ventilation system.

Each of the four diesel generator rooms and day tank room ventilation systems provides continuous ventilation for the day tank room during normal plant operation, ventilation for the diesel generator when it operates, and a source of combustion air for the diesel generator. Each diesel generator room and day tank room ventilation system consists of outside air intake louvers, air plenum where air from the outside air intake louvers is mixed with recirculated air from the diesel generator room, vane axial supply fan, associated intake and recirculation dampers, and day tank room exhaust fan. The diesel generator and day tank room ventilation systems are designed to operate under all normal and abnormal plant operating conditions except for the following conditions: (1) in the event of a fire protection system actuation, the ventilation system is shutdown, and (2) in the event of a high energy line break in the turbine building which causes the fire dampers in these rooms to close. Each diesel generator room ventilation supply fan is normally in standby and operates when its associated diesel generator is in operation. The diesel generator room exhaust fan is normally operating except when the supply fan is operating. The diesel generator room and day tank room ventilation systems are safety-related and in scope for license renewal.

Each diesel oil storage room ventilation system consists of two exhaust fans, one of which is normally in standby, which draw air from the turbine building. The air is drawn through the diesel oil storage room and exhausted to the turbine building preventing a possible accumulation of oil fumes within the diesel oil storage room. The intake and exhaust lines, located in the turbine building, are routed such that flooding in the turbine building cannot impact safety-related SSCs in the Auxiliary Building and are evaluated with the Auxiliary Building. Each diesel oil storage room is provided with a heat and smoke ventilator which operates during and after a postulated fire. Each diesel oil storage room ventilation system is designed to operate under all normal and abnormal plant operating conditions, except in the event of a high energy line break in the turbine building which causes fire dampers in these rooms to close. The diesel oil storage room ventilation system is safety-related and in scope for license renewal, except for the heat and smoke ventilator which is nonsafety-related, does not perform a license renewal intended function and, therefore, is not in scope for license renewal.

Miscellaneous Electric Equipment Room Ventilation:
The ESF portion of the miscellaneous electric equipment room ventilation system serves the miscellaneous electric equipment and battery rooms for Units 1 and 2. Each room is provided with an independent ventilation system. In each miscellaneous electric equipment room, supplemental nonsafety-related cooling is provided to the rod drive cabinets and, at Byron only, the inverters by stand-alone air conditioners. The ESF portion of the miscellaneous electric equipment room ventilation system is designed to remove equipment heat to limit the room temperature in accordance with equipment requirements, except in the event of a high energy line break in the turbine building which causes the fire dampers to close. The Division 12 and 22 miscellaneous electric equipment and battery rooms are provided ventilation by a supply fan which draws outside air through the air intake louvers, and continues to an air plenum where air from the outside air intake louvers is mixed with recirculated air from the associated switchgear room. The supply fan also draws air through a filter and distributes flow to the associated miscellaneous electric equipment and battery rooms. The Division 11 and 21 miscellaneous electric equipment and battery rooms are supplied by the switchgear heat removal supply fans. An exhaust fan is provided for each miscellaneous electrical equipment room to limit hydrogen concentration to 2% and to maintain the rooms at atmospheric pressure when the supply fans are in full outside air mode. The exhaust air for all divisions is exhausted to the turbine building. An exhaust fan is provided for each battery room to maintain ventilation of the battery area to limit the hydrogen concentration. The ESF portion of the system is safety-related and in scope for license renewal. The supplemental, non-ESF portion of the system is nonsafety-related and does not perform a license renewal intended function and, therefore, is not in scope for license renewal.

Switchgear Heat Removal:
The switchgear ventilation system serves the ESF and non-ESF switchgear rooms. Independent switchgear ventilation systems are provided for each ESF switchgear Division (i.e. 11, 12, 21, and 22) including the Division 11 and 12 power cable spreading rooms, the ESF switchgear rooms in the Auxiliary Building, and the Essential Service Water Cooling Tower ESF switchgear rooms (Byron only). The ESF switchgear ventilation systems are designed to remove equipment heat to maintain the switchgear room temperatures. The ESF switchgear ventilation systems are designed to operate under all normal and abnormal plant operating conditions, except in the event of a high energy line break in the turbine building which causes the fire dampers in the ESF switchgear rooms to close. Each ESF switchgear ventilation system provides cooling from outside air. Each of the switchgear ventilation subsystems are provided with a supply fan which induces air through the outside air intake, air plenum where air from the outside air intake is mixed with recirculated air from the associated switchgear or cable spread room, and filter, and distributes it to the areas served by it. The exhaust air is relieved to the turbine building except in cases of the Essential Service Water Cooling Tower ESF switchgear rooms (Byron only) where the exhaust air is exhausted to the atmosphere. The ESF switchgear ventilation systems are safety-related and in scope for license renewal. The non-ESF switchgear ventilation system is nonsafety related and does not perform a license renewal intended function and, therefore, is not in scope for license renewal.

Radwaste / Remote Shutdown Control Room HVAC:
The radwaste / remote shutdown control room HVAC system is common to both units. The system serves the control room which contains the radwaste system control panels and the remote shutdown panels, and the associated HVAC equipment room. The supply air is filtered, cooled, and humidified prior to being distributed. A return air fan recirculates the majority of the return air to an air plenum on the suction of the supply fan where it is mixed with infiltrated air from the Auxiliary Building. The remainder of the return air is exhausted to the Auxiliary Building. Packaged air conditioning units are provided for the Unit 2 remote shutdown control panel area and the radwaste demineralizer panel area. The radwaste / remote shutdown control room HVAC plant system is nonsafety-related and does not perform a license renewal intended function and, therefore, is not in scope for license renewal.

Machine Shop Ventilation:
The machine shop ventilation system provides tempered air to the machine shop areas and carpentry shop which are located in the service building. A combination of outside air and air recirculated from the machine shop is mixed in a mixing box on the suction side of the machine shop air handling unit. The air is filtered prior to being drawn into the air handling unit. The air handling unit consists of a heating coil and a supply fan. Several exhaust fans are installed in the machine shop area. These include a return fan which exhausts air from the machine shop and store rooms. A portion of the air discharged from the return fan is exhausted to atmosphere. The remainder is recirculated to the mixing box on the suction side of the machine shop air handling unit. Exhaust fans are provided for each of the following areas: break room, welding area, paint and oil room, storage room, and lavatory. The air from each of these exhaust fans is discharged to atmosphere. A dust collection package is installed for the carpentry shop. The discharge of the dust collection package is connected to an after filter and then exhausted to atmosphere. The maintenance shop ventilation system is nonsafety-related and does not perform a license renewal intended function and, therefore, is not in scope for license renewal.

Laboratory HVAC:
The laboratory HVAC system is common to both units. The system serves the high level laboratory, the low level laboratory, the high radiation sampling system (HRSS) room, the counting room, the decontamination room, the laundry room, the Byron mask cleaning room, the Braidwood instrument storage room, and other related offices located in the laboratory area of the Auxiliary Building. Air is supplied to these areas from two (2) supply fans. Air is supplied from the outside air or at Braidwood only from the turbine building to a mixing box on the suction side of the supply fans. Additionally, air recirculated from several clean laboratory areas is provided to this mixing box. The air from the mixing box is drawn by the supply fans through a filter and then across a heating coil. The air is then split between hot air ductwork with a hot water heating coil and cold air ductwork with a chilled water cooling coil. The hot air ductwork and cold air ductwork supply the air to the laboratory area. Mixing boxes, where air from the cold ductwork and air from the hot ductwork are mixed, are installed throughout the laboratory area. Several exhaust fans are installed in order to exhaust air from the laboratory area to the auxiliary building HVAC system including HRSS laboratory exhaust fans, laundry hood exhaust fan, laundry room exhaust fan, and fume hood exhaust fans. Exhaust from the fume hoods is monitored prior to release to the vent stack. The laboratory HVAC system is nonsafety-related and does not perform a license renewal intended function and, therefore, is not in scope for license renewal.

Containment & Auxiliary Building Filtered Vents:
The containment & auxiliary building filtered vents system is designed to filter the potential radioactive particulates and iodine from vent gases from tanks and equipment in the Auxiliary Building and radwaste building. The vents are piped to a common tank vent filter unit. The filter unit consists of a moisture separator, prefilter, electric heating coil, HEPA filters, charcoal adsorber, two centrifugal fans and associated backdraft dampers, air-operated butterfly valves, and instrumentation. A water deluge system is provided for the charcoal adsorbers for fire protection purposes. The filtered gases are monitored and then exhausted to the Unit 2 Auxiliary Building vent stack. The intended function of the containment & auxiliary building filtered vents for license renewal is to maintain leakage boundary integrity to preclude system interactions. For this reason, this system's pressure-retaining components located in proximity to other components performing safety-related functions have been included in the scope of license renewal. This system is not required to operate to support license renewal intended functions, and is in scope for potential spatial interaction.

Containment & Auxiliary Building Non-Filtered Vents:
The containment and auxiliary building non-filtered vents system provides a vent for the gaseous radwaste gas decay tanks and the radwaste release tanks. The vent lines from these tanks are connected to the non-filtered tank vent header. Air from the gas decay tanks is monitored prior to release to the nonfiltered vent header. This header connects to the common Auxiliary Building exhaust plenum which is exhausted to the Auxiliary Building vent stacks. The intended function of the containment & auxiliary building non-filtered vents for license renewal is to maintain leakage boundary integrity to preclude system interactions. For this reason, this system's pressure-retaining components located in proximity to other components performing safety-related functions have been included in the scope of license renewal. This system is not required to operate to support license renewal intended functions, and is in scope for potential spatial interaction.

Radwaste Facility Ventilation:
The radwaste facility ventilation system is common to both units. The system serves the empty drum storage area, the high level and low level drum storage area, the truck-dock area, and the volume reduction system equipment. The system is designed to provide protection from radioactive contamination by providing proper airflow patterns from accessible areas to potentially contaminated areas. The system also ensures that the temperature is kept within an allowable range, in order to comply with equipment requirements. The exhaust air from the system flows through the radwaste transfer tunnel, then through the drum processing and decant tank rooms to the radwaste exhaust filter units to remove the radioactive particulate prior to discharging to the Unit 2 vent stack. The radwaste facility ventilation system is nonsafety-related and does not perform a license renewal intended function and, therefore, is not in scope for license renewal.

For more detailed information, see UFSAR Sections 6.5.1, 9.4.2, 9.4.3, 9.4.5, 9.4.7, 11.5.2.2 and Table 3.2-1.

<u>Boundary</u>

The following is a description of the license renewal scoping boundary of each of the plant systems described above which are included in the Auxiliary Building Ventilation System.

Auxiliary Building HVAC:
The auxiliary building HVAC scoping boundary begins at the outdoor air intake plenums. The scoping boundary for the supply air portion continues through prefilters and medium efficiency filters, hot water heating coils, chilled water cooling coils, supply fans, and then continues through ductwork and dampers. The scoping boundary for the supply air portion of the system ends at the supply air registers to the clean aisles, clean walkways, pipe tunnels, and rooms inside the Auxiliary Building and Fuel Handling Building. The scoping boundary for the exhaust portion begins at the return air registers in the Auxiliary Building and Fuel Handling Building. The scoping boundary continues through ductwork and dampers, then continues through HEPA and charcoal filters, and then finally passes through the exhaust fans. The scoping boundary continues through ductwork and dampers and terminates at the end of the plant vent stacks discharge. Also included in the auxiliary building HVAC scoping boundary are the individual cubicle coolers and ductwork. The individual cubicle coolers are mounted locally near vital pumping equipment. Also included in the auxiliary building HVAC scoping boundary at Byron only is the decontamination pad and machine shop room, and at Braidwood only the hot machine shop filter units and the mask and cleaning room package air conditioning unit.

Diesel Generator Room Ventilation:
The diesel generator room ventilation scoping boundary begins at the outdoor air intake plenums. The scoping boundary for the supply air portion continues through the air plenum, the supply fan and continues through ductwork and dampers. The scoping boundary for the supply air portion of the system ends at the supply air registers in the diesel generator and oil day tank rooms. The scoping boundary for the exhaust portion of the system begins at the return air registers in the diesel generator and oil day tank rooms. The scoping boundary continues through ductwork and dampers to the exhaust fans. The scoping boundary also includes the recirculation path between the diesel generator room and the air plenum. The scoping boundary continues through ductwork and dampers and ends at the exhaust to the turbine building.

Miscellaneous Electric Equipment Room Ventilation:
The miscellaneous electric equipment room ventilation system scoping boundary for the Division 12 and 22 miscellaneous electric equipment rooms, battery rooms, and electrical pipe tunnels begins at the outside air intake plenums. The scoping boundary continues through ductwork and dampers to the mixing plenums on the suction side of the supply fans. The scoping boundary continues through medium efficiency filters, through the supply fan and continues through the ductwork and dampers on the discharge of the fan. The scoping boundary for the supply air portion of the system ends at the supply air registers in the miscellaneous electric equipment rooms associated battery rooms and electrical pipe tunnels. For the miscellaneous electric equipment room ventilation system the scoping boundary also begins at the supply ductwork for the Division 11 and 21 miscellaneous electric equipment rooms, battery rooms, and electrical pipe tunnels. This supply ductwork is on the discharge of the Division 11 and 21 ESF switchgear room supply fans. The scoping boundary for the supply air portion of the system ends at the supply air registers in the Division 11 and 21 miscellaneous electric equipment rooms, associated battery rooms, and electrical pipe tunnels. The scoping boundary for the exhaust portion of the system begins at the return air registers in the miscellaneous electric equipment rooms, associated battery rooms, and electrical pipe tunnels. The scoping boundary continues through ductwork and dampers to the exhaust fans. The scoping boundary also includes the recirculation path between the associated switchgear or cable spread room and the air plenum. The scoping boundary continues through the exhaust fans, and then the ductwork and dampers on the discharge of

the exhaust fans. The scoping boundary ends at the exhaust to the turbine building. The scoping boundary also includes the packaged air conditioning units which provide cooling for the rod drive units, and, at Byron only, for the inverters.

Switchgear Heat Removal:
The switchgear heat removal scoping boundary begins at the outdoor air intake plenums. The scoping boundary continues through the air plenum, a medium efficiency filter, the supply fan and continues through ductwork and dampers to the supply air registers in the ESF and non-ESF switchgear rooms, cable spreading rooms, and electrical pipe tunnels. The scoping boundary also includes the ductwork and dampers between these rooms and the turbine building. The scoping boundary also includes the recirculation path between the associated switchgear or cable spread room and the air plenum. The scoping boundary ends at the exhaust to the turbine building. The scoping boundary also begins at the outdoor air intake ductwork for the Essential Service Water Cooling Tower electric substation bus rooms (Byron only). The scoping boundary continues through the inlet air plenum, a medium efficiency filter, the supply fan and then continues through ductwork and dampers to the supply air registers in the electric substation bus rooms. The scoping boundary also includes the ductwork and dampers between these rooms and the relief to outdoors. The scoping boundary also includes the recirculation path between the associated electric substation bus room and the air plenum. The scoping boundary ends at the exhaust to the outdoors.

Radwaste / Remote Shutdown Control Room HVAC:
The radwaste / remote shutdown control room HVAC scoping boundary for the supply portion begins at the air inlet to the ductwork which supplies the air plenum on the suction of the supply fan. The air for the system is drawn from the Auxiliary Building. The scoping boundary continues through dampers, the air plenum, a medium efficiency filter, a direct expansion cooling coil, then the supply fan. The scoping boundary continues through ductwork and dampers on the discharge of the supply fan. The scoping boundary for the supply portion of the system ends at the supply air registers in the radwaste and remote shutdown control rooms and HVAC equipment room. The scoping boundary for the exhaust portion begins at the return air inlets at the radwaste and remote shutdown control rooms and HVAC equipment room. The scoping boundary continues through ductwork and dampers, the exhaust fan, and then continues through the additional ductwork and dampers on the discharge of the exhaust fan. The scoping boundary also includes the recirculation path between the fan discharge and the air plenum. The scoping boundary ends at the exhaust to the Auxiliary Building. The scoping boundary also includes the packaged air conditioning unit which provides cooling to the Unit 2 radwaste and remote shutdown control room.

Machine Shop Ventilation:
The machine shop ventilation scoping boundary for the supply portion begins at the outdoor air intake plenum. The scoping boundary continues through dampers and ductwork to the mixing box on the suction side of the supply fan. The scoping boundary continues through the mixing box, prefilters, hot water heating coils, and then the supply fan. The scoping boundary continues through the ductwork and dampers on the discharge of the supply fan. The scoping boundary ends at the supply air registers in the various machine shop rooms. The scoping boundary for the exhaust portion begins at the return air registers in the various machine shop rooms. The scoping boundary continues through ductwork and dampers to several exhaust fans which exhaust air to atmosphere, as well as ductwork and dampers which return a portion of the air to be recirculated. The scoping boundary also includes the packaged air conditioning unit which provides cooling for the test equipment storage room at Byron only. The scoping boundary also begins at the localized air inlets for the for the machine shop

machines/equipment. The scoping boundary continues through ductwork and dampers, the exhaust fan, and the discharge ductwork. The scoping boundary ends where the air is exhausted to atmosphere.

Laboratory HVAC:
The laboratory HVAC scoping boundary for the supply portion begins at the outdoor air intake plenum and at Braidwood only the turbine building air intake. The scoping boundary continues through dampers and ductwork to the mixing box on the suction side of the supply fans. The scoping boundary continues through the mixing box, then a medium efficiency filter, hot water heating coil, and then the supply fans. The scoping boundary continues through the humidifier, hot water heating coil and chilled water cooling coil on the discharge of the supply fans. The scoping boundary continues through ductwork and dampers to the high level laboratory, the low level laboratory, the high radiation sampling system (HRSS) room, the counting room, the decontamination room, the Byron mask cleaning room, the Braidwood instrument storage room, and other related offices located in the laboratory area of the Auxiliary Building. The scoping boundary ends at the supply air registers in these areas. The scoping boundary of the exhaust portion of the system begins at the return air registers, hoods, and equipment interfaces in the high level laboratory, the low level laboratory, the high radiation sampling system (HRSS) room, the counting room, the decontamination room, the laundry room, the Byron mask cleaning room, the Braidwood instrument storage room, and other related offices located in the laboratory area of the Auxiliary Building. The scoping boundary continues through ductwork and dampers, the HRSS laboratory exhaust fans, laundry hood exhaust filter unit then laundry room exhaust fan, fume hood exhaust filter units then fume hood exhaust fans, and laboratory return fans. The HRSS exhaust fans exhaust directly to the limited access area of the HRSS laboratory where this portion of the scoping boundary ends. The scoping boundary includes the ductwork and dampers on the discharge of the laundry room exhaust fan and fume hood exhaust fans. This portion of the scoping boundary ends where this ductwork connects to the Auxiliary Building exhaust ductwork upstream of the vent stack. The scoping boundary includes the ductwork and dampers on the discharge of the laboratory return fans. This portion of the scoping boundary ends where this ductwork connects to the mixing plenum on the suction side of the supply fans.

Containment & Auxiliary Building Filtered Vents:
The containment & auxiliary building filtered vents scoping boundary begins at the vent valve interface with the numerous tanks and pieces of equipment in the Auxiliary Building and the radwaste building. The scoping boundary continues through piping to the common tank vent filter unit, the filtered tank vents exhaust fans, and then the discharge ductwork and dampers. The scoping boundary ends where this ductwork connects to the Auxiliary Building exhaust ductwork upstream of the vent stack.

Containment & Auxiliary Building Non-Filtered Vents:
The containment & auxiliary building non-filtered vents scoping boundary begins at the radwaste release tanks and the gaseous radwaste decay tanks vent header. The scoping boundary continues through the non-filtered tank vents header to the Auxiliary Building exhaust plenum. The scoping boundary ends where the header connects to the Auxiliary Building exhaust plenum.

Radwaste Facility Ventilation:
The radwaste facility ventilation scoping boundary for the supply portion begins at the outdoor air intake plenum. The scoping boundary continues through dampers and ductwork, prefilters, hot water heating coils, chilled water cooling coils, and then the supply fans. The scoping

boundary continues through the ductwork and dampers on the discharge of the supply fans to various areas in the radwaste building. The scoping boundary for the supply portion of the system ends at the supply air registers in these areas. The scoping boundary for the exhaust portion of the system begins at the return air registers in the radwaste building. The scoping boundary continues through the return air ductwork and dampers, and then through the radwaste tunnel. The scoping boundary continues through the drum processing and decant rooms, and then through the radwaste exhaust filter units and associated radwaste exhaust fans. The scoping boundary continues through the ductwork and dampers on the discharge of the radwaste exhaust fans. This portion of the scoping boundary ends where this ductwork connects to the Auxiliary Building exhaust ductwork upstream of the Unit 2 vent stack.

All associated piping, components, and instrumentation contained in the flow paths described above are included in the system evaluation boundary.

The Auxiliary Building Ventilation System interfaces with the Auxiliary Feedwater System. One of the diesel driven auxiliary feedwater pump cubicle cooler fans is driven by the auxiliary feedwater pump diesel engine. The auxiliary feedwater pump diesel engine is included as part of the Auxiliary Feedwater System scoping boundary and is evaluated with the Auxiliary Feedwater System.

The Auxiliary Building Ventilation System interfaces with the Chilled Water System. The tube side of the chilled water cooling coils containing water is included in the Chilled Water System scoping boundary and is evaluated with the Chilled Water System.

The Auxiliary Building Ventilation System interfaces with the Compressed Air System. The Compressed Air System provides air to the diesel oil storage room heat and smoke ventilators. The Compressed Air System piping, which provides the compressed air, is included as part of the Compressed Air System scoping boundary and is evaluated with the Compressed Air System.

The Auxiliary Building Ventilation System interfaces with the Containment Ventilation System. The primary containment purge plant system portion of the Containment Ventilation System draws supply air from the Auxiliary Building Ventilation System intake plenum. Additionally, the primary containment purge plant system portion of the Containment Ventilation System exhausts to the Auxiliary Building Ventilation System exhaust stacks. The primary containment purge plant system is included as part of the Containment Ventilation System scoping boundary and is evaluated with the Containment Ventilation System.

The Auxiliary Building Ventilation System interfaces with the Demineralized Water System. The demineralized water supplies to the humidifiers are included as part of the Demineralized Water System scoping boundary and are evaluated with the Demineralized Water System.

The Auxiliary Building Ventilation System interfaces with Heating Water and Heating Steam System. The tube side of the hot water heating coils containing water is included in the Heating Water and Heating Steam System scoping boundary and is evaluated with the Heating Water and Heating Steam System.

The Auxiliary Building Ventilation System interfaces with the Fire Protection System. The deluge systems associated with the charcoal filter units and the fire barrier intended function of the fire dampers throughout the system are included in the Fire Protection System scoping boundary and are evaluated with the Fire Protection System.

The Auxiliary Building Ventilation System interfaces with the Radiation Monitoring System. The particulate, noble gas, and iodine gas monitors are included in the Radiation Monitoring System scoping boundary and are evaluated with the Radiation Monitoring System.

The Auxiliary Building Ventilation System interfaces with the Service Water System. The packaged air conditioning condenser for the mask cleaning room and the Unit 2 remote shutdown control panel area are cooled by the Service Water System. The water side of the condensing coils is included in the Service Water System scoping boundary and is evaluated with the Service Water System. The Service Water System provides the cooling water for the diesel driven auxiliary feedwater pump cubicle cooler cooling coil. The Service Water System provides the cooling water to the cooling coils for the essential service water pump room coolers, residual heat removal pump room coolers, containment spray pump room coolers, safety injection pump room coolers, positive displacement charging pump room coolers, centrifugal charging pump room coolers, and the spent fuel pit pump room coolers. The tube side of the cooling coils for these cubicle coolers are included as part of the Service Water System scoping boundary and is evaluated with the Service Water System.

Also included in the license renewal scoping boundary of the Auxiliary Building Ventilation System are those water/oil/steam filled portions of nonsafety-related piping and equipment located in proximity to equipment performing a safety-related function. This includes the nonsafety-related portions of the system located within the Auxiliary Building. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Also included in the license renewal scoping boundary of the Auxiliary Building Ventilation System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor. Included in this boundary are components relied upon to preserve the structural support intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included in the scope of license renewal are the following plant systems: radwaste / remote shutdown control room HVAC, machine shop ventilation, laboratory HVAC, and radwaste facility ventilation. Additionally, not included in the scope for license renewal are those nonsafety-related portions of the following plant systems: auxiliary building HVAC, diesel generator room ventilation, miscellaneous electric equipment room ventilation, switchgear heat removal, the packaged air conditioning units which provide cooling for the inverters and rod drive units at Byron only, and the packaged air conditioning unit for the mask cleaning room and the hot machine shop HVAC at Braidwood only since they do not perform or support system intended functions.

Reason for Scope Determination

The Auxiliary Building Ventilation System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Auxiliary Building Ventilation System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Auxiliary Building Ventilation System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire

Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), and Station Blackout (10 CFR 50.63). The Auxiliary Building Ventilation System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61) or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provide heat removal from safety-related equipment. The Auxiliary Building Ventilation System maintains the ESF equipment cubicle temperature within design limits required for operation. 10 CFR 54.4(a)(1)

2. Maintain the dose consequences within the guidelines of 10 CFR 50.67 or 10 CFR 100. The Auxiliary Building Ventilation System minimizes the spread of airborne radioactivity or contamination within the Auxiliary Building and Fuel Handling Building and filters the effluent prior to release to the environment under accident conditions where radioactive iodine may be present. 10 CFR 54.4(a)(1)

3. Maintain emergency temperature limits within areas containing safety-related components. The Auxiliary Building Ventilation System provides temperature control and fume removal capability to diesel generator and day tank rooms during diesel generator operations. 10 CFR 54.4(a)(1)

4. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Auxiliary Building Ventilation System contains nonsafety-related water-filled lines in the Auxiliary Building that have the potential for spatial interactions (spray or leakage) with safety-related SSCs. The filtered vent system (refueling water storage tank vent) includes nonsafety-related piping that is in scope to provide structural support for safety-related piping. 10 CFR 54.4 (a)(2)

5. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The Auxiliary Building Ventilation System charcoal filter units have a deluge system installed to extinguish fires in the charcoal filter trays installed in these filter units. 10 CFR 54.4(a)(3)

6. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Auxiliary Building Ventilation System provides ventilation for miscellaneous electric equipment rooms, battery rooms, non-ESF switchgear rooms, ESF switchgear rooms and cable spreading rooms. 10 CFR 54.4(a)(3)

7. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). The Auxiliary Building Ventilation System provides ventilation and maintains negative pressures to general areas of the Auxiliary Building and important SBO load cubicles. 10 CFR 54.4(a)(3)

UFSAR References

6.5.1
9.4.2
9.4.3

9.4.5
9.4.7
11.5.2.2
Table 3.2-1

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-50, Sheet 1C, 1D
LR-BYR-M-61, Sheet 1B
LR-BYR-M-62, Sheet 1
LR-BYR-M-64, Sheet 3A, 3B, 4A, 4B, 5, 6, 7
LR-BYR-M-97, Sheet 1
LR-BYR-M-105, Sheet 1
LR-BYR-M-115, Sheet 1

Byron Unit 2:
LR-BYR-M-98, Sheet 1
LR-BYR-M-106, Sheet 1
LR-BYR-M-116, Sheet 1
LR-BYR-M-130, Sheet 1A, 1B

Byron Common:
LR-BYR-M-48, Sheet 2, 3A, 3B, 6A, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20A, 20B, 21A, 21B, 21C, 23, 26, 27, 38, 39, 40, 54
LR-BYR-M-63, Sheet 1B, 1C
LR-BYR-M-64, Sheet 8
LR-BYR-M-65, Sheet 1B, 3, 4, 5A, 5B, 6
LR-BYR-M-69, Sheet 1
LR-BYR-M-77, Sheet 1, 2
LR-BYR-M-95, Sheet 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
LR-BYR-M-102, Sheet 1
LR-BYR-M-113, Sheet 3
LR-BYR-M-119, Sheet 1
LR-BYR-M-128, Sheet 2
LR-BYR-M-136, Sheet 1
LR-BYR-M-137, Sheet 1
LR-BYR-M-138, Sheet 3A, 3B, 4, 5A, 6, 7

Braidwood Unit 1:
LR-BRW-M-97, Sheet 1
LR-BRW-M-105, Sheet 1
LR-BRW-M-115, Sheet 1

Braidwood Unit 2:
LR-BRW-M-98, Sheet 1
LR-BRW-M-116, Sheet 1
LR-BRW-M-136, Sheet 1
LR-BRW-M-137, Sheet 1
LR-BRW-M-138, Sheet 6, 7

Braidwood Common:
LR-BRW-M-48, Sheet 2, 3A, 3B, 6A, 6C, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 20A, 20B, 21A, 21B, 21C, 23, 38, 39, 40, 54, 57
LR-BRW-M-50, Sheet 1C, 1D
LR-BRW-M-61, Sheet 1B
LR-BRW-M-62, Sheet 1
LR-BRW-M-63, Sheet 1B, 1C
LR-BRW-M-64, Sheet 3A, 3B, 4A, 5, 6, 7
LR-BRW-M-65, Sheet 1B, 4, 5A, 5B
LR-BRW-M-69, Sheet 1
LR-BRW-M-77, Sheet 1, 2
LR-BRW-M-95, Sheet 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
LR-BRW-M-102, Sheet 1
LR-BRW-M-106, Sheet 1
LR-BRW-M-113, Sheet 3
LR-BRW-M-128, Sheet 2
LR-BRW-M-130, Sheet 1A, 1B
LR-BRW-M-138, Sheet 3A, 3B, 4A, 4B, 5A, 5B

Table 2.3.3-1 Auxiliary Building Ventilation System Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Damper Housing	Pressure Boundary
Door Seal	Pressure Boundary
Ducting and Components	Direct Flow
	Pressure Boundary
Fan Housing	Pressure Boundary
Filter Housing	Pressure Boundary
Flow Device	Pressure Boundary
Heat Exchanger - (AFW Cubicle Coolers) Fins	Heat Transfer
Heat Exchanger - (AFW Cubicle Coolers) Shell Side Components	Pressure Boundary
Heat Exchanger - (AFW Cubicle Coolers) Tube Sheet	Pressure Boundary
Heat Exchanger - (AFW Cubicle Coolers) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (ECCS Pump [CV, SI, RH, CS, SX] Cubicle Coolers) Fins	Heat Transfer
Heat Exchanger - (ECCS Pump [CV, SI, RH, CS, SX] Cubicle Coolers) Shell Side Components	Pressure Boundary
Heat Exchanger - (ECCS Pump [CV, SI, RH, CS, SX] Cubicle Coolers) Tube Sheet	Pressure Boundary
Heat Exchanger - (ECCS Pump [CV, SI, RH, CS, SX] Cubicle Coolers) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Fins	Heat Transfer
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Fins	Heat Transfer
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Tube Sheet	Pressure Boundary

Component Type	Intended Function
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Tubes	Heat Transfer
	Pressure Boundary
Piping Element	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
	Structural Support
Strainer Body	Leakage Boundary
Tanks - (Humidifier)	Leakage Boundary
Valve Body	Leakage Boundary
	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.3.2-1	Auxiliary Building Ventilation System Summary of Aging Management Evaluation

2.3.3.2 Chemical & Volume Control System

Description

The Chemical & Volume Control System is a normally operating, mechanical system designed to control the inventory of the Reactor Coolant System during normal reactor operation. The Chemical & Volume Control System consists of four plant systems: chemical and volume control system, boric acid processing system, primary water system, and boron thermal regeneration system. The Chemical & Volume Control System is in scope for license renewal.

The chemical addition portion of the system is designed to provide various chemistry functions related to the operation of the Reactor Coolant System, the Spent Fuel Cooling System, and the Radwaste System. In the event the Safety Injection System refueling water storage tank, which is the primary water source for design basis accidents, is unavailable the boric acid storage tanks and transfer pumps of the chemical addition portion of the system provide the concentrated boric acid needed to achieve cold shutdown.

The Chemical & Volume Control System has the following purposes: (1) emergency core cooling, (2) maintain the required Reactor Coolant System inventory, (3) maintain seal water injection flow to the reactor coolant pumps, (4) control reactor coolant water chemistry conditions, activity level, soluble neutron absorber concentration, and makeup, and (5) provide a means of filling, draining, and pressure testing the Reactor Coolant System during shutdown and refueling operations. The Chemical & Volume Control System accomplishes these purposes by providing the necessary tanks, pumps, heat exchangers, demineralizers, filters, piping systems, gas manifolds, and associated valves and controls to perform the required functions.

Chemical and Volume Control System:
The chemical and volume control system consists of the following major components for each unit: two centrifugal charging pumps, one positive displacement charging pump, filters (reactor coolant, boric acid, seal water injection, and seal water return), heat exchangers (regenerative, letdown, excess letdown, and seal water), demineralizers (mixed bed and cation bed), orifices (letdown, ESF minimum flow, chemical mixing tank, and seal bypass), and the volume control tank.

In the event of a LOCA, the chemical and volume control system has an emergency core cooling system (ECCS) function to inject high pressure borated water through the Safety Injection System and Reactor Coolant System into the reactor vessel for emergency core cooling and inventory makeup and to provide containment isolation for piping penetrations following a design basis event. The ECCS function is initiated from the engineered safety features plant system by the following automatic actuation signals: (1) low pressurizer pressure, (2) low steamline pressure, or (3) high containment pressure. Additionally, the ECCS function can be manually initiated from the Control Room. Automatic operation of the valves and pumps due to the automatic actuation signals from the engineered safety features plant system aligns the system from its normal standby mode to deliver borated water from the refueling water storage tank into the reactor vessel through all four reactor coolant cold leg lines. The two high-pressure centrifugal charging pumps automatically start upon receipt of an emergency safeguards initiation signal from the engineered safety features plant system. Each pump is capable of delivering the required high-pressure injection flow and is sufficient to prevent core damage for smaller leak sizes that do not cause the Reactor Coolant System pressure to decrease rapidly. Operation of the chemical and volume control system in the emergency injection mode continues until aligned by operator action to the cold leg recirculation mode.

During the ECCS actuation, the following automatic actions occur in the chemical and volume control system: the two centrifugal charging pumps start automatically, the positive displacement charging pump is tripped, two motor-operated suction valves between the refueling water storage tank and the charging pump suction header open, two motor-operated valves in the charging pump discharge header open, and the two motor-operated discharge valves from the volume control tank close. The charging flow from the refueling water storage tank is pumped directly through the Safety Injection System through two parallel motor-operated valves and divides into the four Reactor Coolant System cold legs. The motor-operated recirculation valves for the centrifugal charging pumps are initially open during normal operation, but are closed based on Reactor Coolant System pressure stabilization. In addition to the automatic actions, the pumps and valves can be operated remotely from the control room. This emergency cold leg injection mode of operation will continue drawing water from the refueling water storage tank until the low-low level setpoint, when the charging pump suction is transferred to draw from the discharge of the A-train residual heat removal pump.

During normal plant power operation, the chemical and volume control system continuously circulates reactor coolant for purification through demineralizers and a filter and supplies seal water to the reactor coolant pumps. The removal of fission and corrosion products from the reactor coolant takes place in the mixed bed demineralizers and reactor coolant filter. Three pumps (one positive displacement and two centrifugal charging pumps) are provided for makeup to the Reactor Coolant System. One charging pump (positive displacement or centrifugal) continuously supplies high-pressure water from the volume control tank to each of the four reactor coolant pump seals, and to the makeup line connection on the cold leg of the reactor coolant loop. A portion of the water supplied to the reactor coolant pump seals leaks off as controlled bleed-off and returns to the volume control tank after passing through the seal water return filter and seal water heat exchanger. Seal water injection to the reactor coolant pumps and normal charging flow requires a continuous letdown of reactor coolant in order to maintain reactor coolant inventory in the specified range. This letdown flow allows removal of fission and corrosion products from the reactor coolant. The letdown fluid is cooled by the regenerative and letdown heat exchangers, reduced in pressure by two of three pressure breakdown orifices, and then directed through one of the chemical and volume control demineralizers. Downstream of the demineralizers, flow passes through the reactor coolant filter to a three-way valve which directs flow either to the volume control tank or the recycle holdup tanks. Boron concentration in the reactor coolant can be reduced by removing boron either through the demineralizers, with effluent returned to the volume control tank, or through a feed-and-bleed operation, where reactor coolant with a higher boron concentration is directed to a recycle holdup tank and primary water is added to the volume control tank. Boron concentration in the Reactor Coolant System is maintained by controlling boron concentration in the volume control tank which is accomplished by adding demineralized water or borated water to the charging flow makeup. Water from the volume control tank is pumped either through the seal injection filter and then into the reactor coolant pump seal package and through the regenerative heat exchanger into the Reactor Coolant System cold leg or pressurizer auxiliary spray line.

The chemical addition portion of the system is designed to provide various chemistry functions related to the operation of the Reactor Coolant System, the Spent Fuel Cooling System, and the Radwaste System. This chemical addition portion also supplies chemicals to the volume control tank or charging pump suction for addition to the reactor coolant. Hydrogen, also used to control oxygen, is added directly to the volume control tank during normal plant operations. An excess-flow check valve is installed upstream of the volume control tank, at the bulk hydrogen storage skid, and is credited to limit flow of hydrogen into the Auxiliary Building in the event of a hydrogen line break to meet fire protection requirements. This is considered an active function and, therefore, the check valve is not subject to aging management review. Nitrogen is used to purge the hydrogen from the volume control tank and the system, when the plant is shut down for refueling operations. Hydrazine is added to scavenge oxygen when the reactor is shut down. Lithium hydroxide is added upstream of the volume control tank to control pH of the reactor coolant system during normal operations. Zinc injection is added to the Reactor Coolant System prior to refueling operations to lower radiation fields, reduce the corrosion of primary system materials, and mitigate the stress corrosion cracking of Alloy 600 materials.

Boric Acid Processing System:
The boric acid processing system consists of the following major components: pumps (boric acid transfer, recycle evaporator feed, monitor tank), tanks (boric acid, boric acid batching, recycle hold-up, recycle monitor), demineralizers (boron recycle evaporator feed and recycle evaporator condensate), filters (recycle evaporator feed, recycle evaporator condensate, and recycle evaporator concentrates), recycle evaporator sample coolers, and the recycle evaporator package. The boric acid processing system of the Chemical & Volume Control System is normally used to increase the boron concentration of the reactor coolant. Boric acid solution is available either in the boric acid tanks, where boric acid solution is prepared and stored, or from the Safety Injection System refueling water storage tank. Concentrated borated water solution can be mixed with demineralized makeup water in the blender or it can be mixed with letdown flow downstream of the volume control tank. A boric acid batch controller regulates flow into the chemical and volume control system downstream of the blender. There are three boric acid transfer pumps with their two associated tanks to provide reactivity control for the Reactor Coolant System during normal operation through the chemical and volume control system. One of the boric acid pumps is aligned to each unit with the third pump capable of being aligned to either unit by transferring the power supply alignment. Boron concentration and performance of the demineralizers are monitored through sampling of the reactor coolant at several locations in the Chemical & Volume Control System through the Sampling System.

The boric acid processing recycle evaporator package was used to reprocess letdown water from the Reactor Coolant System into the recycle hold-up tanks to recover boric acid and primary water. The recycle evaporator package includes the following components: feed preheater, evaporator with absorption tower, concentrates pump, distillate pump, distillate cooler, evaporator condenser, stripping column, and vent condenser. The recycle evaporator portion of the boric acid processing system is no longer used at the Byron and Braidwood stations, but is included in scope for potential spatial interaction.

Primary Water System:
The primary water system is used to regulate boron concentration in the reactor coolant. This portion of the Chemical & Volume Control System provides the demineralized water to reduce the boron concentration in the Reactor Coolant System for power operation. This system is tied into the chemical and volume control system at the blender, where it can be mixed with the boric acid solution to achieve the desired boron concentration, or used unmixed to reduce the boron concentration in the Reactor Coolant System. The primary water system provides

demineralized water to several other systems and components for flushing and makeup. This system is in scope for potential spatial interaction.

Boron Thermal Regeneration System:
The boron thermal regeneration system was used for diluting and borating a portion of the reactor coolant letdown flow for load follow operations. The boron thermal regeneration system was designed to release or hold boron in the demineralizers based on the temperature of the fluid moving through the resin bed, and discharge downstream of the mixed bed and cation bed demineralizers. The boron thermal regeneration system includes the chiller surge tank, chilled water pumps, chillers, heat exchangers (moderating, letdown reheat, letdown chiller), and thermal regeneration demineralizers. The boron thermal regeneration system is no longer used at the Byron and Braidwood stations, but is included in scope for potential spatial interaction.

The demineralizers in the Chemical & Volume Control System have service lines to each demineralizer for resin bed replacement, including resin fill, water injection, backwash, sluice, and rinse water. The other operational alignments of the chemical and volume control system, the boric acid processing system, the primary water system, and the boron thermal regeneration system are performed manually by the operators in the control room and locally at the local control panels.

For more detailed information, see UFSAR Sections 6.3.2 and 9.3.4.

Boundary

The following is a description of the license renewal scoping boundary of the Chemical & Volume Control System which as described previously consists of the following four plant systems: chemical and volume control system, boric acid processing system, primary water system, and boron thermal regeneration system.

Chemical and Volume Control System:
The chemical and volume control system scoping boundary for the ECCS flow path begins at the downstream side of the charging pump suction header check valve from the refueling water storage tank. The scoping boundary continues through the suction lines from the refueling water storage tank to the centrifugal charging pumps and positive displacement charging pump, and terminates at the upstream side of the charging pump cold leg isolation valves. Included in this scoping boundary are the minimum flow recirculation lines from each of the centrifugal charging pump discharge lines. The minimum recirculation flow lines join together and return to the volume control tank through the seal water heat exchanger. The scoping boundary for the positive displacement charging pump also includes the recirculation line and the discharge relief valve line. Included in the chemical and volume control system scoping boundary for the high-pressure injection flow path is the piping downstream of the isolation valves from the A-train residual heat removal low-pressure injection pump discharge. Also included in this scoping boundary is the portion of the charging pump to safety injection pump suction header which begins downstream of the Safety Injection System at the motor-operated suction cross-connect isolation valves.

The normal (non-emergency) flow path for the chemical and volume control system scoping boundary begins at the volume control tank and continues through the suction supply line to the charging pump suction header and the centrifugal charging pumps and positive displacement charging pump. The scoping boundary continues through the common discharge line for the charging pumps supplying the seal injection and makeup flow, and divides into two lines: the first line supplying seal injection flow to the reactor coolant pumps, and the second line supplying flow to the makeup line connections on the reactor coolant loop cold legs or pressurizer auxiliary spray line.

The first line which supplies seal injection flow begins through one of two seal injection water filters, continues to a header which divides into four lines, and terminates at the upstream side of the inlet check valves to each of the four reactor coolant pump seal packages. The scoping boundary also includes letdown flow from the seal leakoff on the reactor coolant pump seals return flow from the Reactor Coolant System. Seal bypass and seal leakoff flow from each of the four reactor coolant pumps are tied together, continue through the seal water return filter and the seal water heat exchanger, and terminate at the volume control tank. The scoping boundary also begins at the reactor coolant cold leg and hot leg drain header lines downstream of the air-operated valves directly upstream of the two excess letdown heat exchangers, continues through the excess letdown heat exchangers, to a common header, which then intersects the seal leakoff line upstream of the seal water return filter. Before the intersection point, this boundary ends at one branch of a three-way valve leading to the reactor coolant drain tank.

The second line which supplies makeup flow begins at the common discharge line of the charging pumps and continues through the containment isolation motor-operated valves and the tube side of one of two regenerative heat exchangers. From the outlet of the regenerative heat exchangers, the scoping boundary continues and terminates at the upstream side of the pressurizer auxiliary spray header isolation valve. This scoping boundary also continues to the lines of the "A" and "B" Reactor Coolant System cold legs and terminates at the upstream side of the first of two charging water inlet check valves.

The continuous letdown flow path for the chemical and volume control system scoping boundary begins downstream of the second isolation valve of the "C" loop reactor coolant cold leg loop 3 letdown, continues through the shell side of one of two regenerative heat exchangers, two of three pressure breakdown orifices, containment isolation valves, through the tube side of one of two letdown heat exchangers, through one or two of the mixed bed demineralizers. The flow path divides, and one flow path ends downstream of the cation demineralizer outlet valves. The main continuous letdown flow path continues through the reactor coolant filter to the volume control tank. The alternate letdown flow path scoping boundary begins at the three-way diverter valve, continues through the boron recycle evaporator feed demineralizers and filters and terminates at the recycle holdup tanks. Upstream of the inlet of the letdown heat exchangers, the scoping boundary also includes the connections to the Residual Heat Removal System. This part of the scoping boundary includes the lines on the upstream side of the residual heat removal inlet flow control valve and downstream side of the letdown booster pump suction isolation valve. Included in the scoping boundary is the zinc injection skid and piping into the volume control tank. The scoping boundary includes the hydrogen and nitrogen gas lines to the top of the volume control tank for structural support.

Boric Acid Processing System:
The scoping boundary for the boric acid processing system includes the boric acid addition portion of the Chemical & Volume Control System comprised of the piping and control valves that deliver borated water from the boric acid tanks to the vapor space or outlet of the volume control tank through the boric acid blender. The scoping boundary for the boric acid addition portion of the system begins at the boric acid tanks, continues through the boric acid transfer

pumps to the boric acid blender and terminates at the volume control tank. The scoping boundary includes the minimum flow line for the boric acid transfer pumps back to the boric acid tanks and the line from the boric acid batching tank to the suction of the boric acid transfer pumps. The scoping boundary continues to the upstream side of the isolation valve that supplies boric acid to the refueling water storage tank.

The scoping boundary for the letdown portion of the boric acid processing system includes tanks (recycle holdup tanks, boric acid, recycle monitor, and boric acid batching), pumps (recycle evaporator feed, boric acid transfer, and recycle monitor tank), filters (recycle evaporator condensate, recycle evaporator feed, and recycle evaporator concentrates), recycle evaporator sample coolers, demineralizers (recycle evaporator condensate and boron recycle evaporator feed), and the recycle evaporator package.

The scoping boundary for the letdown portion of the boric acid processing system begins at the recycle holdup tanks and continues to the suction header of the recycle evaporator feed pumps, continues through the pumps to a common discharge line to the recycle evaporator condensate demineralizer. Flow from the recycle evaporator feed pumps could be routed through the boric acid processing recycle evaporator packages and returned to the common pump discharge line upstream of the recycle evaporator condensate demineralizer. The scoping boundary continues to the recycle monitor tanks, through the recycle monitor tank pumps, and ends at the Auxiliary Building wall.

Included in this scoping boundary for the letdown portion of the boric acid processing system are the drain lines from the Safety Injection System, Spent Fuel Cooling System, and the reactor coolant drain tank. The scoping boundary includes the recycle holdup tank connections for processing water to the Radwaste System and the recycle evaporator package. Although the boric acid reprocessing recycle evaporators are no longer used at the Byron and Braidwood stations, this portion of the scoping boundary is included in scope for potential spatial interaction. This scoping boundary for the boric acid processing system recycle evaporator package begins at the piping from the feed preheater, continues through the various components including the evaporator with the absorption tower, concentrates pump, distillate pump, evaporator condenser, distillate cooler, stripping column, and vent condenser of the evaporator. The vent condenser receives inputs from sources including the stripping column and the evaporator condenser. The concentrates pump takes suction from the evaporator and discharges to the recycle evaporator concentrates filter.

Primary Water System:
The scoping boundary for the primary water system begins where the primary water storage tank pipe to the primary water make-up pump suction piping enters the Auxiliary Building from the outdoor tanks by way of the underground piping and the turbine building. The primary water system scoping boundary continues through one of the two primary water pumps, to the various loads in the Auxiliary Building (up to the boric acid blender and component isolation valves). The scoping boundary for the primary water system also includes the piping from the discharge of the primary water pumps and ends at the containment isolation valve that provides primary water to the pressurizer relief tank and the standpipes of the reactor coolant pumps. These portions are not safety-related but are included in scope for potential spatial interaction.

Boron Thermal Regeneration System:
The scoping boundary for the boron thermal regeneration system begins at the inlet piping to the moderating heat exchanger, continues through the tube side of the moderating heat

exchanger, through the tube side of the letdown chiller heat exchanger, and through the shell side of the letdown reheat heat exchanger. Downstream of these heat exchangers, the scoping boundary for the boron thermal regeneration system continues through the boron thermal regeneration demineralizers, to the shell side of the moderating heat exchanger. The scoping boundary continues from the shell side of the moderating heat exchanger and ends at the moderating heat exchanger to reactor coolant filter isolation valve upstream of the reactor coolant filter. This portion of the boron thermal regeneration system also includes the chiller surge tank, two chiller pumps, and boron thermal regeneration chiller, which provides the cooling on the shell side of the letdown chiller heat exchanger. Although this system is not currently used at Byron and Braidwood stations, the capability to utilize the system still exists and therefore it is included in the scope of license renewal due to the potential spatial interaction.

All associated piping, components, and instrumentation contained in the above described flow paths necessary for performance of their design function are included in the system evaluation boundary.

Not included in the Chemical & Volume Control System scoping boundary are the portions of components that are cooled by the Component Cooling System and the Service Water System. The shell sides of the letdown heat exchanger, excess letdown heat exchanger, and seal water heat exchanger are evaluated with the Component Cooling System. The tube sides of the positive displacement pump lube oil coolers and gyrol oil coolers are evaluated with the Component Cooling System. The tube side of the pump cubicle coolers, the centrifugal charging pump bearing oil coolers, and the centrifugal charging pump gear oil coolers are evaluated with the Service Water System.

Not included in the Chemical & Volume Control System scoping boundary are the tube side components of the recycle evaporator heat exchanger and the shell side components of the recycle feed preheater heat exchanger, which are evaluated with the Heating Water and Heating Steam System.

Not included in the Chemical & Volume Control System scoping boundary are the reactor coolant pump seal packages, connections on the reactor coolant cold legs, and pressurizer spray lines, which are evaluated with the Reactor Coolant System.

Also included in the license renewal scoping boundary of the Chemical & Volume Control System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the system located within the Containment Structure and the Auxiliary Building. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Also included in the license renewal scoping boundary of the Chemical & Volume Control System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor. Included in this boundary are components relied upon to preserve the structural support intended function. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included in the scope of license renewal is the primary water system portion of Chemical & Volume Control System located outdoors or underground and outside of the Auxiliary Building, as this portion of the system is not located within an area in proximity to components performing a safety-related function. These components (primary water storage tank, underground piping, and piping in the Turbine Building Complex) that are not required to support the system's leakage boundary intended function and do not perform or support system intended functions are not included in the scope of license renewal.

Reason for Scope Determination

The Chemical & Volume Control System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Chemical & Volume Control System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Chemical & Volume Control System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Anticipated Transient Without Scram (10 CFR 50.62), and Station Blackout (10 CFR 50.63). The Chemical & Volume Control System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61).

Intended Functions

1. Provide reactor coolant pressure boundary. The Chemical & Volume Control System has connections to the Reactor Coolant System on the cold legs and reactor coolant pump seals through a series of check valves. 10 CFR 54.4(a)(1)

2. Achieve and maintain the reactor core subcritical for any mode of normal operation or event. The Chemical & Volume Control System injects borated water into the Reactor Coolant System for emergency core cooling, and provides for chemical conditioning of the Reactor Coolant System for reactivity control under normal operating conditions. 10 CFR 54.4(a)(1)

3. Introduce emergency negative reactivity to make the reactor subcritical. The Chemical & Volume Control System injects borated water into the Reactor Coolant System for emergency core cooling, and provides for chemical conditioning of the Reactor Coolant System for reactivity control under normal operating conditions. 10 CFR 54.4(a)(1)

4. Provide and maintain sufficient reactor coolant inventory for core cooling. The Chemical & Volume Control System injects borated water into the Reactor Coolant System from the refueling water storage tank for emergency core cooling. 10 CFR 54.4(a)(1)

5. Introduce negative reactivity. The Chemical & Volume Control System injects borated water into the reactor coolant and provides for chemical conditioning of the Reactor Coolant System for reactivity control under normal operating conditions. 10 CFR 54.4(a)(1)

6. Provide primary containment boundary. The Chemical & Volume Control System has piping connections penetrating the primary containment and valves that provide the containment isolation function. 10 CFR 54.4(a)(1)

7. Maintain the dose consequences within the guidelines of 10 CFR 50.67 or 10 CFR 100. The Chemical & Volume Control System maintains adequate reactor coolant inventory in the reactor vessel to limit core damage. The Chemical & Volume Control System ensures that there is no significant reduction in shutdown margin when cooling water is introduced into the reactor, which ensures that radioactive releases are satisfied for the offsite dose criteria. 10 CFR 54.4(a)(1)

8. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The system is comprised of liquid-filled lines with a potential for spatial interaction with safety-related systems, and contains nonsafety-related piping that provides structural support for safety-related piping. 10 CFR 54.4(a)(2)

9. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The Chemical & Volume Control System is designed to provide borated water to the reactor coolant pump seals for an Appendix R fire. 10 CFR 54.4(a)(3)

10. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Chemical & Volume Control System provides indication and controls to mitigate the consequences of design basis events utilizing equipment in the Environmental Qualification Program. 10 CFR 54.4(a)(3)

11. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Anticipated Transients Without Scram (10 CFR 50.62). The Chemical & Volume Control System is credited with mitigating the consequences of an Anticipated Transients Without Scram by adding negative reactivity to the reactor core. 10 CFR 54.4(a)(3)

12. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). The Chemical & Volume Control System is designed to mitigate the consequences of a Station Blackout by providing seal water flow to the reactor coolant pump seals. 10 CFR 54.4(a)(3)

<u>UFSAR References</u>

6.3.2
9.3.4
9.3.4.1
9.3.4.2

<u>License Renewal Boundary Drawings</u>

Byron Unit 1:
LR-BYR-M-60, Sheet 1A, 2, 3, 4, 6
LR-BYR-M-61, Sheet 1A, 2, 3, 4, 6
LR-BYR-M-62, Sheet 1
LR-BYR-M-64, Sheet 1, 2, 3A, 3B, 4A, 4B, 5, 6, 7, 8
LR-BYR-M-65, Sheet 7

LR-BYR-M-66, Sheet 4A
LR-BYR-M-68, Sheet 1A, 1B, 6

Byron Unit 2:
LR-BYR-M-65, Sheet 8
LR-BYR-M-66, Sheet 4B
LR-BYR-M-135, Sheet 1A, 2, 3, 4, 6
LR-BYR-M-136, Sheet 1, 2, 3, 4, 6
LR-BYR-M-137, Sheet 1
LR-BYR-M-138, Sheet 1, 2, 3A, 3B, 4, 5A, 5B, 6, 7, 8
LR-BYR-M-140, Sheet 1, 5

Byron Common:
LR-BYR-M-48, Sheet 7, 9, 10, 11, 12, 13, 14, 15, 17, 18, 29, 47, 48, 49
LR-BYR-M-63, Sheet 1C
LR-BYR-M-65, Sheet 1A, 1B, 2A, 2B, 2C, 3, 4, 5A, 5B, 6
LR-BYR-M-69, Sheet 2
LR-BYR-M-70, Sheet 2
LR-BYR-M-74, Sheet 1, 2
LR-BYR-M-152, Sheet 60

Braidwood Unit 1:
LR-BRW-M-60, Sheet 1A, 2, 3, 4, 6
LR-BRW-M-61, Sheet 1A, 1B, 2, 3, 4, 6
LR-BRW-M-62, Sheet 1
LR-BRW-M-64, Sheet 1, 2, 3A, 3B, 4A, 4B, 5, 6, 7, 8
LR-BRW-M-65, Sheet 7
LR-BRW-M-66, Sheet 4A
LR-BRW-M-68, Sheet 1A, 1B, 6

Braidwood Unit 2:
LR-BRW-M-65, Sheet 8
LR-BRW-M-66, Sheet 4B
LR-BRW-M-135, Sheet 1A, 2, 3, 4, 6
LR-BRW-M-136, Sheet 1, 2, 3, 4, 6
LR-BRW-M-137, Sheet 1
LR-BRW-M-138, Sheet 1, 2, 3A, 3B, 4A, 4B, 5A, 5B, 5C, 6, 7, 8
LR-BRW-M-140, Sheet 1A, 1B, 5

Braidwood Common:
LR-BRW-M-48, Sheet 7, 9, 10, 11, 12, 13, 14, 15, 17, 18, 29, 57
LR-BRW-M-63, Sheet 1C
LR-BRW-M-65, Sheet 1A, 1B, 2A, 2B, 2C, 3, 4, 5A, 5B, 6
LR-BRW-M-69, Sheet 2
LR-BRW-M-70, Sheet 2
LR-BRW-M-74, Sheet 1, 2
LR-BRW-M-152, Sheet 47

Table 2.3.3-2 Chemical & Volume Control System Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Eductor	Pressure Boundary
Filter Element (Resin Retention)	Filter
Filter Housing	Leakage Boundary
	Pressure Boundary
Gearbox (Speed Increaser)	Pressure Boundary
Heat Exchanger - (Boron Thermal Regeneration Chiller Condenser) Shell Side Components	Leakage Boundary
Heat Exchanger - (Charging Pump Bearing Oil Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (Charging Pump Bearing Oil Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (Charging Pump Bearing Oil Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Charging Pump Gear Oil Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (Charging Pump Gear Oil Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (Charging Pump Gear Oil Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Excess Letdown) Tube Sheet	Pressure Boundary
Heat Exchanger - (Excess Letdown) Tube Side Components	Pressure Boundary
Heat Exchanger - (Excess Letdown) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Letdown Chiller) Shell Side Components	Leakage Boundary
Heat Exchanger - (Letdown Chiller) Tube Sheet	Pressure Boundary
Heat Exchanger - (Letdown Chiller) Tube Side Components	Pressure Boundary
Heat Exchanger - (Letdown Chiller) Tubes	Pressure Boundary
Heat Exchanger - (Letdown Reheat) Shell Side Components	Pressure Boundary
Heat Exchanger - (Letdown Reheat) Tube Sheet	Pressure Boundary

Component Type	Intended Function
Heat Exchanger - (Letdown Reheat) Tube Side Components	Pressure Boundary
Heat Exchanger - (Letdown Reheat) Tubes	Pressure Boundary
Heat Exchanger - (Letdown) Tube Sheet	Pressure Boundary
Heat Exchanger - (Letdown) Tube Side Components	Pressure Boundary
Heat Exchanger - (Letdown) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Moderating) Shell Side Components	Pressure Boundary
Heat Exchanger - (Moderating) Tube Sheet	Pressure Boundary
Heat Exchanger - (Moderating) Tube Side Components	Pressure Boundary
Heat Exchanger - (Moderating) Tubes	Pressure Boundary
Heat Exchanger - (PD Charging Pump Lube/Gyrol Cooler) Shell Side Components	Leakage Boundary
Heat Exchanger - (PD Charging Pump Lube/Gyrol Cooler) Tube Sheet	Leakage Boundary
Heat Exchanger - (PD Charging Pump Lube/Gyrol Cooler) Tubes	Leakage Boundary
Heat Exchanger - (Recycle Distillate Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (Recycle Distillate Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (Recycle Distillate Cooler) Tubes	Pressure Boundary
Heat Exchanger - (Recycle Evaporator Condenser) Shell Side Components	Pressure Boundary
Heat Exchanger - (Recycle Evaporator Condenser) Tube Sheet	Pressure Boundary
Heat Exchanger - (Recycle Evaporator Condenser) Tubes	Pressure Boundary
Heat Exchanger - (Recycle Evaporator Sample Cooler) Tube Side Components	Leakage Boundary
Heat Exchanger - (Recycle Evaporator) Shell Side Components	Pressure Boundary
Heat Exchanger - (Recycle Evaporator) Tube Sheet	Pressure Boundary
Heat Exchanger - (Recycle Evaporator) Tubes	Pressure Boundary
Heat Exchanger - (Recycle Feed Preheater) Tube Sheet	Pressure Boundary
Heat Exchanger - (Recycle Feed Preheater) Tube Side Components	Pressure Boundary

Component Type	Intended Function
Heat Exchanger - (Recycle Feed Preheater) Tubes	Pressure Boundary
Heat Exchanger - (Recycle Vent Condenser) Shell Side Components	Pressure Boundary
Heat Exchanger - (Recycle Vent Condenser) Tube Sheet	Pressure Boundary
Heat Exchanger - (Recycle Vent Condenser) Tubes	Pressure Boundary
Heat Exchanger - (Regenerative) Shell Side Components	Pressure Boundary
Heat Exchanger - (Regenerative) Tube Sheet	Pressure Boundary
Heat Exchanger - (Regenerative) Tube Side Components	Pressure Boundary
Heat Exchanger - (Regenerative) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Seal Water) Tube Sheet	Pressure Boundary
Heat Exchanger - (Seal Water) Tube Side Components	Pressure Boundary
Heat Exchanger - (Seal Water) Tubes	Heat Transfer
	Pressure Boundary
Piping Element	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
	Structural Support
Pump Casing (BTR Chiller)	Leakage Boundary
Pump Casing (Boric Acid Transfer)	Pressure Boundary
Pump Casing (CV Auxiliary Lube Oil)	Pressure Boundary
Pump Casing (CV Gear Oil)	Pressure Boundary
Pump Casing (Centrifugal Charging)	Pressure Boundary
Pump Casing (Letdown Booster)	Leakage Boundary (Byron only)
	Pressure Boundary (Braidwood only)
Pump Casing (PD Pump Aux Lube Oil)	Leakage Boundary
Pump Casing (PD Pump Packing Lube)	Leakage Boundary
Pump Casing (Positive Displacement Charging)	Pressure Boundary
Pump Casing (Primary Water)	Leakage Boundary
Pump Casing (Recycle Concentrate)	Leakage Boundary
Pump Casing (Recycle Distillate)	Leakage Boundary
Pump Casing (Recycle Evaporator Feed)	Pressure Boundary
Pump Casing (Recycle Monitor Tank)	Leakage Boundary
Pump Casing (Valve Leakoff Drain Tank)	Leakage Boundary
Pump Casing (Zinc Injection)	Leakage Boundary
Restricting Orifice	Pressure Boundary

Component Type	Intended Function
Restricting Orifice	Throttle
Strainer Body	Leakage Boundary
	Pressure Boundary
Tanks (Boric Acid Batching)	Leakage Boundary
Tanks (Boric Acid)	Pressure Boundary
Tanks (Boron Concentration Measurement)	Leakage Boundary
Tanks (Cation Bed Demin)	Pressure Boundary
Tanks (Charging Pump Lube Oil Reservoir)	Pressure Boundary
Tanks (Chemical Mixing)	Leakage Boundary
Tanks (Chiller Surge)	Leakage Boundary
Tanks (Distillate Sample)	Leakage Boundary
Tanks (Mixed Bed Demin)	Pressure Boundary
Tanks (PD Pump Oil Reservoir)	Leakage Boundary
Tanks (PD Pump Packing Lube Sump)	Leakage Boundary
Tanks (Recycle Absorption Tower)	Pressure Boundary
Tanks (Recycle Evaporator Condensate Demin)	Leakage Boundary
Tanks (Recycle Evaporator Feed Demin)	Pressure Boundary
Tanks (Recycle Holdup)	Pressure Boundary
Tanks (Recycle Monitor)	Leakage Boundary
Tanks (Recycle Stripping Column)	Pressure Boundary
Tanks (Resin Fill)	Leakage Boundary
Tanks (Thermal Regeneration Demin)	Pressure Boundary
Tanks (Valve Leakoff Drain)	Leakage Boundary
Tanks (Volume Control)	Pressure Boundary
Tanks (Zinc Injection)	Leakage Boundary
Valve Body	Leakage Boundary
	Pressure Boundary
	Structural Support

The aging management review results for these components are provided in:

Table 3.3.2-2	Chemical & Volume Control System Summary of Aging Management Evaluation

2.3.3.3 Chilled Water System

Description

The Chilled Water System is a normally operating, mechanical system designed to provide cooling to safety-related and nonsafety-related ventilation systems. The Chilled Water System consists of the following four independent chilled water plant subsystems associated with the following loads or buildings: control room, containment, auxiliary building, and service building. Of these four plant subsystems, only the control room chilled water subsystem provides cooling for safety-related loads during all phases of normal operation and design basis accident conditions. All four plant subsystems of the Chilled Water System are in scope for license renewal.

The purpose of the Chilled Water System is to provide cooling water and remove heat from the following loads or buildings during various modes of operation: The control room chilled water subsystem (control room cooling coils), the containment chilled water subsystem (reactor containment fan coolers), the auxiliary building chilled water subsystem (HVAC chiller room area coolers, chilled water coil banks, and the elevator machine room area cooler), and the service building chilled water subsystem (service building Systems I, II, and III, laboratory, control room offices, secondary sample room, radwaste building, and future offices).

The purpose of the control room chilled water subsystem is to provide cooling water to the control room ventilation coils to maintain the control room habitable during normal and emergency operations.

The control room chilled water subsystem accomplishes this purpose by circulating cooling water through the ventilation heat exchangers for the normal and accident control room ventilation alignments. The control room envelope is shared by Unit 1 and Unit 2.

The control room chilled water subsystem is relied upon during Station Blackout (SBO) events.

The control room chilled water subsystem is a common system comprised of two independent full capacity trains which meet single failure criteria. Each train is located in the Auxiliary Building and includes a pump, a chiller (refrigeration unit), chilled water coils, a standpipe, an air separator, and the necessary piping, valves, and instrumentation. During normal operation, one train is in operation and the other train is in standby. Each train is powered by an independent engineered safety features (ESF) bus. Essential service water serves as cooling water to the chiller condenser and is provided during normal and abnormal conditions. Makeup water is provided by the Demineralized Water System. Both trains automatically start on a Unit 1 loss of offsite power or safety injection (SI) actuation. If necessary, one train is manually started on a Unit 2 loss of offsite power or safety injection (SI) actuation. The control room chilled water subsystem is protected from tornadoes, missiles, pipe whip, and flooding.

The nonsafety-related portions of the Chilled Water System include the following three subsystems which cool loads or buildings: The containment, the auxiliary building, and the service building chilled water subsystems.

The purpose of the containment chilled water subsystem is to provide cooling water to reactor containment fan cooler (RCFC) coils during normal operating conditions to maintain the area temperatures within a suitable range. The containment chilled water subsystem also provides a primary containment penetration isolation function and contains environmentally qualified equipment, but the subsystem is nonsafety-related and is not required for any design basis accidents. Each unit has a containment chilled water subsystem comprised of two independent full capacity trains. Each train includes a pump and chiller, located in the Auxiliary Building, and RCFC coils, located inside containment. During normal operation, one train is in operation and the other train is in standby. The containment chilled water pumps and chillers trip during a loss of offsite power or SI actuation. Essential service water serves as cooling water to the chiller condenser. Essential service water also provides the safety-related cooling to the RCFC units through independent cooling coils. On loss of offsite power, the chillers and chilled water pumps have provisions to be manually transferred to the ESF busses.

The purpose of the auxiliary building chilled water subsystem is to provide cooling water to areas inside the Auxiliary Building during normal operating conditions to maintain the area temperatures within a suitable range. The auxiliary building chilled water subsystem is nonsafety-related and is not required for any design basis accidents. The auxiliary building chilled water subsystem is a common system comprised of two (Byron) or three (Braidwood) 50% capacity trains. At Byron, one of the three trains has been abandoned in place. During normal operation, one (1) or two (2) trains are in operation. Each train, includes a pump and a chiller located in the Auxiliary Building. The trains combine to supply chilled water to various area room coolers located in the Auxiliary Building. Non-essential service water serves as cooling water to the chiller condenser. On loss of offsite power, the chillers and chilled water pumps have provisions to be manually transferred to the ESF busses.

The purpose of the service building chilled water subsystem is to provide cooling water to areas in the Radwaste and Service Building Complex, Turbine Building Complex, and Auxiliary Building during normal operating conditions to maintain the area temperatures within a suitable range. The service building chilled water subsystem is nonsafety-related and is not required for any design basis accidents. The service building chilled water subsystem is a common system comprised of two independent full capacity trains. During normal operation, one train is in operation and the other train is in standby. Each train, includes a pump and chiller located in the service building. The trains combine to supply chilled water to various area room coolers located in the Radwaste and Service Building Complex, Turbine Building Complex, and Auxiliary Building. Non-essential service water serves as cooling water to the chiller condenser. On loss of offsite power, the service building chilled water subsystem is inoperative.

For more detailed information, see UFSAR Section 6.2.2.2, 9.2.7 and Table 9.2-7.

Boundary

The following is a description of the license renewal scoping boundary of the Chilled Water System which as described previously consists of the following four (4) independent chilled water subsystems: control room chilled water subsystem, containment chilled water subsystem, auxiliary building chilled water subsystem, and service building chilled water subsystem.

Control Room Chilled Water Subsystem:
The Chilled Water System license renewal scoping boundary for the control room chilled water subsystem begins at the air separator tanks and continues through the chilled water pumps to the two chillers. Downstream of the chillers, the flow path continues through the chilled water

cooling coils with a portion of the flow cooling the chiller pump out units. Downstream of these cooling coils the closed-loop flow terminates at the chilled water air separator tanks. Each control room chilled water subsystem train has an associated chemical feed tank. The inlet to chilled water from the chemical feed tank is upstream of the chilled water pump, and the chilled water outlet to the chemical feed tank is downstream of the chilled water pump. Make-up to the control room chilled water subsystem is supplied by the Demineralized Water System to the air separator tanks and the standpipes.

Containment Chilled Water Subsystem:
The Chilled Water System license renewal scoping boundary for the containment chilled water subsystems begins at the air separator tank and continues through the chilled water pumps to the two chillers. Downstream of the chillers, flow continues into containment and through the four RCFC units. Additionally, a portion of the flow cools the chiller oil coolers. Downstream of the four RCFC units, flow exits containment and the closed-loop flow terminates at the air separator tanks. The containment chilled water subsystems each have an associated chemical feed tank. The chemical feed tank inlet to chilled water is upstream of the chilled water pump, and the chilled water outlet to the chemical feed tank is downstream of the chilled water pump. Make-up to the containment chilled water subsystems is supplied by the Demineralized Water System to the air separator tank and the chilled water tank.

Auxiliary Building Chilled Water Subsystem:
The Chilled Water System license renewal scoping boundary for the auxiliary building chilled water subsystem begins at the air separator tank and continues through the chilled water pumps to the chillers. Downstream of the chillers, flow continues through HVAC chiller room area coolers, chilled water coil banks, and the elevator machine room area cooler. Additionally, a portion of the flow cools the chiller oil coolers and pump out units. Downstream of these heat exchangers the closed-loop flow terminates at the air separator tanks. At Byron, one of the trains has been abandoned in place. The auxiliary building chilled water subsystem has an associated chemical feed tank. The chemical feed tank inlet to chilled water is upstream of the chilled water pump, and the chilled water outlet to the chemical feed tank is downstream of the chilled water pump. Make-up to the auxiliary building chilled water subsystem is supplied by the Demineralized Water System to the air separator tank and the chilled water tank.

Service Building Chilled Water Subsystem:
The Chilled Water System license renewal scoping boundary for the service building chilled water subsystem begins at the air separator tank, and continues through the chilled water pumps to the chillers. Downstream of the chillers, flow continues through the radwaste building cooling coils, the various radwaste building area coolers, and the service building HVAC chilled water cooling coils. Additionally, service building chilled water flows to the suction of the service building chiller booster pumps and continues to the laboratory chilled water cooling coils, the secondary sample room cooling coil, the future office cooling coils, the control room offices cooling coils. Downstream of the heat exchangers the closed-loop flow terminates at the air separator tank. Make-up to the service building chilled water subsystem is supplied by the Demineralized Water System to the air separator tank and the chilled water tank.

All associated piping, components, and instrumentation contained in the flow paths described above for the control room chilled water subsystem, containment chilled water subsystems, auxiliary building chilled water subsystem, and service building chilled water subsystem are included in the system evaluation boundary.

Not included in the Chilled Water System scoping boundary is the cooling water to the safety-related RCFC cooling coils. The safety-related cooling water supply for the RCFC units is evaluated with the Service Water System.

Not included in the Chilled Water System scoping boundary is the cooling side (tube side) of the safety-related and nonsafety-related refrigeration condensers. The cooling side (tube side) of the safety-related and nonsafety-related refrigeration condensers is evaluated with the Service Water System.

Not included in the Chilled Water System scoping boundary is the air side (shell side) of the control room cooling coils. The air side (shell side) is evaluated with the Control Area Ventilation System.

Not included in the Chilled Water System scoping boundary is the air side (shell side) of the of the RCFC units. The air side (shell side) is evaluated with the Containment Ventilation System.

Not included in the Chilled Water System scoping boundary is the air side (shell side) of the HVAC chiller room area coolers, chilled water coil banks, elevator machine room area cooler, and the laboratory coolers. The air side (shell side) of these heat exchangers is evaluated with the Auxiliary Building Ventilation System.

Also included in the license renewal scoping boundary of the Chilled Water System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the system located within the Auxiliary Building and Containment Structure. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Also included in the license renewal scoping boundary of the Chilled Water System are those water filled portions of nonsafety-related piping and equipment located in proximity to equipment performing a safety-related function. This includes the nonsafety-related portions of the system located within the Auxiliary Building and Containment Structure. This also includes specific water filled piping sections of the service building chilled water subsystem that are located in the turbine building in proximity to the safety-related Auxiliary Building wall HVAC penetrations. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included within the scope of license renewal are the portions of the service building chilled water subsystem located in the service building and turbine building, with the exception of piping and components included for turbine building spatial interaction since they do not perform or support system intended functions. Also not included within the scope of license renewal is the abandoned auxiliary building chiller at Byron only. This train of the auxiliary building chilled water subsystem is vented and drained. It does not perform or support system intended functions and, therefore, is not within the scope of license renewal.

Reason for Scope Determination

The Chilled Water System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Chilled Water System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Chilled Water System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49) and Station Blackout (10 CFR 50.63). The Chilled Water System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Pressurized Thermal Shock (10 CFR 50.61), or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provide heat removal from safety-related equipment. The control room chilled water system cools the control room HVAC system supply air to dissipate the heat generated from all the equipment contained within the control room envelope and to maintain the control room environment for personnel comfort. 10 CFR 54.4(a)(1)

2. Provide primary containment boundary. The containment chilled water system contains valves that provide the primary containment isolation function to confine radioactive materials. 10 CFR 54.4(a)(1)

3. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Chilled Water System contains nonsafety-related water-filled lines in the Auxiliary Building and Containment Structure that have the potential for spatial interactions (spray or leakage) with safety-related SSCs. The Chilled Water System contains water filled portions of nonsafety-related piping and equipment located in proximity to equipment performing a safety-related function. 10 CFR 54.4 (a)(2)

4. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Environmental Qualification (10 CFR 50.49). The containment chilled water system primary containment isolation valves contain equipment and instrumentation that is used for automatic actuation of its protective functions following a design basis accident. 10 CFR 54.4(a)(3)

5. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Station Blackout (10 CFR 50.63). The Chilled Water System provides cooling water to control room HVAC chilled water coils to maintain control room habitability and dissipate the heat generated from equipment contained within the control room envelope. 10 CFR 54.4(a)(3)

UFSAR References

6.2.2.2
9.2.7
Table 9.2-7

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-118, Sheet 4, 5

Byron Unit 2:
LR-BYR-M-118, Sheet 6, 7

Byron Common:
LR-BYR-M-68, Sheet 2
LR-BYR-M-82, Sheet 15
LR-BYR-M-118, Sheet 1, 8, 9, 10, 13, 14, 16

Braidwood Unit 1:
LR-BRW-M-118, Sheet 4, 5

Braidwood Unit 2:
LR-BRW-M-118, Sheet 6, 7

Braidwood Common:
LR-BRW-M-82, Sheet 15
LR-BRW-M-118, Sheet 1, 8, 9, 10, 13, 14, 16

Table 2.3.3-3 Chilled Water System Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Flow Device	Leakage Boundary
Heat Exchanger - (Auxiliary Building Cooling Coil – Chilled Water Coil Bank) Tube Side Components	Leakage Boundary
Heat Exchanger - (Auxiliary Building Cooling Coil – Chilled Water Coil Bank) Tubes	Leakage Boundary
Heat Exchanger - (Auxiliary Building Cooling Coil – Elevator Machine Room Area Cooler) Tube Side Components	Leakage Boundary
Heat Exchanger - (Auxiliary Building Cooling Coil – Elevator Machine Room Area Cooler) Tubes	Leakage Boundary
Heat Exchanger - (Auxiliary Building Cooling Coil – HVAC Chiller Room Area Cooler) Tube Side Components	Leakage Boundary
Heat Exchanger - (Auxiliary Building Cooling Coil – HVAC Chiller Room Area Cooler) Tubes	Leakage Boundary
Heat Exchanger - (Auxiliary Building Refrigeration Unit Evaporator) Tube Side Components	Leakage Boundary
Heat Exchanger - (Auxiliary Building Refrigeration Unit Evaporator) Tubes	Leakage Boundary
Heat Exchanger - (Auxiliary Building Refrigeration Unit Oil Cooler) Shell Side Components	Leakage Boundary
Heat Exchanger - (Auxiliary Building Refrigeration Unit Oil Cooler) Tube Side Components	Leakage Boundary
Heat Exchanger - (Auxiliary Building Refrigeration Unit Pump Out Unit) Tubes	Leakage Boundary
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Tube Sheet	Pressure Boundary
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Tube Side Components	Pressure Boundary
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Tubes	Heat Transfer
	Pressure Boundary

Component Type	Intended Function
Heat Exchanger - (Control Room Refrigeration Unit Condenser) Shell Side Components	Pressure Boundary
Heat Exchanger - (Control Room Refrigeration Unit Condenser) Tube Sheet	Pressure Boundary
Heat Exchanger - (Control Room Refrigeration Unit Condenser) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Control Room Refrigeration Unit Evaporator) Shell Side Components	Pressure Boundary
Heat Exchanger - (Control Room Refrigeration Unit Evaporator) Tube Sheet	Pressure Boundary
Heat Exchanger - (Control Room Refrigeration Unit Evaporator) Tube Side Components	Pressure Boundary
Heat Exchanger - (Control Room Refrigeration Unit Evaporator) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Control Room Refrigeration Unit Pump Out Unit) Shell Side Components	Pressure Boundary
Heat Exchanger - (Control Room Refrigeration Unit Pump Out Unit) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Cooling Water Isolation Skid – Byron only) Nozzles	Leakage Boundary
Heat Exchanger - (Cooling Water Isolation Skid – Byron only) Plates	Leakage Boundary
Heat Exchanger - (Laboratory HVAC Chilled Water Cooling Coil) Tube Side Components	Leakage Boundary
Heat Exchanger - (Laboratory HVAC Chilled Water Cooling Coil) Tubes	Leakage Boundary
Heat Exchanger - (Primary Containment Refrigeration Unit Evaporator) Tube Side Components	Leakage Boundary
Heat Exchanger - (Primary Containment Refrigeration Unit Evaporator) Tubes	Leakage Boundary
Heat Exchanger - (Primary Containment Refrigeration Unit Oil Cooler) Shell Side Components	Leakage Boundary
Heat Exchanger - (Primary Containment Refrigeration Unit Oil Cooler) Tube Side Components	Leakage Boundary

Component Type	Intended Function
Heat Exchanger - (RCFC Chilled Water Coils) Tube Sheet	Leakage Boundary
Heat Exchanger - (RCFC Chilled Water Coils) Tube Side Components	Leakage Boundary
Heat Exchanger - (RCFC Chilled Water Coils) Tubes	Leakage Boundary
Piping Element	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
Pump Casing (Auxiliary Building Chilled Water Pump)	Leakage Boundary
Pump Casing (Control Room Chilled Water Pump)	Pressure Boundary
Pump Casing (Primary Containment Chilled Water Pump)	Leakage Boundary
Strainer Body	Leakage Boundary
Tanks - (Air Separator - Control Room)	Pressure Boundary
Tanks - (Air Separator With Strainer - Containment and Auxiliary Building)	Leakage Boundary
Tanks - (Chemical Feed)	Leakage Boundary
Tanks - (Chilled Water Tank - Containment and Auxiliary Building)	Leakage Boundary
Tanks - (Control Room Chilled Water System Standpipe)	Pressure Boundary
Valve Body	Leakage Boundary
	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.3.2-3 Chilled Water System
Summary of Aging Management Evaluation

2.3.3.4 Circulating Water System

Description

The intended function of the Circulating Water System (Byron only) for license renewal is to maintain leakage boundary integrity to preclude system interactions. For this reason, this system's pressure-retaining components located in proximity to other components performing safety-related functions have been included in the scope of license renewal. This system is not required to operate to support license renewal intended functions and is in scope for potential spatial interaction at Byron only. The Circulating Water System at Braidwood is not in scope for license renewal.

The Circulating Water System is a normally operating, mechanical system designed to provide cooling water to the main condenser. The Circulating Water System consists of the following plant systems: circulating water and raw water (circulating water) including the circulating water makeup and blowdown subsystems. The purpose of the Circulating Water System is to remove the majority of the plant heat load. The Circulating Water System accomplishes this by pumping raw water through the main condenser where rejected heat is transferred from the condensate to the circulating water. The circulating water then releases this heat to the environment in one of two methods. At Byron Station, heat is transferred to the environment using hyperbolic natural draft cooling towers. At Braidwood Station, heat is transferred to the environment using a cooling lake.

The Circulating Water System at Braidwood is not in scope for license renewal. The portions of the Circulating Water System at Byron that are evaluated for license renewal scope are the components located in the River Screen House, Essential Service Water Cooling Towers and the Essential Service Water makeup line pit, which is located in the Yard, immediately west of the Essential Service Water Cooling Towers and is evaluated as part of the Yard Structures. In these areas, safety-related Essential Service Water System components are in close proximity to nonsafety-related Circulating Water System components.

The Circulating Water System accomplishes its purpose using pumps, valves, condensers, cooling towers, piping, and piping components.

For more detailed information, see UFSAR Sections 9.2.5 (Byron), 9.2.5 (Braidwood), 10.4.5 (Byron), and 10.4.5 (Braidwood).

Boundary

The license renewal scoping boundary of the Circulating Water System at Byron encompasses the water/oil/steam filled portion of the system that is located in proximity of equipment performing a safety-related function. This includes the water/oil/steam filled portions of the Circulating Water System located within the River Screen House, Essential Service Water Cooling Towers and the Essential Service Water makeup line pit, which is located in the Yard, immediately west of the Essential Service Water Cooling Towers. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this system. For more information, refer to the license renewal boundary drawings for identification of this boundary, shown in red.

Not included in the scoping boundary of the Circulating Water System are the Natural Draft Cooling Towers, which are separately evaluated as license renewal structures.

Not included in the scope of license renewal is the entire Circulating Water System at Braidwood and portions of the Circulating Water System at Byron, including pumps, valves, condensers, piping and piping components located in structures that do not house safety-related components or have safety-related components which are not in close proximity to Circulating Water System components. Components that are not required to support the system's leakage boundary intended function are not included in the scope of license renewal.

Reason for Scope Determination

The Circulating Water System is not in scope under 10 CFR 54.4(a)(1) because no portions of the system are safety-related or relied upon to remain functional during and following design basis events. The Circulating Water System meets 10 CFR 54.4(a)(2) for Byron only because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Circulating Water System is not in scope under 10 CFR 54.4(a)(3) because it is not relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function at Byron only. The Circulating Water System at Byron only has the potential for spatial interaction (spray or leakage) with safety-related components in structures that house safety-related components. 10 CFR 54.4(a)(2)

UFSAR References

9.2.5 (Byron)
9.2.5 (Braidwood)
10.3.3
10.4.5 (Byron)
10.4.5 (Braidwood)
11.2.2

License Renewal Boundary Drawings

Byron Unit 1:
None.

Byron Unit 2:
None.

Byron Common:
LR-BYR-M-42, Sheet 6
LR-BYR-M-44, Sheet 3A, 3B, 3D, 5

Braidwood Station:
Not Applicable.

Table 2.3.3-4 Circulating Water System
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting - (Byron only)	Mechanical Closure
Piping, piping components, and piping elements - (Byron only)	Leakage Boundary
Pump Casing (Circulating Water Make-up Pumps) - (Byron only)	Leakage Boundary
Restricting Orifice - (Byron only)	Leakage Boundary
Valve Body - (Byron only)	Leakage Boundary

The aging management review results for these components are provided in:

Table 3.3.2-4 Circulating Water System
Summary of Aging Management Evaluation

2.3.3.5 Component Cooling System

Description

The Component Cooling System is a normally operating, mechanical system designed to provide cooling to safeguards equipment associated with heat removal from the Reactor Coolant System during all phases of normal reactor operation. In the event of a loss of coolant accident (LOCA), the system has an Emergency Core Cooling System (ECCS) function to reduce Reactor Coolant System temperature through the residual heat removal heat exchangers for long-term core cooling. The Component Cooling System consists of the component cooling plant system. The Component Cooling System is in scope for license renewal.

The purpose of the Component Cooling System is to provide an intermediate cooling loop between heat exchangers that contain radioactive fluid and the Service Water System for safety-related and nonsafety-related plant loads. By providing a buffer heat sink for heat exchangers that contain radioactive fluid, radioactive leaks can be detected in the Component Cooling System before any release to the environment.

The Component Cooling System accomplishes this purpose by circulating cooling water treated with a nitrite inhibitor through the shell side of the safety-related component cooling heat exchanger(s), to the components using the cooling water and back to the component cooling pumps suction line. The heat collected from the safety-related and nonsafety-related loads is then transferred from the Component Cooling System to the essential service water portion of the Service Water System.

The Component Cooling Water System is a shared system between the two units comprised of five (5) pumps (2 per unit, 1 shared), three (3) tube and shell heat exchangers (1 per unit, 1 shared), two (2) surge tanks (1 per unit) each with one (1) internal divider, and the associated piping, valves, and instrumentation. Cross connections and isolation valves allow sharing of equipment between units and provide passive failure protection in the system during the recirculation phase of a LOCA. During normal operation, two (2) pumps (1 pump in operation, 1 pump in standby), one (1) heat exchanger, and one (1) surge tank serve each unit. With the maximum spent fuel pit heat load, a standby pump would be employed from either unit. For post-LOCA recovery, two (2) pumps, two (2) heat exchangers, and one (1) surge tank are provided for the unit undergoing post-LOCA recovery per design. The component cooling water pumps are powered by safety-related diesel generator backed electrical busses.

The flow path downstream of the safety-related component cooling heat exchanger(s) consists of three (3) cooling trains per unit. Two (2) of the cooling trains supply cooling water to safety-related cooling loads and the third cooling train supplies cooling water to nonsafety-related cooling loads. The safety-related cooling loads include the residual heat removal heat exchangers and residual heat removal pump seal coolers. The nonsafety-related cooling loads include the reactor coolant pump thermal barriers and motor oil coolers, chemical and volume control excess letdown heat exchangers, letdown heat exchangers, seal water heat exchangers, positive displacement lube/gyrol coolers, recycle distillate coolers, recycle evaporator condenser, recycle vent condenser, spent fuel cooling heat exchanger, waste gas compressor heat exchangers, sample cooler panels, and containment penetrations. The cooling train supplying cooling water for nonsafety-related cooling loads can be cross connected between the units to provide cooling to common equipment such as the recycle evaporator condenser and the waste gas compressor heat exchangers. This cooling circuit can also be isolated by remotely-operated, motor-operated valves. Radiation monitors are provided in each component cooling heat exchanger discharge line to provide the operator with indication of leakage from one of the heat loads that contain radioactive fluid.

Demineralized makeup water is supplied to the system surge tank from the Demineralized Water System as required. A backup source of makeup water is provided from the Chemical & Volume Control System primary water storage tank. Chemicals can be added via the component cooling system chemical addition tank.

Containment isolation valves are incorporated in all cooling water lines penetrating the Containment Structure. Containment isolation valves are installed in the component cooling water inlet and outlet headers to the excess letdown heat exchangers and the reactor coolant pumps. In the event of a safety injection signal, the air operated excess letdown heat exchanger isolation valves close on a Phase A isolation and the motor operated reactor coolant pumps isolation valves close upon activation of a Phase B isolation. Check valves are also provided inside the containment on the inlet headers and the supply lines to the reactor coolant pump thermal barriers. In addition, the component cooling suction thermal barrier return line will automatically isolate on high coolant flow preventing reactor coolant pump thermal barrier leakage from entering the component cooling system.

For more detailed information, see UFSAR Section 9.2.2.

Boundary

The Component Cooling System scoping boundary begins at the surge tank, continues through the component cooling pumps, through the component cooling heat exchangers to a common discharge header. From the common discharge header the component cooling flow is divided into three (3) cooling circuits per unit. Two (2) of the cooling circuits supply cooling water flow to safety-related heat loads, and the third cooling circuit, which can be isolated by remotely-operated, motor-operated valves, supplies cooling water flow to nonsafety-related heat loads. The cooling water flow in the three (3) cooling circuits then returns to a common suction header completing the flow path.

The Component Cooling System safety-related heat loads are the Residual Heat Removal System residual heat removal heat exchangers and residual heat removal pump seal coolers.

The Component Cooling System nonsafety-related heat loads are the Reactor Coolant System reactor coolant pump thermal barrier and motor oil coolers, the Chemical & Volume Control System excess letdown heat exchangers, letdown heat exchangers, seal water heat exchangers, positive displacement lube/gyrol coolers, recycle distillate coolers, recycle evaporator condenser, and recycle vent condenser, the Sampling System sample cooler panels, the Spent Fuel Cooling System spent fuel cooling heat exchangers, the Radwaste System waste gas compressor heat exchanger, and the Containment Structure penetration coolers.

All associated piping, components, and instrumentation contained within the flow path described above are included in the system evaluation boundary.

The Component Cooling system boundary interface with the Reactor Coolant System is at the inlet and outlet flanges of the reactor coolant pump thermal barrier and motor oil coolers.

The Component Cooling System boundary interface with the Demineralized Water System is at the upstream side of the manual ball valves in the demineralized water supply lines to the component cooling surge tanks and at the downstream side of the check valves in the demineralized water supply lines to the component cooling surge tank loop seals.

The Component Cooling System boundary interface with the Chemical & Volume Control System is at the upstream side of the manual ball valves in the primary water supply lines to the component cooling surge tanks.

The Component Cooling System boundary interface with the Radioactive Drain System is at the upstream side of the manual ball valves in the discharge lines from the chromated drain tank pumps.

For Braidwood, the Component Cooling System boundary interface with the Radiation Monitoring System is at the manual globe valves in the component cooling to radiation monitor inlet and outlet lines. For Byron, the Component Cooling System boundary with the Radiation Monitoring System is at the inlet and outlet valves on the radiation monitors.

Not included in the Component Cooling System scoping boundary is the tube side of the following safety-related heat exchangers. The tube side of the component cooling heat exchangers is evaluated with the Service Water System. The tube side of the residual heat removal and residual heat removal pump seal cooler heat exchangers is evaluated with the Residual Heat Removal System. The tube side of the recycle distillate cooler is evaluated with the Chemical & Volume Control System.

Not included in the Component Cooling System scoping boundary is the tube side of the following nonsafety-related heat exchangers. The tube side of the letdown, excess letdown, and seal water heat exchangers is evaluated with the Chemical & Volume Control System. The tube side of the spent fuel cooling heat exchanger is evaluated with the Spent Fuel Cooling System. The tube side of the sample coolers on the sample cooler panels is evaluated with the Sampling System.

Not included in the Component Cooling System scoping boundary is the shell side of the following nonsafety-related heat exchangers. The shell side of the recycle evaporator condenser, recycle vent condenser, and the positive displacement lube/gyrol cooler heat exchangers is evaluated with the Chemical & Volume Control System. The shell side of the waste gas compressor heat exchanger is evaluated with the Radwaste System.

Also included in the license renewal scoping boundary of the Component Cooling System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the system located within the Auxiliary Building and the Containment Structure. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Reason for Scope Determination

The Component Cooling System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Component Cooling System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Component Cooling System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), and Station Blackout (10 CFR 50.63). The Component Cooling System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61) or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provide heat removal from safety-related equipment. The Component Cooling System provides cooling to heat exchangers in multiple plant systems including Residual Heat Removal, Chemical & Volume Control, and Spent Fuel Pool Systems. 10 CFR 54.4(a)(1)

2. Provide primary containment boundary. The Component Cooling System contains valves that isolate the cooling lines that penetrate the containment structure on containment high pressure signals. 10 CFR 54.4(a)(1)

3. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Component Cooling System contains nonsafety-related water-filled lines, which have the potential for spatial interactions (spray or leakage) with safety-related equipment. 10 CFR 54.4(a)(2)

4. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The Component Cooling System is credited for fire protection by providing cooling to the residual heat removal pump seal coolers, the residual heat removal heat exchangers, and other equipment credited for fire safe shutdown. 10 CFR 54.4(a)(3)

5. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Component Cooling System contains environmentally qualified equipment, such as the containment isolation valves, that are safety-related and in a harsh environment. 10 CFR 54.4(a)(3)

6. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). The Component Cooling System is credited with providing cooling to Station Blackout components and containment penetrations, and containment isolation. 10 CFR 54.4(a)(3)

UFSAR References

9.2.2

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-60, Sheet 1A, 2, 3, 4
LR-BYR-M-62, Sheet 1
LR-BYR-M-63, Sheet 1C
LR-BYR-M-64, Sheet 3A, 4A, 5
LR-BYR-M-66, Sheet 1A, 1B, 2, 4A
LR-BYR-M-70, Sheet 2
LR-BYR-M-93, Sheet 1

Byron Unit 2:
LR-BYR-M-63, Sheet 1B
LR-BYR-M-66, Sheet 4B
LR-BYR-M-93, Sheet 2
LR-BYR-M-135, Sheet 1A, 2, 3, 4
LR-BYR-M-137, Sheet 1
LR-BYR-M-138, Sheet 3A, 4, 5A
LR-BYR-M-139, Sheet 1, 2

Byron Common:
LR-BYR-M-48, Sheet 29
LR-BYR-M-65, Sheet 3, 6
LR-BYR-M-66, Sheet 3A, 3B, 4C, 4D
LR-BYR-M-78, Sheet 7

Braidwood Unit 1:
LR-BRW-M-60, Sheet 1A, 2, 3, 4
LR-BRW-M-62, Sheet 1
LR-BRW-M-63, Sheet 1C
LR-BRW-M-64, Sheet 3A, 4A, 5
LR-BRW-M-65, Sheet 3
LR-BRW-M-66, Sheet 1A, 1B, 2, 4A
LR-BRW-M-70, Sheet 2
LR-BRW-M-93, Sheet 1

Braidwood Unit 2:
LR-BRW-M-63, Sheet 1B
LR-BRW-M-65, Sheet 6
LR-BRW-M-66, Sheet 4B
LR-BRW-M-93, Sheet 2
LR-BRW-M-135, Sheet 1A, 2, 3, 4
LR-BRW-M-137, Sheet 1
LR-BRW-M-138, Sheet 3A, 4B, 5A
LR-BRW-M-139, Sheet 1, 2

Braidwood Common:
LR-BRW-M-48, Sheet 29
LR-BRW-M-66, Sheet 3A, 3B, 4C, 4D

Table 2.3.3-5 **Component Cooling System**
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Heat Exchanger - (Component Cooling) Shell Side Components	Pressure Boundary
Heat Exchanger - (Component Cooling) Tube Sheet	Pressure Boundary
Heat Exchanger - (Component Cooling) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Containment Penetration Cooling Coils) Tubes	Leakage Boundary
Heat Exchanger - (Excess Letdown) Shell Side Components	Pressure Boundary
Heat Exchanger - (Excess Letdown) Tube Sheet	Pressure Boundary
Heat Exchanger - (Excess Letdown) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Letdown) Shell Side Components	Pressure Boundary
Heat Exchanger - (Letdown) Tube Sheet	Pressure Boundary
Heat Exchanger - (Letdown) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (PD Charging Pump Lube/Gyrol Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (PD Charging Pump Lube/Gyrol Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (PD Charging Pump Lube/Gyrol Cooler) Tubes	Pressure Boundary
Heat Exchanger - (Recycle Distillate Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (Recycle Distillate Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (Recycle Distillate Cooler) Tubes	Pressure Boundary
Heat Exchanger - (Recycle Evaporator Condenser) Tube Sheet	Pressure Boundary
Heat Exchanger - (Recycle Evaporator Condenser) Tube Side Components	Pressure Boundary
Heat Exchanger - (Recycle Evaporator Condenser) Tubes	Pressure Boundary
Heat Exchanger - (Recycle Vent Condenser) Tube Sheet	Pressure Boundary

Component Type	Intended Function
Heat Exchanger - (Recycle Vent Condenser) Tube Side Components	Pressure Boundary
Heat Exchanger - (Recycle Vent Condenser) Tubes	Pressure Boundary
Heat Exchanger - (Residual Heat Removal Pump Seal Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (Residual Heat Removal Pump Seal Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Residual Heat Removal) Shell Side Components	Pressure Boundary
Heat Exchanger - (Residual Heat Removal) Tube Sheet	Pressure Boundary
Heat Exchanger - (Residual Heat Removal) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Sample Cooler Panel Coolers) Shell Side Components	Leakage Boundary
Heat Exchanger - (Seal Water) Shell Side Components	Pressure Boundary
Heat Exchanger - (Seal Water) Tube Sheet	Pressure Boundary
Heat Exchanger - (Seal Water) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Spare Sample Cooler Panel Coolers) Shell Side Components	Leakage Boundary
Heat Exchanger - (Spare Sample Cooler Panel Coolers) Tube Sheet	Leakage Boundary
Heat Exchanger - (Spare Sample Cooler Panel Coolers) Tubes	Leakage Boundary
Heat Exchanger - (Spent Fuel Cooling) Shell Side Components	Pressure Boundary
Heat Exchanger - (Spent Fuel Cooling) Tube Sheet	Pressure Boundary
Heat Exchanger - (Spent Fuel Cooling) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Waste Gas Compressor) Tube Sheet	Pressure Boundary
Heat Exchanger - (Waste Gas Compressor) Tube Side Components	Pressure Boundary
Heat Exchanger - (Waste Gas Compressor) Tubes	Pressure Boundary
Piping Element	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary

Component Type	Intended Function
Pump Casing (Component Cooling)	Pressure Boundary
Restricting Orifice	Pressure Boundary
	Throttle
Sensor Element (Radiation Detector)	Pressure Boundary
Tanks (Chemical Addition Tank)	Leakage Boundary
Tanks (Surge Tank)	Pressure Boundary
Valve Body	Leakage Boundary
	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.3.2-5	Component Cooling System Summary of Aging Management Evaluation

2.3.3.6 Compressed Air System

Description

The Compressed Air System is a normally operating, mechanical system designed to provide motive power for safety-related and nonsafety-related instrumentation, controls, and equipment. The Compressed Air System also provides compressed air to service air connections throughout the plant. The Compressed Air System consists of the following plant systems: the service air system (including the River Screen House service air system), the instrument air system (including the River Screen House instrument air system), the emergency breathing air system, the sparging air system, and portions of the primary containment isolation system. The Compressed Air System is in scope for license renewal. However, portions of the Compressed Air System are not required to perform intended functions and are not in scope.

The purpose of the Compressed Air System is to provide a continuous supply of compressed air at the appropriate pressure, temperature, flowrate, and air quality, to support pneumatic instrumentation and controls and air operated plant and service equipment at Byron and Braidwood Stations. The Compressed Air System accomplishes this purpose by drawing, compressing, and conditioning air through the use of compressors, filters, moisture separators, receivers, and driers.

At Byron, four motor driven rotary screw air compressors provide the compressed air supply to the system for both units. Ambient air is utilized to provide intercooling between stages and for aftercooling. Air discharged from the aftercoolers passes through moisture separators before entering the station air receivers. There is a station air receiver for each of the two Byron Unit 1 rotary screw compressors. The two Byron Unit 2 rotary screw compressors share a common station air receiver.

At Braidwood, three motor driven centrifugal air compressors provide the compressed air supply to the system for both units. The Service Water System is utilized to provide cooling water for intercooling between stages and for aftercooling. Air discharged from the aftercoolers passes through moisture separators before entering the station air receivers. There is a station air receiver for each centrifugal compressor.

The station air compressors at both Byron Station and Braidwood Station are located in the turbine building. Each of the three station air receivers at Byron and Braidwood stations have two discharge connections. One discharge connection feeds the service air system and the other discharge connection feeds the instrument air system.

The three station air receivers discharge to the service air system and are cross-tied to a header that feeds three instrument air dryer units. The air dryer units consist of dual prefilter, dryer, and afterfilter trains. Discharge from the three air dryer units is cross-tied to a header that supplies the instrument air receivers located in the turbine building. The instrument air receivers supply a source of dried and filtered air for air operated equipment located throughout the station. Additional air receivers are located throughout the station to provide additional surge capacity in areas of heavy air usage.

The three station air receivers discharge to the service air system and are cross-tied with the turbine building service air header. This header supplies service air to general plant and maintenance users throughout the Turbine Building Complex. The turbine building service air header also supplies service air to the Auxiliary Building, Fuel Handling Building, and Containment Structure.

A separate compressed air system is provided for the River Screen House. The River Screen House at Byron and Braidwood Stations is provided with two air compressors that supply air to a single air receiver. The River Screen House air receiver discharges air to the service air header which supplies air for general maintenance use. The service air header also supplies air to the prefilter, air dryer, and afterfilter which process the air. The afterfilter discharges dried and filtered air to the River Screen House instrument air header which supplies air to pneumatic instrumentation and controls.

The Compressed Air System has no safety-related function other than the containment isolation function supported by containment penetration piping and valves. In addition, the Compressed Air System functionally supports the safety-related function of the spent fuel pool gate seals. Portions of the Compressed Air System other than the penetration piping and valves, the equipment supporting the spent fuel pool gate seals, and potentially water filled drain piping in the Byron River Screen House, including the emergency breathing air system and the sparging air system, do not perform a license renewal intended function and, therefore, are not in scope for license renewal.

For more detailed information, see UFSAR Section 9.3.1.

Boundary

The Compressed Air System scoping boundary begins in the turbine building at the inlet air filter and continues through the station air compressors, intercoolers, aftercoolers, and moisture separators to the three station air receivers. The discharge from the station air receivers continues to either the service air header or three instrument air dryer skids.

The service air header in the turbine building terminates at attachment points to the host pneumatic components located in the Turbine Building Complex, and also continues to connections feeding the service air header in the Auxiliary Building. The service air header in the Auxiliary Building continues to the supply headers for the Containment Structure and Fuel Handling Building service air systems, the sparging air system supply header, and the attachment points to the host pneumatic components located in the Auxiliary Building. The Compressed Air System scoping boundary continues to the Containment Structure and Fuel Handling Building service air systems, and terminates at the host pneumatic components located in these structures.

The Compressed Air System scoping boundary also includes the instrument air system which begins at the discharge of the three station air receivers and continues through three parallel air dryer skids. The three air dryer skids discharge to an instrument air header which supplies the three instrument air receivers. The Compressed Air System scoping boundary continues through the turbine building instrument air loop header. The Compressed Air System continues through the supply headers feeding the makeup demineralizer building, circulating water pump house (Byron only), lake screen house (Braidwood only), service building, MSIV room, Essential Service Water Cooling Tower (Byron only), and Auxiliary Building and terminates at various air operated components and instrumentation located throughout the station.

All associated piping, components, and instrumentation contained within the flow path described above are included in the system evaluation boundary.

Included within the license renewal scoping boundary of the Compressed Air System are the safety-related segments of piping that penetrate containment and the associated safety-related containment isolation valves. In addition, safety-related piping provided for testing of the containment personnel air lock seals is included within the scoping boundary of the Compressed Air System.

Also included in the license renewal scoping boundary of the Compressed Air System are the nonsafety-related piping and components that functionally support the safety-related function of the spent fuel pool gate seals.

Not included within the Compressed Air System scoping boundary are the safety-related subsystems consisting of accumulators and associated piping and valves that provide a backup compressed air supply to the PORVs and the auxiliary feedwater flow control valves to the steam generators. These components are evaluated with the Reactor Coolant System and the Auxiliary Feedwater System, respectively. Also not included within the Compressed Air System scoping boundary are the emergency diesel generator starting air systems. The emergency diesel generator starting air systems are evaluated with the Emergency Diesel Generator & Auxiliaries System.

Also included in the license renewal scoping boundary of the Compressed Air System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related drain lines located within the Byron River Screen House that are relied upon to preserve the leakage boundary intended function due to potential spatial interaction with safety related SSCs. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included in the scope of license renewal is the portion of the Compressed Air System that includes the compressors, filters, moisture separators, receivers, and driers. Also not included in the scope of license renewal is the distribution piping and valves which supply compressed air to various safety-related and nonsafety-related components located throughout the station. Also not included within the scope of license renewal are the Compressed Air System components located in the River Screen House, other than the drain lines, including compressors, filters, moisture separators, driers, and associated piping and valves. These portions of the system are nonsafety-related and do not perform or support system intended functions and are, therefore, not within the scope of license renewal.

Reason for Scope Determination

The Compressed Air System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Compressed Air System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Compressed Air System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Compressed Air System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provide primary containment boundary. The Compressed Air System includes piping that penetrates the containment and includes equipment used for testing the personnel air lock seals. The containment penetrations, including containment isolation valves, are relied upon to ensure containment integrity. 10 CFR 54.4(a)(1)

2. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. Nonsafety-related service air components are required to provide functional support to maintain air pressure on the fuel pool gates inflatable seals. The Compressed Air System includes nonsafety-related piping that is directly attached and provides structural support to safety-related piping. The Compressed Air System also includes nonsafety-related water filled drain piping that has the potential for spatial interaction with safety-related SSCs. 10 CFR 54.4(a)(2)

3. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). Solenoid valves and position switches associated with Compressed Air System air-operated containment isolation valves are included in the scope of the Environmental Qualification Program. 10 CFR 54.4(a)(3)

UFSAR References

6.4.1 (Byron)
6.4.1 (Braidwood)
9.3.1

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-55, Sheet 4, 9

Byron Unit 2:
LR-BYR-M-55, Sheet 5, 7D

Byron Common:
LR-BYR-M-54, Sheet 2, 3
LR-BYR-M-55, Sheet 3
LR-BYR-M-63, Sheet 1A

Braidwood Unit 1:
LR-BRW-M-55, Sheet 10, 11
Braidwood Unit 2:
LR-BRW-M-55, Sheet 14, 15

Braidwood Common:
LR-BRW-M-54, Sheet 2
LR-BRW-M-63, Sheet 1A

Table 2.3.3-6 Compressed Air System Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Gas Bottles (Nitrogen)	Pressure Boundary
Piping, piping components, and piping elements	Leakage Boundary - (Byron only)
	Pressure Boundary
	Structural Support
Valve Body	Leakage Boundary - (Byron only)
	Pressure Boundary
	Structural Support

The aging management review results for these components are provided in:

Table 3.3.2-6 Compressed Air System
Summary of Aging Management Evaluation

2.3.3.7 Containment Ventilation System

Description

The Containment Ventilation System is a normally operating, mechanical system designed to provide environmental conditions conducive to component life and improved habitability in containment. The Containment Ventilation System also includes the piping used during an integrated leak rate test to monitor containment pressure as well as pressurize and depressurize containment. The Containment Ventilation System also includes the air release components installed across each door of the personnel hatch and equipment hatch. The Containment Ventilation System consists of the following plant systems: primary containment ventilation system and primary containment purge system. The Containment Ventilation System is in scope for License Renewal. However, portions of the Containment Ventilation System are not required to perform intended functions and are not in scope for license renewal.

The primary containment ventilation plant system portion of the Containment Ventilation System includes the following subsystems: the reactor containment fan cooler (RCFC) subsystem; the containment charcoal filter units subsystem; the control rod drive mechanism (CRDM) ventilation subsystem; and the reactor cavity ventilation subsystem. The primary containment purge plant system portion of the Containment Ventilation System includes the following subsystems: miniflow purge subsystem; normal purge subsystem; and post-LOCA purge subsystem. Also included as part of the primary containment purge plant system portion of the Containment Ventilation System are the test connections and piping used during an integrated leak rate test (ILRT). Finally, included as part of the primary containment purge plant system portion of the Containment Ventilation System are the air release valves and associated piping installed on the personnel hatch and the equipment hatch.

The purpose of the Containment Ventilation System is to cool and dehumidify the containment to provide a suitable operating environment for mechanical, structural, and electrical components; reduce the concentration of fission product activity in the containment atmosphere; supply cool air flow for various components inside the containment structure including the reactor cavity and the magnetic coil windings of the control rod drive mechanisms (CRDMs); dissipate the heat released and limit the containment pressure and temperature following a LOCA; and provide for automatic containment ventilation isolation. The Containment Ventilation System accomplishes this purpose with a combination of fans, filter trains, isolation dampers, cooling coils, and heating coils.

The following is a description of the Containment Ventilation System which, as described above, includes the primary containment ventilation plant system and the primary containment purge plant system. The primary containment ventilation plant system includes the following subsystems: the reactor containment fan cooler (RCFC) subsystem; the containment charcoal filter units subsystem; the control rod drive mechanism (CRDM) ventilation subsystem; and the reactor cavity ventilation subsystem. The primary containment purge plant system includes the following subsystems: miniflow purge subsystem; normal purge subsystem; post-LOCA purge subsystem; ILRT test connections and piping; and the air release valves and associated piping installed on the personnel hatch and the equipment hatch.

Primary Containment Ventilation Plant System

Reactor Containment Fan Cooler (RCFC) Subsystem:
The RCFC subsystem consists of two (2) 100% capacity trains. Each train is powered from a separate redundant essential bus. Each train consists of two RCFC units. The 'A' and 'C' units comprise the 'A' train and the 'B' and 'D" units comprise the 'B' train. Each RCFC unit consists of a two speed fan and motor assembly, an essential service water (ESW) cooling coil assembly, a chilled water cooling coil assembly, a check damper, housing, and ductwork. The chilled water coil assembly is used only for normal operation and is nonsafety-related. The other components of the RCFC subsystem are safety-related. The housing encloses the ESW and chilled water cooling coils and the fan and motor assembly.

Air circulation pattern during normal operation is the same as the post LOCA accident phase, however, the rate of airflow is higher in the normal operation phase. Air is drawn from the upper volume of the containment approximately 50 feet above the operating floor by a return air riser. There is one riser for each RCFC unit. The return air is then routed through the ESW coils, the chilled water cooling coils, the fan, and discharge duct where the check damper is located where the return air exits the housing. Each RCFC unit has its own discharge duct. The RCFC discharges directly into the lower containment volume.

Only one of the two (2) 100% capacity trains is required to operate under all operating conditions. Following a LOCA signal, the operating fans will trip and restart operation on the low speed mode following a 20 second time delay. The RCFC fans which were not operating during normal operation will also commence operation on low speed 20 seconds after receipt of the initiating signal to allow all fans to operate on the low speed mode.

During normal conditions, the RCFC subsystem cools and dehumidifies the containment to meet the operating environment required by the mechanical, structural, and electrical components within containment.

Containment Charcoal Filter Units Subsystem:
The containment charcoal filter units subsystem reduces the concentration of fission product activity in the containment atmosphere, prior to routine personnel access at power or in advance of a scheduled reactor shutdown. The containment charcoal filter units subsystem is nonsafety-related.

The containment charcoal filter units subsystem operation is intermittent and is not essential to power operation, therefore, this subsystem is not required to remain functional during and following design basis or regulated events. During a loss of offsite power, the containment charcoal filter units subsystem will not be available.

The system consists of two (2) 50% capacity units located on opposite sides of the containment operating floor in the space between the containment wall and the secondary shield wall. Each unit consists of: prefilters at 85% efficiency; high efficiency particulate air (HEPA) filters at 99.97% efficiency; tray type charcoal adsorbers capable of removing not less than 90% methyl iodine; a fire protection deluge system for the charcoal filters; and a centrifugal fan.

Control Rod Drive Mechanism (CRDM) Ventilation Subsystem:
The CRDM ventilation subsystem is a forced air cooling system provided for removal of heat from the CRDM magnetic coil windings.

The CRDM ventilation subsystem includes four (4) 50% capacity supply fans and four 50% exhaust fans. The supply fans provide cooling air to the CRDM magnetic coil housing during normal reactor operation. The subsystem discharges containment air into the area above the CRDM assemblies and down over the faces of the coil housings. The air exits below the coil housing and across the upper surface of the reactor vessel head via a return duct to the exhaust fans which exhaust to the containment atmosphere. The exhaust fans are mounted on the upper section of the shroud structure.

The CRDM ventilation subsystem is a nonsafety-related system, therefore, this subsystem is not required to remain functional during and following design basis or regulated events.

Reactor Cavity Ventilation Subsystem:
The purpose of the reactor cavity ventilation subsystem is to provide ventilation in the reactor vessel cavity to remove the thermal and gamma heat losses from the reactor vessel and, thereby, limit the maximum temperature of the primary shield wall to 150 degrees Fahrenheit. In addition, the subsystem is designed to limit the normal maximum exhaust air temperature in the cavity and annulus areas to 124 degrees Fahrenheit.

The reactor cavity ventilation subsystem is nonsafety-related, therefore, this subsystem is not required to remain functional during and following design basis or regulated events.

The reactor cavity ventilation subsystem consists of two (2) 100% capacity fans located on the lower floor between the containment wall and the shield wall. Operation of either fan draws relatively cool air from the above location and the discharge is ducted to the reactor cavity where it flows into the following paths. First, through the eight (8) excore neutron detector cavity drain lines into the eight (8) excore neutron detector cavities to dissipate thermal and gamma heat, then upward through eight (8) inch diameter pipes and into the cable junction boxes, where the airflow escapes through the sleeve space around the eight (8) reactor vessel nozzles. Second, upward through the annular gap between the biological shield wall and the reactor vessel, where part of the flow will escape through the reactor vessel flange annulus and the balance of the air will flow out through the sleeve space around the eight (8) reactor vessel nozzles.

<u>Primary Containment Purge Plant System</u>

Miniflow Purge Subsystem:
The miniflow purge subsystem may be used during normal plant operating conditions to reduce the concentration of noble gases within containment prior to and during personnel access and to equalize internal and external pressures. These functions are administratively controlled. The miniflow purge subsystem may also be used during shutdown conditions.

The miniflow purge subsystem primary containment inboard and outboard isolation valves and the equipment and components between the isolation valves are safety-related. The equipment and components between the isolation valves includes a tee connection in the miniflow purge ductwork. This tee connection is located outside of primary containment. The ductwork which branches off at the tee provides a flow path to the post-LOCA purge subsystem isolation valve at the inlet to the post-LOCA purge filter unit. These components up to and including the post-LOCA purge subsystem isolation valve are safety-related. Additionally, a safety-related local leak rate test connection is located outside containment between the isolation valves. The remainder of the system is nonsafety-related.

At Braidwood the exhaust air from this subsystem is filtered through a separate miniflow purge exhaust filter unit to remove radioactive particulate prior to release to atmosphere.

At Byron the exhaust air from this subsystem is filtered through the normal purge filter subsystem to remove radioactive particulate prior to release to atmosphere.

A supply fan draws air through the outside air louvers, prefilters, medium efficiency filters, and a heating coil then distributes this air to the normal purge subsystem ductwork inside the containment.

Air is exhausted from the containment by the miniflow exhaust fan and is filtered through prefilters and HEPA filters prior to discharging to the atmosphere via the plant stack.

Each of the miniflow purge supply subsystem containment penetrations contains two isolation valves, one inside containment and one outside containment. Each of the miniflow purge exhaust subsystem containment penetrations contain four (4) isolation valves, one (1) inside containment and three (3) outside containment. These valves automatically close upon receipt of an isolation signal.

Normal Purge Subsystem:
The normal purge subsystem was originally designed to be used during shutdown conditions to supply outside air into the containment for ventilation and cooling or heating and to reduce the concentration of noble gases within containment prior to and during personnel access. However, the normal purge subsystem is not normally used. This is due to issues with the supply air causing water ripples in the refueling cavity and issues with the containment isolation valves being able to maintain a leaktight closed position after use. The normal purge supply air is distributed around the periphery of the refueling cavity just above the water level. The intent was to provide an air curtain effect to reduce dose to the workers just above the cavity. However, experience has shown that the design causes rippling of the water which adversely affects the ability to view the fuel below the surface of the water. Additionally, the containment isolation valves have a soft seat to ensure a leaktight seal. Opening and closing of the valves causes wear to the soft seat. Wear of the seat increases the leakage past the seat. Excessive leakage past the seat will result in entering a 24 hour shutdown LCO. The miniflow purge subsystem is used in place of the normal purge subsystem.

The normal purge subsystem primary containment inboard and outboard isolation valves, the piping between the two isolation valves, and a safety-related local leak rate test connection located outside containment between the isolation valves is safety-related. The remainder of the system is nonsafety-related.

Two (2) 100% capacity supply fans are provided to draw outside air through air louvers, prefilters, and medium efficiency filters and distribute the air in the containment via ductwork around the periphery of the reactor refueling pool.

Two (2) 100% capacity purge exhaust fans are provided to draw air from the containment. The purge exhaust is filtered through prefilters and HEPA filters prior to release to the atmosphere via the plant stack. Radiation monitor sample inlet lines are installed in the common portion of the normal purge exhaust discharge ductwork upstream of the ventilation stack.

Each of the normal purge subsystem containment penetrations contains two isolation valves, one inside containment and one outside containment. These valves automatically close upon receipt of an isolation signal.

Post-LOCA Purge Subsystem:
The post-LOCA purge system takes its suction from the containment through the miniflow purge exhaust penetration. The air is then passed through prefilters, HEPA filters, and charcoal filters before being released to the stack. A manually activated water deluge system is provided for fire protection of the charcoal filters.

The post-LOCA purge subsystem primary containment outboard isolation valve and the piping between the isolation valve and the miniflow purge exhaust penetration are safety-related. The remainder of the system is nonsafety-related. The system can be used to help reduce the concentration of combustible gas in the containment atmosphere following an accident after the activity in the containment has reached a level low enough to allow its exhaust to the atmosphere.

ILRT Test Connections and Piping:
The piping associated with the ILRT test connections and piping includes two penetrations per unit. A portion of this piping allows connecting instrumentation to monitor pressure inside containment. This piping is capped inside containment during normal operation and includes manual valves inside and outside of containment. The piping on the outside of containment is also capped during normal operations. There are two pipes through the same containment penetration which are used to monitor pressure inside containment. These components are safety-related. Additional piping is provided to allow pressurizing containment during an ILRT. This piping extends into containment through the second containment penetration and is provided with a test connection and manual valve inside containment. The piping inside containment and outside containment has blind flanges installed during normal operation. This portion of the piping is safety-related. The remainder of the ILRT equipment and components are nonsafety-related. In preparation for an ILRT, the blind flanges inside and outside containment are removed which provides a flow path from portable air compressors to the containment being tested. Also included in this piping are the vent lines to atmosphere which are used to depressurize containment at the conclusion of the ILRT. Two common vent lines are provided, each with a ball valve. Four flex hoses are included to connect the portable compressors to the piping. These hoses do not interface with any other system during normal operation. They do not perform any intended function since they are installed only during outages. A depressurization sparger is provided to allow depressurizing containment after an ILRT. The sparger is connected on the outboard side of the post-LOCA purge isolation valve. The sparger is only connected when the unit is in cold shutdown. The sparger does not interface with any other system during normal operation. It does not perform any intended function since it is installed only during outage periods. For Braidwood Unit 2 only, a depressurization sparger is permanently installed which is also not connected to containment purge during normal operations.

Personnel and Equipment Hatch Air Release Valves and Associated Piping:
Each access includes two (2) hand wheel operated hatches in series to access containment. This results in an airlock between outside of containment and inside of containment. A safety-related air release valve is installed to allow equalizing the pressure between the airlock and the other side of the hatch being opened. When the hand wheel is turned to open one of the hatches, the air release valve opens first in order to equalize the pressure across the hatch being opened. After the air release valve is opened, the hatch opens. The air release valve

closes after the hatch is closed. One side of the air release valve is attached to the hatch. The other side of the air release valve has associated piping which is an elbow installed in order to direct any air being released towards the floor. The personnel and equipment hatch are part of the Containment Structure.

Not included in the scope for license renewal are the following primary containment ventilation system subsystems: containment charcoal filter units subsystem; control room drive mechanism (CRDM) ventilation subsystem; and reactor cavity ventilation subsystem. Additionally, not included in the scope for license renewal are those nonsafety-related portions of the primary containment purge system subsystems: miniflow purge subsystem; normal purge subsystem; post-LOCA purge subsystem, and the nonsafety-related portions of the ILRT piping.

For more detailed information, see UFSAR Sections 6.2.2, 6.2.4, 6.2.5, 9.4.8, 9.4.9, and E.30.

Boundary

The following is a description of the license renewal scoping boundary of the Containment Ventilation System which as described previously includes the primary containment ventilation plant system and the primary containment purge plant system. The scoping boundaries of the primary containment ventilation plant system includes the following subsystems: the reactor containment fan cooler (RCFC) subsystem; the containment charcoal filter units subsystem; the control room drive mechanism (CRDM) ventilation subsystem; and the reactor cavity ventilation subsystem will be discussed first followed by the scoping boundaries of the primary containment purge plant system which includes the following subsystems: miniflow purge subsystem; normal purge subsystem; post-LOCA purge subsystem; ILRT test connections and piping; and the air release valves and associated piping installed on the personnel hatch and the equipment hatch.

Primary Containment Ventilation Plant System

For the RCFC subsystem, the scoping boundary begins at the RCFC inlet ductwork in the upper containment atmosphere. The scoping boundary continues to the RCFC housing and includes the ESW cooling coil assembly, the chilled water cooling coil assembly, the fan and motor assembly, and the check damper. The scoping boundary ends at the discharge ductwork outlet in the lower containment atmosphere.

For the containment charcoal filter units subsystem, the scoping boundary begins at the inlet to the containment charcoal filter subsystem inlet. The scoping boundary continues to the filter train and includes the inlet damper, and the filter unit, including the filters and charcoal filter deluge system. The scoping boundary continues to the containment charcoal filter unit fan and discharge damper. The scoping boundary ends at the outlet of the discharge damper.

For the CRDM ventilation subsystem, the scoping boundary begins at the inlet to the CRDM ductwork on the suction side of the CRDM supply fan located in the lower containment atmosphere. The scoping boundary continues through the CRDM supply fan and associated discharge ductwork. The scoping boundary ends at the outlet of the CRDM supply fan discharge ductwork at the CRDM cooling shroud. For the CRDM ventilation subsystem, the scoping boundary also includes the CRDM exhaust fan portion of the CRDM ventilation subsystem. The scoping boundary for the exhaust portion begins at the inlet to the ductwork on the suction side of the CRDM exhaust fan. The scoping boundary continues through the CRDM exhaust fan and associated discharge ductwork. The scoping boundary ends at the outlet of the CRDM exhaust fan discharge ductwork.

For the reactor cavity ventilation subsystem, the scoping boundary begins at the inlet to the reactor cavity ventilation ductwork on the suction of the reactor cavity ventilation fan. The scoping boundary continues through the inlet damper and then the reactor cavity ventilation fan and associated discharge ductwork. The scoping boundary ends at the outlet of the reactor cavity ventilation fan discharge ductwork at the reactor cavity.

Primary Containment Purge Plant System

For the miniflow purge subsystem, the scoping boundary begins at the inlet of the miniflow purge subsystem ductwork which connects to the normal purge subsystem ductwork downstream of the normal purge subsystem heating coil. The scoping boundary continues through the damper on the suction side of the miniflow purge supply fan and through the fan. The boundary continues through the miniflow purge supply fan and associated discharge ductwork to the outboard miniflow purge subsystem supply isolation valve. The scoping boundary continues through the containment penetration to the inboard isolation valve and continues to where the ductwork ties in to the normal purge supply ductwork inside the containment where the scoping system boundary ends. For the miniflow purge subsystem, the scoping boundary also includes the components associated with the miniflow purge exhaust.

At Byron, this scoping boundary begins at the inlet to the miniflow purge subsystem exhaust ductwork inside containment. The system scoping boundary continues through the inboard ductwork, the inboard miniflow purge subsystem exhaust isolation valve, the containment penetration, the outboard upstream and downstream exhaust isolation valves and downstream ductwork. The scoping boundary ends where this ductwork ties in to the normal purge subsystem ductwork upstream of the normal purge subsystem exhaust filters. The scoping boundary also begins where the miniflow purge exhaust ductwork ties into the normal purge subsystem exhaust ductwork on the outlet side of the normal purge subsystem exhaust filters. The scoping boundary continues through the miniflow purge exhaust fan and associated discharge ductwork. The scoping boundary ends where the miniflow exhaust fan discharge ductwork ties in to the normal purge exhaust fan ductwork.

At Braidwood, this scoping boundary begins at the inlet to the miniflow purge subsystem exhaust ductwork inside containment. The scoping system boundary continues through the inboard ductwork, the inboard miniflow purge subsystem exhaust isolation valve, the containment penetration, the outboard upstream and downstream exhaust isolation valves and downstream ductwork. The scoping boundary continues through the miniflow purge filter unit, the miniflow purge exhaust fan, and associated discharge ductwork. The scoping boundary ends where the miniflow exhaust fan discharge ductwork ties in to the normal purge exhaust fan ductwork.

For the normal purge subsystem, the scoping boundary begins at the inlet to the normal purge ductwork at the auxiliary building outside air intake. The scoping boundary continues through the inlet damper, filters, heating coil, normal purge supply fan, and associated discharge ductwork to the outboard normal purge supply isolation valve. The scoping boundary continues through the containment penetration, through the inboard normal purge isolation valve, and through the normal purge supply ductwork inside containment. The scoping boundary ends at the outlet of the normal purge supply ductwork. For the normal purge subsystem, the scoping boundary also includes the components associated with the normal purge exhaust. This scoping boundary begins at the inlet to the normal purge exhaust ductwork at the refueling pool. The scoping boundary continues through the inboard normal purge exhaust isolation valve, through the containment penetration, through the outboard normal purge exhaust isolation valve, and through the normal purge exhaust filters to the normal purge exhaust fan. The scoping boundary continues through the fan and associated discharge ductwork. The scoping boundary ends where the normal purge exhaust ductwork ties into the auxiliary building exhaust ductwork.

For the post-LOCA purge subsystem, the scoping boundary begins where the post-LOCA purge subsystem ductwork ties into the miniflow purge exhaust ductwork between the inboard and outboard miniflow purge isolation valves. The scoping boundary continues through the post-LOCA purge outboard isolation valve, through the post-LOCA purge filter unit, through the post-LOCA purge exhaust fan and associated ductwork. The scoping boundary ends where the post-LOCA purge ductwork ties in to the normal purge exhaust ductwork on the discharge of the normal purge exhaust fans.

For the integrated leak rate test (ILRT) piping, the scoping boundary begins inside containment at the capped pipe inside containment. The scoping boundary continues through the inboard manual isolation valve, through the containment penetration, through the outboard manual valve, and ends at the pipe cap on the piping connected to the outboard manual valve. There are two (2) of these penetrations per unit. Also included in the scoping boundary for the integrated leak rate test system is the piping which is connected to air compressors which are used to pressurize containment during the ILRT. This scoping boundary begins inside containment at the blind flange and includes the test connection piping with manual valve and pipe cap. The scoping boundary continues through the containment penetration, through the spool piece, through two (2) ball valves, and then a third ball valve which is common to the piping for both units. The scoping boundary includes two common vent lines and ball valve on each vent line. The scoping boundary continues to where the piping divides into multiple compressed air supply lines and associated ball valves and blind flanges where the scoping boundary ends.

For the personnel and equipment hatch air release valves, the scoping boundary begins with the air release valve and ends with the exhaust elbow connected to the air release valve. The other side of the air release valve is connected to the airlock which is evaluated as part of the Containment Structure package.

All associated piping, components, and instrumentation contained in the flow paths described above are included in the system evaluation boundary.

The Containment Ventilation System interfaces with the Auxiliary Building Ventilation System. The primary containment purge plant system portion of the Containment Ventilation System draws supply air from the Auxiliary Building Ventilation System intake plenum. Additionally, the primary containment purge plant system portion of the Containment Ventilation System exhausts to the Auxiliary Building Ventilation System exhaust stacks. The intake plenum and exhaust stacks are included as part of the Auxiliary Building Ventilation System scoping boundary and are evaluated with the Auxiliary Building Ventilation System.

The Containment Ventilation System interfaces with the Chilled Water System. The tube side of the chilled water cooling coil in the RCFC housing is included in the Chilled Water System scoping boundary and is evaluated with the Chilled Water System.

The Containment Ventilation System interfaces with the Containment Structure. The air release valves and associated piping are installed on the personnel hatch and equipment hatch. The personnel hatch and equipment hatch are included as part of the Containment Structure scoping boundary and are evaluated with the Containment Structure.

The Containment Ventilation System interfaces with the Fire Protection System. The deluge systems associated with the containment charcoal filter units and the post LOCA purge filter unit are included in the Fire Protection System scoping boundary and are evaluated with the Fire Protection System.

The Containment Ventilation System interfaces with the Heating Water and Heating Steam System. The tube side of the hot water heating coil upstream of the normal purge supply fans is included in the Heating Water and Heating Steam System scoping boundary and is evaluated with the Heating Water and Heating Steam System.

The Containment Ventilation System interfaces with the Service Water System. The tube side of the service water cooling coil in the RCFC housing is included in the Service Water System scoping boundary and is evaluated with the Service Water System.

The Containment Ventilation System interfaces with the Radiation Monitoring System. The particulate, iodine, and gas monitors on the common discharge ductwork of the normal purge system are evaluated with the Radiation Monitoring System.

Also included in the license renewal scoping boundary of the Containment Ventilation System are those water/oil/steam filled portions of nonsafety-related piping and equipment located in proximity to equipment performing a safety-related function. This includes the nonsafety-related portions of the system located within the Containment Structure. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Also included in the license renewal scoping boundary of the Containment Ventilation System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor. Included in this boundary are components relied upon to preserve the structural support intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included in the scope of license renewal are the following primary containment ventilation system subsystems: containment charcoal filter units subsystem; control room drive mechanism (CRDM) ventilation subsystem; and reactor cavity ventilation subsystem. These subsystems of the primary containment ventilation system are nonsafety-related and do not perform or support system intended functions and are, therefore, not included in the scope of license renewal.

Also not included in the scope of license renewal are those nonsafety-related portions of the following primary containment purge system subsystems: miniflow purge subsystem; normal purge subsystem; and the portion of the post-LOCA purge subsystem which does not provide structural support for safety-related piping. These portions of the primary containment purge system are nonsafety-related and do not perform or support system intended functions and are, therefore, not included in the scope of license renewal.

Reason for Scope Determination

The Containment Ventilation System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Containment Ventilation System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Containment Ventilation System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48) and Environmental Qualification (10 CFR 50.49). The Containment Ventilation System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provide heat removal from safety-related equipment. The RCFC subsystem cooling coils remove containment heat following a loss of coolant accident. 10 CFR 54.4(a)(1)

2. Provide primary containment boundary. The primary containment isolation valves associated with the miniflow purge subsystem, the normal purge subsystem, and the post-LOCA purge subsystem isolate upon receipt of an isolation signal. Additionally, the primary containment manual isolation valves associated with the ILRT test connections and piping, and the personnel and equipment hatch air release valves are part of the primary containment boundary. 10 CFR 54.4(a)(1)

3. Provide heat removal from primary containment and provide primary containment pressure control. The RCFC subsystem cooling coils remove containment heat following a loss of coolant accident. 10 CFR 54.4(a)(1)

4. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety related function. The Containment Ventilation System contains nonsafety-related water-filled lines in the Containment Structure that have the potential for spatial interactions (spray or leakage) with safety-related SSCs. Portions of the Containment Ventilation System include nonsafety-related piping that is in scope to provide structural support for safety-related piping. 10 CFR 54.4 (a)(2).

5. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The RCFC containment charcoal filter units and post-LOCA purge filter unit have a deluge system installed to extinguish fires in the charcoal filter trays installed in these filter units. 10 CFR 54.4(a)(3)

6. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49).

The RCFC subsystem provides containment cooling following a loss of coolant accident.
10 CFR 54(a)(3)

UFSAR References

6.2.2
6.2.4
6.2.5
9.4.8
9.4.9
E.30

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-103, Sheet 2
LR-BYR-M-105, Sheet 1

Byron Unit 2:
LR-BYR-M-104, Sheet 2
LR-BYR-M-106, Sheet 1

Byron Common:
LR-BYR-M-70, Sheet 3
LR-BYR-M-105, Sheet 3

Braidwood Unit 1:
LR-BRW-M-103, Sheet 2
LR-BRW-M-105, Sheet 1

Braidwood Unit 2:
LR-BRW-M-104, Sheet 2
LR-BRW-M-106, Sheet 1

Braidwood Common:
LR-BRW-M-70, Sheet 3
LR-BRW-M-105, Sheet 3

Table 2.3.3-7 **Containment Ventilation System**
Components Subject to Aging Management Review

Component Type	**Intended Function**
Bolting	Mechanical Closure
Damper Housing	Pressure Boundary
Ducting and Components	Pressure Boundary
Fan Housing	Pressure Boundary
Filter Housing	Structural Support
Heat Exchanger - (RCFC Essential Service Water Coils) Shell Side Components	Pressure Boundary
Heat Exchanger - (RCFC Essential Service Water Coils) Tube Sheet	Pressure Boundary
Heat Exchanger - (RCFC Essential Service Water Coils) Tubes	Heat Transfer
	Pressure Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
	Structural Support
Valve Body	Leakage Boundary
	Pressure Boundary
	Structural Support

The aging management review results for these components are provided in:

Table 3.3.2-7 Containment Ventilation System
Summary of Aging Management Evaluation

2.3.3.8 Control Area Ventilation System

Description

The Control Area Ventilation System is a normally operating, safety-related mechanical system designed to provide environmental conditions conducive to habitability and long component life in the control room envelope under normal and abnormal station conditions. The Control Area Ventilation System consists of the control and auxiliary electrical equipment room HVAC plant system. The system is designed with redundancy to meet the single failure criteria.

The Control Area Ventilation System is in scope for License Renewal. However, portions of the Control Area Ventilation System are not safety-related and are not required to perform intended functions and are not in scope for license renewal.

The Control Area Ventilation System provides ventilation to the control room and adjacent areas which comprise the control room envelope. These areas include the units 1 and 2 control rooms, the units 1 and 2 HVAC equipment rooms, the units 1 and 2 auxiliary electrical equipment rooms, the common upper cable spreading room, the security control center, the records room, the locker room, the storage room lavatory, the storage room, the instrument shops, and at Braidwood only the control room kitchen. The lower cable spread room is included in the control room envelope, but there is no supply or exhaust ventilation associated with this area.

The purpose of the Control Area Ventilation System is to maintain room temperatures, humidity, and habitability of the control room envelope under normal and design basis accident conditions. The system maintains the control room at a positive differential pressure with respect to adjacent areas in order to limit unfiltered inleakage to the control room envelope. The Control Area Ventilation System accomplishes this purpose with two (2) redundant equipment trains. These trains include missile protected air inlets and exhausts, supply fans, return fans, makeup air fans, makeup filter trains, recirculation filters, isolation dampers, cooling coils, heating coils, and humidifiers.

The Control Area Ventilation System operates in several modes of operation to maintain habitability based on plant conditions. These conditions include: normal operation; high radiation; safety injection actuation; high ionization; purge operations; and control room isolation (Braidwood only).

Normal Conditions:
Under normal conditions, outside air is drawn in through outside air intake louvers. The air follows a missile protected path and is ducted through isolation valves to the suction of the return air fan. Control room air intake particulate and iodine gas monitor sample inlets are located in the area between the outside air intake louvers and the missile protected air intake. The return air fan draws in the outside air along with air recirculated from the control room envelope. The discharge of the return air fan is ducted to the mixed air plenum on the suction side of the supply fan. The supply fan draws air from the mixed air plenum across a medium efficiency filter and then through ductwork which bypasses the recirculation charcoal adsorber on the suction side of the supply fan. The discharge of the supply fan is conditioned as it passes through a chilled water cooling cabinet, a heating coil, and a humidifier. The air is then ducted to the various areas of the control room envelope. Additional electric heating coils are

installed in several areas of the control room envelope to provide supplemental heat for personal comfort.

High Radiation or Safety Injection:
When high radiation is detected at the outside air intake, or when a safety injection is present, the normal outside air intake is isolated and makeup air is provided from the turbine building. Air is drawn in through missile protected intake louvers and ducted through an isolation damper to the inlet of the makeup air filter unit. The makeup air filter unit includes a moisture separator, electric heating coil, and a medium efficiency filter to assure the optimum air conditions entering the high-efficiency particulate air (HEPA) filters and charcoal adsorbers. The outlet of the makeup air filter unit is ducted to the suction of the makeup air filter unit fan. The discharge of the makeup air filter unit fan is ducted to the suction of the return fan. Additionally, the recirculation charcoal adsorber on the suction side of the supply fan is placed in service with the bypass damper closed. Air intake particulate, noble gas, and iodine gas monitor inlets are located in the discharge ductwork of the makeup filter unit fan.

High Ionization:
Products of combustion are monitored by ionization detectors in the makeup air intakes and return ducts. An alarm is annunciated in the control room when products of combustion are detected. The makeup air can be switched to the redundant flow path utilizing a remote intake from the turbine building. Additionally, the recirculation charcoal adsorber, on the suction side of the in-service supply fan, may be placed in service depending upon which ionization detector is activated. The recirculation charcoal adsorber automatically realigns when high ionization is detected in the recirculation charcoal adsorber bypass.

Purge:
Control room purge capability, utilizing 100% outside air, is provided. Outside air is ducted through a purge intake damper to the mixed air plenum on the suction side of the supply fan. A purge exhaust damper on the discharge of the return fan is provided to exhaust the air to the turbine building. The normal flow path between the return fan and the mixed air plenum is isolated. Purge capability is overridden by a high radiation, safety injection, or manual isolation (Braidwood only) signal.

Manual Isolation (Braidwood only):
The control room HVAC system is provided with control switches on the local control panels which can manually isolate the system upon notification of an accidental release of toxic gas from sources external to the station. In the isolation mode the control room HVAC system operates in 100% recirculation mode with all outside air intakes closed and recirculation charcoal filter in operation.

Not included in the scope of license renewal are the Control Area Ventilation System equipment and components which provide ventilation to the following areas: control room personnel support ventilation area and the lower cable spread room area. The equipment and components in the control room personnel support ventilation area and lower cable spread room area are not required during a design basis event. These areas are identified in the dashed areas on the license renewal boundary drawings.

For more detailed information, see UFSAR Sections 6.4 (Byron), 6.4 (Braidwood), 6.5.1, 7.3.1.1.9, and 9.4.1.

Boundary

Under normal conditions, the Control Area Ventilation System supply air scoping boundary begins at the outside air intake louvers. The scoping boundary continues through supply air ductwork connecting to two (2) isolation dampers in series and then to the suction of the return fan where the supply air ductwork connects with the return air ductwork from the various areas which are ventilated by the Control Area Ventilation System. The discharge of the return fan is ducted to a mixed air plenum on the suction side of the supply fan. From the mixed air plenum, the scoping boundary continues through a supply filter. Downstream of this filter, the duct divides into two paths. The first path is through a recirculation charcoal adsorber. The second path bypasses this filter. Isolation dampers are provided on the inlet and outlet of the charcoal adsorber. An isolation damper is also installed in the bypass ductwork. The two paths are joined at the outlet of the charcoal adsorber. The scoping boundary continues through ductwork to the supply fan. The discharge of the supply fan is ducted through a chilled water cooling coil cabinet and an electric heating coil. The scoping boundary then continues through ductwork to the control room envelope ventilation supply air registers. The supply air scoping boundary ends at the supply air registers in the following control room envelope areas: the Unit 1 and 2 control rooms, the Unit 1 and 2 HVAC equipment rooms, the Unit 1 and 2 auxiliary electrical equipment rooms, the common upper cable spreading room, the security control center, the records room, the locker room, the storage room lavatory, the storage room, the instrument shops, and at Braidwood only the control room kitchen.

An alternate flow path is available when high radiation is detected at the outside air intake or if a safety injection system is actuated. The boundary path which normally provides outside air to the suction of the return air fan is isolated by the two (2) isolation dampers. To provide for the alternate flow path, the Control Area Ventilation System boundary includes a missile protected makeup air intake from the turbine building to the suction of the return air fan. This boundary includes the turbine building air intake which is ducted through an isolation damper and then to the makeup air filter unit. The makeup air filter unit includes a moisture separator, electric heating coil, a medium efficiency filter, an upstream HEPA filter, two charcoal adsorbers, and a downstream HEPA filter. The boundary continues from the outlet of the filter train through ductwork to the suction of the makeup air fan. The discharge of the makeup air fan is ducted to the suction of the return air fan.

An additional alternate flow path is available to allow for purging the control room envelope. This additional ductwork starts at the same outside air intake used under normal conditions and continues through a purge intake damper. The outlet of the purge intake damper is ducted to the mixed air plenum on the suction side of the supply fan.

The Control Area Ventilation System return air boundary begins at the return air registers in the control room envelope. The return air boundary continues from the control room envelope areas to the suction side of the return air fan.

The return air boundary is the same under normal, high radiation, and safety injection conditions. In order to provide an alternate flow path for use when the control room is being purged, the boundary includes ductwork on the discharge of the return air fan which connects to a purge exhaust damper. The purge exhaust damper is ducted to a missile protected relief to the turbine building.

The scoping boundaries previously described encompass the equipment and components required to operate when high ionization is detected and when the system is manually isolated (Braidwood only).

All associated piping, components, and instrumentation contained in the flow path described above are included in the system evaluation boundary.

The Control Area Ventilation System interfaces with the Chilled Water System. The portion of the chilled water cooling coil on the discharge of the supply fan containing water is included in the Chilled Water System scoping boundary and is evaluated with the Chilled Water System.

The Control Area Ventilation System interfaces with the Fire Protection System. The deluge systems associated with the charcoal filter units and the fire barrier intended function of the fire dampers throughout the system are included in the Fire Protection System scoping boundary and are evaluated with the Fire Protection System.

The Control Area Ventilation System interfaces with the Radiation Monitoring System. The control room outside air intake and makeup filter discharge particulate, noble gas, and iodine gas monitors are evaluated as part of the Radiation Monitoring System.

The Control Area Ventilation System interfaces with the Demineralized Water System. The demineralized water supplies to the humidifiers are evaluated as part of the Demineralized Water System.

Also included in the license renewal scoping boundary of the Control Area Ventilation System are those water filled portions of nonsafety-related piping and equipment located in proximity to equipment performing a safety related function. This includes the nonsafety related portions of the system located in the control room envelope. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary shown in red.

Not included in the scope of license renewal are ventilation equipment and components which support ventilation in the lower cable spread room area. The equipment and components do not perform or support system intended functions and are, therefore, not included in the scope of license renewal.

Not included in the scope of license renewal at Braidwood Station is the control room personnel support ventilation area which includes the equipment and components which provide ventilation to the following areas: men’s locker room; men’s toilet; janitor’s closet; control room kitchen, control room storage room toilet, security control center, electronics shop, and associated corridors A-320, A-402, and A-416. These portions of the Control Area Ventilation System are nonsafety-related and do not perform or support system intended functions and are, therefore, not included in the scope of license renewal.

Not included in the scope of license renewal at Byron Station is the control room personnel support ventilation area which includes the equipment and components which provide ventilation to the following areas: men’s locker room; men’s toilet; locker room; janitor's closet, control room storage room toilet, security control center, electronics shop, and associated corridors A-320, A-402, and A-416. These portions of the Control Area Ventilation System are nonsafety-related and do not perform or support system intended functions and are, therefore, not included in the scope of license renewal.

Reason for Scope Determination

The Control Area Ventilation System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Control Area Ventilation System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Control Area Ventilation System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48) and Station Blackout (10 CFR 50.63). The Control Area Ventilation System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Maintain emergency temperature limits within areas containing safety-related components. The Control Area Ventilation System maintains the control room environment for personnel comfort and ensures that a temperature of 90 degrees Fahrenheit is not exceeded for equipment concerns. The Control Area Ventilation System is designed to provide a controlled temperature of 75 degrees Fahrenheit plus or minus two (2) degrees Fahrenheit and a relative humidity of 20 percent to 60 percent in the control room, auxiliary electric equipment rooms, record room, storage room and security control center. 10 CFR 54.4(a)(1)

2. Provide a centralized area for control and monitoring of nuclear safety-related equipment. The Control Area Ventilation System maintains a habitable environment in the event of a radiological emergency by maintaining the control room at a positive differential pressure with respect to adjacent areas in order to limit unfiltered inleakage to the control room envelope, providing filtered make up air, and filtering recirculation air. 10 CFR 54.4(a)(1)

3. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Control Area Ventilation System contains nonsafety-related liquid filled piping in the control room envelope which has potential spatial interactions with safety-related SSCs. 10 CFR 54.4(a)(2)

4. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the commission's regulations for Fire Protection (10 CFR 50.48). Fire dampers are installed throughout the system in order to support fire containment. Manually operated deluge systems are provided at the makeup filter trains and recirculation filters for the purpose of fire suppression. 10 CFR 54.4(a)(3)

5. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the commission's regulations for Station Blackout (10 CFR 50.63). The Control Area Ventilation System is relied upon to provide temperature control for the control room envelope during a station blackout event. 10 CFR 54.4(a)(3)

UFSAR References

6.4 (Byron)
6.4 (Braidwood)
6.5.1
7.3.1.1.9
9.4.1

License Renewal Boundary Drawings

Byron Unit 1:
None.

Byron Unit 2:
None.

Byron Common:
LR-BYR-M-96, Sheet 1, 2, 3, 4, 5
LR-BYR-M-128, Sheet 2

Braidwood Unit 1:
None.

Braidwood Unit 2:
None.

Braidwood Common:
LR-BRW-M-96, Sheet 1, 2, 3, 4, 5
LR-BRW-M-128, Sheet 2

Table 2.3.3-8 Control Area Ventilation System Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Damper Housing	Pressure Boundary
Door Seal	Pressure Boundary
Ducting and Components	Direct Flow
	Pressure Boundary
Electric Heaters (Housing)	Pressure Boundary
Fan Housing	Pressure Boundary
Filter Housing	Pressure Boundary
Flow Device	Pressure Boundary
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Fins	Heat Transfer
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Shell Side Components	Pressure Boundary
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Tube Sheet	Pressure Boundary
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Tubes	Heat Transfer
	Pressure Boundary
Piping Element	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
Strainer Body	Leakage Boundary
Tanks (Humidifier)	Leakage Boundary
Valve Body	Leakage Boundary
	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.3.2-8 Control Area Ventilation System
Summary of Aging Management Evaluation

2.3.3.9 Cranes and Hoists

Description

The Cranes and Hoists system is comprised of load handling overhead bridge cranes, trolley beams, jib cranes, lifting devices, and hoists provided throughout the facility to support operation and maintenance activities. The system includes cranes, patented tracks systems, jib cranes, trolley beams, and hoists required to comply with the requirements of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants", and hoists for handling light loads. Major cranes include the Containment Building Polar Crane, the Fuel Building Overhead Bridge Crane, and the Turbine Building Crane.

The purpose of the Cranes and Hoists system is to safely move material and equipment supporting operations and maintenance activities. The Cranes and Hoists system accomplishes this by compliance with NUREG-0612 and administrative controls so damage from a heavy load drop does not prevent safe shutdown of the reactor.

The Containment Building Crane supports refueling outage activities and is used to lift heavy loads such as the reactor vessel integrated head, and upper and lower reactor vessel internals. The Fuel Building Overhead Bridge Crane in the Fuel Handling Building handles new fuel and also spent fuel casks. The Turbine Building Crane services the turbine building, primarily for maintenance activities associated with the main turbines and generators.

Included in the evaluation boundary of the Cranes and Hoists system is load handling equipment in various areas of the facility. Cranes and hoists that are within the scope of NUREG-0612 are in scope for license renewal. Other cranes and hoists that are not in the scope of NUREG-0612, but travel in the vicinity of safety-related systems, structures, and components (SSCs) are also within the scope of license renewal. As a result, the following cranes and hoists are in scope for license renewal:

- Containment Building Polar Cranes
- Reactor Vessel Head Stud Tensioning Hoists
- Fuel Building Overhead Bridge Crane
- Turbine Building Cranes
- Jib Cranes *
- Trolley Beams and Associated Hoists *
- Patented Track Systems *
- Single Girder Cranes *

* Located within structures housing safety-related equipment which includes Containment, Auxiliary Building, Fuel Handling Building, lake screen house (Braidwood), and River Screen House (Byron).

The boundary for the Cranes and Hoists system is limited to load bearing structural components such as, the bridge, trolley, rail system (rails, rail clips, and rail fasteners), structural bolts, lifting devices, trolley beams, and jib crane structural members.

Those cranes and hoists, including station elevators, not located within safety-related structures or that do not operate over safety-related equipment, are not within the scope of license renewal. Personnel lifts, pump up hydraulic lifts, and small portable hoists are portable equipment and are also not in scope for license renewal.

Not included in the scoping boundary of the Cranes and Hoists system is refueling machines, fuel transfer carriage hoists, overhead crane structural support steel, and crane runway girders. The refueling machine and fuel transfer carriage hoists and associated equipment including the spent fuel pool bridge crane, spent fuel upending device, containment fuel upending device, new fuel elevator winch, and fuel transfer system (underwater conveyor car) are evaluated with the Fuel Handling & Fuel Storage System. The structural support steel and runway girders for all cranes and hoists are evaluated with the structure serviced by the crane.

For more detailed information, refer to UFSAR Sections 9.1.4, 9.1.5 and Table 9.1-7.

Boundary

Not required.

Reason for Scope Determination

The Cranes and Hoists system is not in scope under 10 CFR 54.4(a)(1) because no portions of the system are safety-related or relied upon to remain functional during and following design basis events. The Cranes and Hoists system meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Cranes and Hoists system is not in scope under 10 CFR 54.4(a)(3) because it is not relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provides a safe means for handling components and loads above or near safety-related components. 10 CFR 54.4(a)(2)

UFSAR References

9.1.4
9.1.5
Table 3.2-1
Table 9.1-7

License Renewal Boundary Drawings

Byron Station:
None.

Braidwood Station:
None.

Table 2.3.3-9 Cranes and Hoists
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting (Structural)	Structural Support
Crane/Hoist (Bridge/Trolley/Girders)	Structural Support
Crane/Hoist (Jib Cranes/Beams/Plates/Anchorage)	Structural Support
Crane/Hoist (Monorail and Trolley Beams/Lifting Devices/Plates)	Structural Support
Crane/Hoist (Rail System)	Structural Support

The aging management review results for these components are provided in:

Table 3.3.2-9 Cranes and Hoists
Summary of Aging Management Evaluation

2.3.3.10 Demineralized Water System

Description

The Demineralized Water System is a normally operating, mechanical system designed to produce high purity water for various uses throughout the station. The Demineralized Water System consists of the following plant systems: the makeup demineralizer system and the well water system. The Demineralized Water System is in scope for license renewal. However, portions of the Demineralized Water System are not required to perform intended functions and are not in scope.

The purpose of the Demineralized Water System is to provide a source of high purity, deaerated, demineralized water for the following purposes; condensate makeup, auxiliary steam boiler makeup, primary and secondary process sampling makeup, chemical feed and handling makeup, waste disposal system, reactor coolant makeup, decanting and drumming station, boric acid processing, component cooling, chemical and volume control and boron thermal regeneration, plant chilled water system, and potable water system. The Demineralized Water System accomplishes this purpose by processing water from the deep wells through filters and demineralizers and transporting the demineralized water to the end user systems.

Portions of the Demineralized Water System perform a primary containment boundary function. The Demineralized Water System accomplishes this function through the use of safety-related piping and valves that ensure primary containment integrity.

At Byron only, portions of the Demineralized Water System support the Service Water System in providing heat removal from safety-related equipment. The deep well pumps and associated piping and valves provide makeup water to the Essential Service Water Cooling Tower basins in the event the essential service water makeup pumps in the River Screen House are unavailable.

Not included in the scope of license renewal are the demineralizer trains located in the makeup demineralizer building and the distribution piping in the turbine building. These portions of the system do not have potential for spatial interaction with safety-related SSCs and are, therefore, not in scope.

For more detailed information, see UFSAR Section 9.2.3.

Boundary

The Byron Station Demineralized Water System license renewal scoping boundary begins at the two (2) station deep wells and continues through three (3) parallel sand filters to the filtered water storage tank.

The Braidwood Station Demineralized Water System license renewal scoping boundary begins at the deep well and continues to the well water storage tank. From the well water storage tank, the Braidwood Station Demineralized Water System continues through two (2) parallel booster pumps, three (3) parallel carbon filters, a single pass reverse osmosis unit, and an ANF filter to the filtered water storage tank.

The Demineralized Water System license renewal scoping boundary at both Byron Station and Braidwood Station continues from the filtered water storage tanks through three (3) parallel transfer pumps to two (2) parallel demineralizer trains. The Demineralized Water System terminates at the makeup headers for the condensate storage tanks and the primary water storage tanks. The condensate storage tanks are evaluated with the Main Condensate and Feedwater System. The primary water storage tanks are evaluated with the Chemical & Volume Control System.

Also included in the Demineralized Water System license renewal scoping boundary is the demineralized water supply piping and components which distributes demineralized water to end user systems throughout the power block. The Demineralized Water System license renewal scoping boundary begins at the condenser hotwell makeup supply header and continues through the demineralized flushing water pumps and distribution piping and terminates at the various demineralized water end user systems and components located in the Auxiliary Building, Containment Structure, Fuel Handling Building, and Turbine Building Complex.

All associated piping, components, and instrumentation contained within the flow path described above are included in the system evaluation boundary.

Also included in the license renewal scoping boundary of the Demineralized Water System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the system located within the Auxiliary Building, Containment Structure, and Fuel Handling Building. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included in the scope of license renewal are the portions of the Demineralized Water System located within the makeup demineralizer building, the turbine building, or located outdoors, as these portions of the system are not located within an area in proximity of components performing a safety-related function. Components that are not required to support the system's leakage boundary intended function and do not perform or support system intended functions are not included in the scope of license renewal. This includes the filtered water storage tank, the demineralizer trains and supply piping to the condensate storage tanks and primary water storage tanks. Also not included within the scope of license renewal is the demineralized water supply piping from the condenser hotwell makeup supply header up to the point where the piping enters the Auxiliary Building.

At Byron only, the deep well pumps and associated piping and valves that supply makeup water to the Essential Service Water Cooling Towers are in scope for license renewal. However, the well water supply line to the demineralizer trains does not perform or support system intended functions and is not included in the scope of license renewal. The portion of the Demineralized Water System that supplies water to the demineralizer trains can be isolated from the in scope portion of the system at the deep well pump discharge header isolation valve.

Reason for Scope Determination

The Demineralized Water System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Demineralized Water System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Demineralized Water System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Demineralized Water System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provide primary containment boundary. The Demineralized Water System includes qualified piping and valves that ensure primary containment integrity. 10 CFR 54.4(a)(1)

2. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Demineralized Water System includes nonsafety-related deep well pumps that functionally support the safety-related function of the Essential Service Water Cooling Towers at Byron Station only by providing a make up water supply to the basins if the safety-related service water makeup pumps are unavailable. The Demineralized Water System also contains nonsafety-related water filled lines in the Auxiliary Building, Containment Structure, and Fuel Handling Building that have the potential for spatial interaction with safety-related SSCs. 10 CFR 54.4(a)(2)

3. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Demineralized Water System includes containment isolation check valves that are included in the scope of the environmental qualification program. 10 CFR 54.4(a)(3)

UFSAR References

7.3.1.1.6
9.2.3
9.2.4
10.4.2.

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-49, Sheet 1A
LR-BYR-M-66, Sheet 4A
LR-BYR-M-118, Sheet 4

Byron Unit 2:
LR-BYR-M-49, Sheet 1B
LR-BYR-M-66, Sheet 4B
LR-BYR-M-118, Sheet 6

Byron Common:
LR-BYR-M-42, Sheet 6
LR-BYR-M-64, Sheet 8
LR-BYR-M-65, Sheet 2B
LR-BYR-M-68, Sheet 2
LR-BYR-M-83, Sheet 1
LR-BYR-M-118, Sheet 1, 8
LR-BYR-M-128, Sheet 2

Braidwood Unit 1:
LR-BRW-M-49, Sheet 1A
LR-BRW-M-66, Sheet 4A
LR-BRW-M-118, Sheet 4

Braidwood Unit 2:
LR-BRW-M-49, Sheet 1B
LR-BRW-M-66, Sheet 4B
LR-BRW-M-118, Sheet 6

Braidwood Common:
LR-BRW-M-64, Sheet 8
LR-BRW-M-65, Sheet 2B
LR-BRW-M-68, Sheet 2
LR-BRW-M-118, Sheet 1, 8
LR-BRW-M-128, Sheet 2

Table 2.3.3-10 Demineralized Water System Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Flow Device - (Byron only)	Pressure Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
Pump Casing (Deep Well - Byron only)	Pressure Boundary
Pump Casing (Laundry Hot Water Tank - Braidwood only)	Leakage Boundary
Strainer Body	Leakage Boundary
Strainer Element - (Byron only)	Filter
Tanks (Laundry Hot Water Tank - Braidwood only)	Leakage Boundary
Valve Body	Leakage Boundary
	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.3.2-10 Demineralized Water System
Summary of Aging Management Evaluation

2.3.3.11 Emergency Diesel Generator & Auxiliaries System

Description

The Emergency Diesel Generator & Auxiliaries System is a standby, mechanical system designed to supply electrical power to key plant components when normal offsite power sources are not available. The Emergency Diesel Generator & Auxiliaries System consists of the diesel generator plant system. The diesel subsystems that support system operation include fuel oil, lubricating oil, combustion air and exhaust, jacket water cooling, starting air, and the pneumatic protection system. The Emergency Diesel Generator & Auxiliaries System is in scope for license renewal. However, portions of the Emergency Diesel Generator & Auxiliaries System are not required to perform intended functions and are not in scope.

The purpose of the Emergency Diesel Generator & Auxiliaries System is to provide an independent emergency source of power in the event of a complete loss of offsite power. The diesel generator supplies all of the electrical loads which are required for reactor safe shutdown either with or without a loss of coolant accident.

The Emergency Diesel Generator & Auxiliaries System accomplishes this purpose utilizing diesel engines to drive generators that are directly attached. When the diesel generator output breaker is closed, the generator is connected to a 4160 volt Engineered Safety Feature (ESF) bus which supports required electrical loads. There are two (2) diesel generators per unit, each capable of generating 5500 kw at a power factor of 0.8. Various subsystems support the operation of the diesels and are described below.

The engine-mounted fuel oil subsystem provides fuel to each of the twenty (20) cylinders making up a single diesel engine. One high pressure fuel injection pump per cylinder delivers fuel to the injector on the cylinder head which sprays fuel into the cylinder for combustion. A single engine driven fuel pump transfers fuel from the day tank to the inlet of each fuel injection pump. The source of fuel to each diesel is provided by the Fuel Oil System which contains various tanks and fuel transfer pumps that provide fuel to each engine for a minimum of 7 days of operation without offsite support.

The lubricating oil subsystem is completely self-contained on the skid. Each engine sump contains approximately 1260 gallons of oil. The primary purpose of the lubricating oil system is to cool the pistons and to lubricate and cool the bearings and other moving parts. Other functions performed are to keep the engine warm to enhance immediate start-up and keeping the engines internals free of corrosion. When the diesel is in service, an engine driven oil pump circulates oil through the engine and the lube oil coolers. When the diesel is in standby, a motor driven oil pump with a heater circulates oil to maintain optimal engine temperatures for fast start capability.

The combustion air and exhaust subsystem provides a source of air to support fuel combustion. Outside air is drawn in through a filter, a silencer, and an overspeed isolation valve and is delivered to the inlet of the turbocharger which increases the air pressure. Air temperature is reduced by intercoolers prior to entering the cylinders to improve overall engine performance. Exhausted combustion gases are used to drive the turbocharger, and are discharged through a silencer to the environment.

The primary purpose of the jacket water cooling subsystem is to transfer heat from the engine cylinders, lubricating oil, combustion air, and the fuel oil systems to the Service Water System. An engine driven pump circulates water through two jacket water heat exchangers connected in series that serve to transfer heat to the essential service water system. Another function of the jacket water system is to circulate warm water through the engine when in standby to ensure fast start capability. This is accomplished using a motor driven pump with a heater.

The starting air subsystem provides the motive force to rotate the engine and accelerate it to support combustion, an air source for the pneumatic protection system, and supply air to the turning gear motor. The system relies on two (2) air receivers to provide a source of compressed air. Each receiver is maintained within a specific pressure band by a separate skid mounted air compressor.

The pneumatic protection subsystem provides the logic to shutdown the engine in the event a protection feature (e.g. low oil pressure, overspeed) is tripped, or when the operator manually shuts down the engine by selecting the stop button. The pneumatic protection system works in conjunction with the electrical protection circuits to secure the engine and open the generator output breaker.

Not included in the scope of license renewal for the Emergency Diesel Generator & Auxiliaries System is the security diesel generator, which provides power to the Low Voltage Auxiliary Power System. This portion of the Emergency Diesel Generator & Auxiliaries System is not required to support any license renewal intended functions, is not safety-related, is not located within an area in proximity of components performing safety-related functions, and is not relied upon to support regulated events described in 10 CFR 54.4 (a)(3).

For more detailed information, see UFSAR Section 8.3.1.

Boundary

The Emergency Diesel Generator & Auxiliaries System scoping boundary encompasses the diesel engines and includes the fuel delivery, lubricating oil, combustion air and exhaust, jacket water, starting air and pneumatic protection subsystems.

The fuel oil subsystem begins at the piping system immediately upstream from the engine mounted strainers located at the suction of the engine driven primary booster fuel oil pump. It continues through the fuel filters, the fuel supply headers, to the injector pumps. Unused fuel is returned back to the Fuel Oil System day tanks through two separate drain lines. The path ends where the return lines leave the engine skid.

The lubricating oil subsystem begins at the engine sump where return oil collects. During engine operations oil pressure is increased by the engine driven oil pump and discharged through a piping system that contains a thermostatically-controlled three way valve. Based on oil temperature a portion of the oil is sent through a pair of series mounted lube oil heat exchangers where jacket water is the cooling medium. The oil flow paths are recombined and oil is passed through a skid mounted filter and strainer. It continues to the engine block where the majority of oil goes directly to engine bearings and pistons. A small portion is filtered further, then provided to the turbocharger bearings where tolerances are much smaller. Oil from the various bearings is returned to the engine sump to complete the cycle. Additionally, when in a standby condition, oil is circulated by a motor driven, skid mounted oil pump. This flow path begins at the sump, through the motor driven pump, bypassing the engine driven pump, then discharging into the inlet of the thermostatically-controlled three way valve. The flow path is then the same as the engine driven oil pump arrangement. Also part of the system scoping boundary is the crankcase vent used to remove oil vapors that collect in the engine oil sump area. The flow path starts at the engine with the pipe ending at the exterior wall of the Auxiliary Building.

The combustion air and exhaust subsystem begins at the air intake located in the Auxiliary Building structure. Incoming air is filtered, passed through a silencer for noise reduction, an inlet butterfly valve and supplied to the inlet of the turbocharger. Air continues through the engine mounted turbocharger, a pair of intercoolers then into the engine intake manifolds. As the various intake valves open on each of the cylinders, the air is forced into the combustion chambers. Once fuel is burned, exhaust gases are released to the exhaust manifold where it then flows through the turbocharger serving as the driving gas. The exhaust gases flow through the exhaust silencer, and then are released to the environment through the exhaust pipe located above the auxiliary building roof.

The jacket water subsystem begins at the skid mounted jacket water standpipe that serves as a reservoir, a deaerator, and an expansion tank for the system. During engine operations, water flows from the standpipe to the suction of the engine driven circulating water pump, through a thermostatically-controlled three way valve to a pair of series mounted heat exchangers which are cooled by essential service water. The jacket water coolant then passes through the combustion air intercoolers, the lube oil coolers, and then to the turbocharger and ends at the engine proper. Water discharged from the engine returns to the standpipe to complete the cycle. Additionally, when the engine is in a standby condition, a second flow path is used. Water is taken from the standpipe and is pumped by a motor driven pump, through a heater and then to the engine which includes the combustion air heaters that are part of the combustion air intercoolers. Water leaving the engine is returned to the standpipe.

The starting air subsystem begins at the compressors and continues through the dryers to the air receivers. The flow path ends at the connection point to the air start valves located on the engine. Each engine has two (2) separate air compressors, dryers, and receivers.

The pneumatic protection subsystem begins at the air inlet header supplied from the starting air headers. It continues through a piping system which is connected to various pneumatic devices that actuate based on abnormal engine conditions. The system ends at the fuel control cylinder which is pneumatically actuated to set the injector pumps to a "no fuel" position in response to the protection system regardless of the control system demand signal.

All associated piping, components, and instrumentation contained within the flow path described above are included in the system evaluation boundary.

Also included in the license renewal scoping boundary of the Emergency Diesel Generator & Auxiliaries System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. Included in this boundary are components relied upon to preserve the structural support intended function. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Reason for Scope Determination

The Emergency Diesel Generator & Auxiliaries System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Emergency Diesel Generator & Auxiliaries System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Emergency Diesel Generator & Auxiliaries System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48) and Station Blackout (10 CFR 50.63). The Emergency Diesel Generator & Auxiliaries System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provide power to safety-related components. The Emergency Diesel Generator & Auxiliaries System is required to power safety-related equipment in the event normal power supplies are not available. 10 CFR 54.4(a)(1)

2. Resists nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The starting air system includes nonsafety-related piping that is in scope to provide a seismic anchor credited for structural support of safety-related piping. Portions of the lube oil system drain piping, which are nonsafety-related, are located within the Auxiliary Building, which creates the potential for spatial interactions (spray or leakage) with safety-related SSCs. 10 CFR 54.4(a)(2)

3. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The diesel generators are credited for support of Fire Safe Shutdown providing essential electrical support. 10 CFR 54.4(a)(3)

4. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). The diesel generators provide an Alternate AC source (AAC) from the non-blacked out unit. Provides for AC power recovery from onsite sources on the blacked out unit. 10 CFR 54.4(a)(3)

UFSAR References

7.3.1.1.10
8.3.1.
9.4.5.2
9.5.4
9.5.5
9.5.6
9.5.7
9.5.8

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-50, Sheet 1C, 1D
LR-BYR-M-54, Sheet 4A
LR-BYR-M-97, Sheet 1

Byron Unit 2:
LR-BYR-M-54, Sheet 4B
LR-BYR-M-98, Sheet 1
LR-BYR-M-130, Sheet 1A, 1B, 2

Byron Common:
LR-BYR-M-49, Sheet 1A, 1B
LR-BYR-M-152, Sheet 9, 10, 14, 15, 16, 17, 20, 20A

Braidwood Unit 1:
LR-BRW-M-50, Sheet 1C, 1D
LR-BRW-M-54, Sheet 4A
LR-BRW-M-97, Sheet 1

Braidwood Unit 2:
LR-BRW-M-54, Sheet 4B
LR-BRW-M-98, Sheet 1
LR-BRW-M-130, Sheet 1A, 1B, 2

Braidwood Common:
LR-BRW-M-49, Sheet 1A, 1B
LR-BRW-M-152, Sheet 9, 10, 14, 15, 16, 17, 20, 20A

Table 2.3.3-11 Emergency Diesel Generator & Auxiliaries System Components Subject to Aging Management Review

Component Type	Intended Function
Accumulator	Pressure Boundary
Bolting	Mechanical Closure
Compressor Housing (Starting Air)	Structural Support
Electric Heaters	Pressure Boundary
Filter Housing	Pressure Boundary
	Structural Support
Heat Exchanger - (EDG Fuel Oil Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (EDG Fuel Oil Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (EDG Fuel Oil Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (EDG Fuel Oil Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (EDG Governor Oil Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (EDG Governor Oil Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (EDG Governor Oil Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (EDG Heater/Intercooler) Fins	Heat Transfer
Heat Exchanger - (EDG Heater/Intercooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (EDG Heater/Intercooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (EDG Heater/Intercooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (EDG Heater/Intercooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (EDG Jacket Water Upper/Lower Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (EDG Jacket Water Upper/Lower Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (EDG Jacket Water Upper/Lower Cooler) Tubes	Heat Transfer
	Pressure Boundary

Component Type	Intended Function
Heat Exchanger - (EDG Lube Oil Upper/Lower Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (EDG Lube Oil Upper/Lower Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (EDG Lube Oil Upper/Lower Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (EDG Lube Oil Upper/Lower Cooler) Tubes	Heat Transfer
	Pressure Boundary
Piping Element	Pressure Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
	Structural Support
Pump Casing (Fuel Oil Engine Driven)	Pressure Boundary
Pump Casing (Jacket Water Engine Driven)	Pressure Boundary
Pump Casing (Jacket Water Motor Driven)	Pressure Boundary
Pump Casing (Lube Oil Engine Driven)	Pressure Boundary
Pump Casing (Lube Oil Motor Driven)	Pressure Boundary
Restricting Orifice	Pressure Boundary
	Throttle
Silencer/Muffler	Pressure Boundary
Strainer Body	Pressure Boundary
Strainer Element	Filter
Turbocharger Casing	Heat Transfer
	Pressure Boundary
Valve Body	Leakage Boundary
	Pressure Boundary
	Structural Support

The aging management review results for these components are provided in:

Table 3.3.2-11	Emergency Diesel Generator & Auxiliaries System Summary of Aging Management Evaluation

2.3.3.12 Fire Protection System

Description

The Fire Protection System is a standby, mechanical system designed for the rapid detection and suppression of a fire at the plant. The Fire Protection System consists of the following plant systems: fire protection & detection system, Halon system, and portions of the carbon dioxide system. In addition, the fire barrier function of structures and structural components (e.g., walls, floors, penetration seals, doors, fuel oil storage tank berm) is evaluated with the Fire Protection System. The Fire Protection System is in scope for license renewal. However, portions of the Fire Protection System are not required to perform intended functions and are not in scope.

The Fire Protection System consists of the fire protection water supply subsystem, deluge subsystems, sprinkler subsystems, foam subsystems, Halon subsystems, carbon dioxide subsystems, fire detection subsystem, and manual fire extinguishing features. These subsystems work in conjunction with the physical plant design features to provide overall protection for Byron and Braidwood Stations. The physical plant features consist of fire barriers, fire doors, fire rated enclosures, and combustible fluid retaining barriers (i.e., curbs and the fuel oil storage tank berm).

The purpose of the Fire Protection System is to prevent fires from starting, promptly detect and suppress fires to limit damage, and in the event of a fire, to allow for safe shutdown to occur. The Fire Protection System accomplishes this purpose by providing fire protection equipment in the form of detectors, alarms, fire barriers, and suppression systems for selected areas of the plant.

Water Supply Subsystem:
The purpose of the fire protection water supply subsystem is to provide a source of water to automatic and manual water based fire suppression subsystems located throughout the plant including; hose stations, deluge subsystems, sprinkler subsystems, and foam subsystems. The fire protection water supply subsystem accomplishes this purpose through the use of pumps, piping, and valves which allow fire water to be distributed throughout the site to the various fire suppression subsystems.

The fire protection water supply subsystem is a direct pumping system with pumps taking suction from the circulating water intake flume at Byron Station or the cooling lake at Braidwood Station. The Fire Protection System is normally kept pressurized by one of the two motor-driven fire protection jockey pumps. If system demand occurs, the system pressure will decrease initiating the automatic start of the motor-driven fire pump. If system demand exceeds the capability of the motor-driven fire pump or in the event of a pump failure, the diesel-driven fire pump will automatically start. The motor-driven fire pump, diesel-driven fire pump, and jockey pumps are located in the circulating water pump house at Byron Station and the lake screen house at Braidwood Station.

The fire pumps at Byron and Braidwood Stations supply the outdoor ring header. The outdoor ring header encircles the entire plant with fire hydrants strategically located approximately 250 feet apart. The fire water enters the power block at several locations from branch headers off the main outdoor ring header. The outdoor ring header also supplies fire water to remote structures away from the power block. Sectionalizing valves of the post indicator type are provided on the outdoor ring header to allow isolation of the various sections for maintenance.

The outdoor ring header supplies the fire suppression water source for the Turbine Building Complex ring header from both the Unit 1 and Unit 2 sides. The Auxiliary Building ring header is fed from the outdoor ring header through the Fuel Handling Building or through cross connections with the Turbine Building Complex ring header. The Containment Structure fire suppression water is fed from the Auxiliary Building ring header. In addition, in the event that both the motor-driven fire pump and the diesel-driven fire pump are unavailable, water can be supplied via the safety-related cross-tie with the Service Water System.

Deluge Subsystems:
The purpose of the deluge subsystems is to discharge water, upon actuation, to provide fire suppression capability, especially in areas where fire spread is likely to be rapid. The deluge subsystems accomplish this purpose through piping, valves, and nozzles which allow large areas to be wetted down at once when a fire is detected. The deluge subsystems provide fire suppression capability to the main, unit auxiliary, and system auxiliary transformers, hydrogen seal oil units, turbine oil reservoir areas, turbine bearings, and various charcoal filters in safety related ventilation systems. Water is supplied to these deluge subsystems via the Turbine Building Complex ring header or the Auxiliary Building ring header. In addition, preaction sprinkler subsystems supplied from the Turbine Building Complex ring header are provided for the main turbine bearings.

Sprinkler Subsystems:
The purpose of the sprinkler subsystems is to provide automatic fire suppression capability to various fire areas throughout the plant. The subsystem accomplishes this purpose through piping and valves from the fire water supply subsystem to sprinkler heads with closure links designed to melt at various temperatures allowing for automatic actuation. The sprinkler subsystems provide fire suppression capability in most areas of the Turbine Building Complex and in other areas where a significant fire hazard exists, such as the component cooling pump areas and the waste oil tank area in the Auxiliary Building. Water supply for the sprinkler subsystems is provided from the Turbine Building Complex ring header. Operation of the sprinkler subsystems is fully automatic.

Foam Subsystems:
The purpose of the foam subsystems is to provide fire suppression capability to the diesel oil storage tanks. The subsystem accomplishes this purpose by utilizing tanks, piping, valves, and nozzles to mix a protein foam concentrate with fire water from the fire water supply subsystem and expand the mixture in a foam-maker chamber for injection into the hazard area. Manual foam subsystems are provided for the 50,000 gallon diesel oil storage tank rooms in the Auxiliary Building at both Byron and Braidwood Stations. The fire water to the foam subsystems is supplied from the Turbine Building Complex ring header. When actuated, the foam subsystems spray fire suppression foam into the diesel oil storage tank rooms.

Halon Subsystems:
The purpose of the Halon subsystem is to provide fire suppression capability in areas where water suppression systems cannot be used. The subsystem accomplishes this purpose by utilizing Halon storage cylinders, piping, valves, and nozzles to deliver the Halon gas to the fire hazard area. Fire suppression for the upper cable spreading room and the QA vault is provided by the automatic Halon subsystems. Actuation of the Halon subsystems for the QA vault is provided by ionization detectors. The Halon subsystem serving the upper cable

spreading room requires signals from both ionization detectors and thermal detectors to actuate. Halon systems have been selected for fire suppression in these areas due to distance from the carbon dioxide storage tank, protection of equipment from water damage, or personnel protection. Following automatic activation of the Halon subsystems, a solenoid valve releases Halon from a storage cylinder into the manifold header. The Halon gas is then discharged through the distribution nozzles onto the fire.

Carbon Dioxide Subsystems:
The purpose of the carbon dioxide subsystems is to provide fire suppression capability to areas where equipment damage would occur should a water based fire suppression system be used. The subsystem accomplishes this purpose by utilizing distribution piping, valves, and nozzles to allow carbon dioxide gas to be transported from the carbon dioxide storage tank to the various fire hazard areas. The carbon dioxide fire suppression subsystem is supplied from a refrigerated 10-ton carbon dioxide storage tank. A single carbon dioxide storage tank, located in the turbine building, supplies carbon dioxide to both units for fire suppression and for main generator hydrogen purging. The portion of the carbon dioxide system that supports the main generator is evaluated with the Main Generator and Auxiliaries System. Actuation of the carbon dioxide subsystem is achieved manually by local pushbuttons or automatically by rate compensated detectors in areas other than cable spreading and cable tunnel areas, and by both ionization and compensated detectors in the cable spreading and cable tunnel areas. Upon actuation, the 10 ton carbon dioxide storage tank supplies carbon dioxide through the master selector valve to the four inch distribution headers and area selector valves. The distribution header provides a flow path to the various fire areas protected by the carbon dioxide subsystem. At Byron Station there is a second carbon dioxide subsystem, including a 2-ton carbon dioxide storage tank, serving the River Screen House. The features of this subsystem are identical to the main carbon dioxide system except that the distribution header, gate valves, master valves, and selector valves are three inch.

Fire Detection Subsystem:
The purpose of the fire detection subsystem is to detect fires, actuate fire protection equipment, inform the main control room of fire location, activate local fire alarms, and monitor status of fire protection components. The subsystem accomplishes this purpose by utilizing ionization, ultraviolet, and thermal detectors to detect fires and activate the fire suppression subsystems.

Manual Fire Extinguishing Features:
The purpose of the manual fire extinguishing features is to allow for manual fire fighting capability throughout the plant. The purpose is accomplished through strategically placed hose stations and portable extinguishers located throughout the site.

Portions of the Fire Protection System perform a primary containment boundary function. The Fire Protection System accomplishes this function through the use of qualified piping and valves that ensure primary containment integrity.

Portions of the Fire Protection system support the Spent Fuel Cooling System in ensuring spent fuel stored in the spent fuel pool remains within acceptable temperature limits. The Fire Protection System includes seismically qualified piping and components in the Auxiliary Building and Fuel Handling Building, including a cross-tie with the safety-related Service Water System, which can be used to provide a make-up water supply source to the spent fuel pool.

For more detailed information, see UFSAR Section 9.5.1.

Boundary

The license renewal scoping boundary of the Fire Protection System consists of the fire water systems, Halon systems, and carbon dioxide system, as follows:

Fire Water Systems:
The fire water systems include the water supply subsystem, the deluge subsystems, the sprinkler subsystems, and the foam subsystems. The water supply system scoping boundary begins at the intake to the motor-driven and diesel-driven fire pumps and the motor driven jockey pumps located in the Circulating Water Pump House at Byron Station and the Lake Screen Structures at Braidwood Station. The system flowpath continues to the outdoor ring header which supplies fire suppression water to deluge, sprinkler, foam, and manual fire suppression features throughout the site, including to remote structures away from the power block. The water supply system boundary continues from the outdoor ring header to the Turbine Building Complex ring header. The outdoor ring header also supplies the Fuel Handling Building and Radwaste and Service Building Complex fire water headers. The Turbine Building Complex ring header terminates at the various water based fire suppression subsystems throughout the Turbine Building Complex, the cross-ties to the Auxiliary Building ring header, and the nonessential service water system. The Auxiliary Building ring header is also supplied from the Fuel Handling Building fire water header. The Auxiliary Building ring header terminates at the various water based fire suppression subsystems throughout the Auxiliary Building, the fire water headers supplying the Containment Structures and the Fuel Handling Building, and the cross-tie to the essential service water system. The Containment Structure and Fuel Handling Building water supply systems terminate at the various water based fire suppression subsystems throughout these structures.

Halon Subsystems:
There are two separate Halon fire suppression subsystems at Byron and Braidwood Stations. One subsystem protects the upper cable spreading room and the other subsystem protects the QA vault. The scoping boundary for both Halon subsystems begins at the Halon storage cylinders. The Halon subsystem boundary continues through the cylinder manifold and deluge valve to the discharge piping and valves. The Halon subsystem scoping boundary terminates at the distribution nozzles.

Carbon Dioxide Subsystems:
The carbon dioxide subsystem scoping boundary begins at the 10-ton carbon dioxide storage tank, located in the turbine building. The subsystem scoping boundary continues through the carbon dioxide supply header to the various fire areas served by the subsystem. The subsystem terminates at the distribution nozzles located in the fire areas served by the carbon dioxide fire suppression subsystem. At Byron Station there is a second carbon dioxide subsystem providing fire suppression capability to the River Screen House. The system scoping boundary of the Byron Station River Screen House carbon dioxide subsystem begins at the 2-ton carbon dioxide storage tank and continues through the supply header terminating at the distribution nozzles located in the fire areas served by this subsystem.

All associated piping, components, and instrumentation contained within the flow path described above are included in the system evaluation boundary.

Portable fire extinguishers are also included within the scoping boundary of this license renewal system, however, a flow path description is not applicable for this self-contained portable equipment. Portable fire extinguishers are provided in accordance with NML, NFPA

10, and OSHA regulations and recommendations. These extinguishers are routinely inspected and replaced by station procedures and are, therefore, not subject to aging management review.

The racks, reels, and supports that make up the hose stations are also included within the scoping boundary of the Fire Protection System. These components are required to provide structural support of fire suppression equipment to demonstrate compliance with fire protection requirements. Hoses are considered consumables and are, therefore, not subject to aging management review.

Also included within the scoping boundary of the Fire Protection System are the physical plant design features that consist of fire barrier walls and slabs, fire barriers, fire doors, fire rated enclosures, and combustible fluid retaining barriers located in structures within the scope of license renewal. These structures include: the Auxiliary Building, Circulating Water Pump House (Byron only), Containment Structure, Fuel Handling Building, Lake Screen Structures (Braidwood only), Turbine Building Complex, Radwaste and Service Building Complex, and River Screen House (Byron only). In addition, since the earthen berm that surrounds the fuel oil storage tanks prevents the spread of combustible fluid, the fire barrier function of this structure is included within the scoping boundary of the Fire Protection System. The fire barrier function of all fire damper housings is evaluated with the Fire Protection System for license renewal aging management review. The pressure boundary function of fire damper housings, if applicable, is evaluated with the appropriate ventilation system.

Not included within the Fire Protection System scoping boundary are the fire detection and signaling and associated circuitry. The fire detection and signaling and associated circuitry are evaluated separately as electrical commodities.

Not included within the Fire Protection System scoping boundary are the diesel oil storage tank and supply piping to the diesel-driven fire pump diesel engine. The diesel oil storage tank and associated supply piping up to diesel engine are evaluated with the Fuel Oil System.

Not included within the Fire Protection System scoping boundary are the reactor coolant pump oil collection systems. The reactor coolant pump oil collection systems are evaluated with the Radioactive Drain System.

Also included in the license renewal scoping boundary of the Fire Protection System are those water filled portions of nonsafety-related piping and equipment located in proximity to equipment performing a safety-related function. This includes the nonsafety-related portions of the system drains located within the Auxiliary Building and Containment Structure. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included within the scope of license renewal is the fire protection equipment located in areas that do not contain safety-related equipment or equipment required for safe shutdown. This includes fire protection features in the Containment Access Facilities, Electrical/Instrument Maintenance Building, FIN Team/Records Management Vault Building (Braidwood), Contractors Facility (Byron), Receiving Building, Receiving Building Warehouse, Security Gatehouse, Training Facilities, and Waste Treatment Building. These areas do not contain safety-related components and are not required to perform or support system intended functions of the Fire Protection System. Therefore, these portions of the Fire Protection System are not included in the scope of license renewal.

Reason for Scope Determination

The Fire Protection System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Fire Protection System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Fire Protection System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48) and Environmental Qualification (10 CFR 50.49). The Fire Protection System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provide primary containment boundary. The Fire Protection System includes isolation valves that provide containment isolation capability. 10 CFR 54.4(a)(1)

2. Ensure adequate cooling in the spent fuel pool to maintain stored fuel within acceptable temperature limits. The Fire Protection System provides a safety-related backup source of unborated water to the spent fuel pool utilizing a cross-tie to the essential service water system. 10 CFR 54.4(a)(1)

3. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. Nonsafety-related piping and components containing water and located in proximity to equipment that performs safety-related functions is required to maintain leakage boundary integrity to preclude spatial interaction with safety-related equipment. 10 CFR 54.4(a)(2)

4. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The Fire Protection System works in conjunction with fire barriers and other plant design features, and established safe shutdown systems and procedures to demonstrate compliance with fire protection regulations. The Fire Protection System provides fire detection, alarms, and suppression for vital areas in the plant, to prevent significant release of radioactive material in the event of fire. 10 CFR 54.4(a)(3)

5. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Fire Protection System includes switches and solenoid valves associated with the air operated containment isolation valves and the charcoal filter deluge valves that are included in the scope of the Environmental Qualification Program. 10 CFR 54.4(a)(3)

UFSAR References

3.4.1.2
9.5.1
9.5.4.3
9.5.9
Byron/Braidwood Stations Fire Protection Report (Amendment 24)

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-103, Sheet 3
LR-BYR-M-105, Sheet 1

Byron Unit 2:
LR-BYR-M-104, Sheet 3
LR-BYR-M-106, Sheet 1

Byron Common:
LR-BYR-M-42, Sheet 2B
LR-BYR-M-48, Sheet 35B
LR-BYR-M-50, Sheet 3
LR-BYR-M-52, Sheet 1, 3, 4, 5, 7, 8, 9, 10, 13, 14, 15
LR-BYR-M-58, Sheet 1, 2, 3, 4
LR-BYR-M-94, Sheet 2
LR-BYR-M-95, Sheet 11, 12
LR-BYR-M-96, Sheet 1, 2
LR-BYR-M-113, Sheet 3
LR-BYR-M-114, Sheet 2
LR-BYR-S-01A

Braidwood Unit 1:
LR-BRW-M-103, Sheet 3
LR-BRW-M-105, Sheet 1

Braidwood Unit 2:
LR-BRW-M-104, Sheet 3
LR-BRW-M-106, Sheet 1

Braidwood Common:
LR-BRW-M-42, Sheet 2B
LR-BRW-M-48, Sheet 35B
LR-BRW-M-50, Sheet 3
LR-BRW-M-52, Sheet 1, 3, 4, 5, 7, 8, 9, 10, 13, 14, 15
LR-BRW-M-58, Sheet 1, 2, 4
LR-BRW-M-94, Sheet 2
LR-BRW-M-95, Sheet 11, 12
LR-BRW-M-96, Sheet 1, 2
LR-BRW-M-113, Sheet 3
LR-BRW-M-114, Sheet 2
LR-BRW-S-01A

Table 2.3.3-12 Fire Protection System
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Concrete Curbs	Direct Flow
Damper Housing	Fire Barrier
Doors	Fire Barrier
Earthen water-control structures (Fuel Oil Storage Tank Berm)	Direct Flow
Fire Barriers (Insulation and Wraps)	Fire Barrier
Fire Barriers (Masonry Walls)	Fire Barrier
Fire Barriers (Penetration Seals)	Fire Barrier
Fire Barriers (Structural Steel Fireproofing)	Fire Barrier
Fire Barriers (Walls, Ceilings, and Floors)	Fire Barrier
Fire Hydrant	Pressure Boundary
Gas Bottles (Halon)	Pressure Boundary
Hose Stations (Racks, Reels, and Supports)	Structural Support
Odorizer	Pressure Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
Pump Casing (Jockey Pump)	Pressure Boundary
Pump Casing (Motor and Diesel Driven Fire Pumps)	Pressure Boundary
Restricting Orifice	Pressure Boundary
	Throttle
Silencer/Muffler	Pressure Boundary
Spray Nozzles (Carbon Dioxide)	Spray
Spray Nozzles (Charcoal Filters)	Spray
Spray Nozzles (Deluge)	Spray
Spray Nozzles (Halon)	Spray
Sprinkler Heads	Pressure Boundary
	Spray
Strainer Body	Pressure Boundary
Strainer Element	Filter
Tanks (10 Ton Carbon Dioxide)	Pressure Boundary
Tanks (2 Ton Carbon Dioxide)	Pressure Boundary
Tanks (Foam Concentrate Storage)	Pressure Boundary
Tanks (Retard Chamber)	Pressure Boundary
Valve Body	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.3.2-12 Fire Protection System
Summary of Aging Management Evaluation

2.3.3.13 Fresh Water System

Description

The intended function of the Fresh Water System for license renewal is to maintain leakage boundary integrity to preclude system interactions. For this reason, this system's pressure-retaining components located in proximity to other components performing safety-related functions have been included in the scope of license renewal. This system is not required to operate to support license renewal intended functions, and is in scope for potential spatial interaction.

The Fresh Water System is a normally operating system designed to supply fresh water for potable, makeup, and sanitary plant water systems. The license renewal Fresh Water System consists of the following plant systems: treated water system at Byron and treated water and raw & potable water systems at Braidwood. The purpose of the system is to supply water in sufficient quantities to satisfy the demand for station potable water, makeup water, safety showers, eye washes, and sanitary water. The Fresh Water System is routed throughout most buildings on site.

The portions of the Fresh Water Supply System that are evaluated for license renewal scope are the components located in structures which contain safety-related components, such as the Auxiliary Building. The Fresh Water System components that are not in scope are the components located in structures, which do not house safety-related components or have safety-related components which are in close proximity to Fresh Water System components, such as the Miscellaneous Not In-Scope Structures, Yard Areas and Turbine Building Complex. The Fresh Water System has no safety-related function.

The Fresh Water System accomplishes its purpose using pumps, valves, piping, piping components, plumbing fixtures, and tanks.

For more detailed information, see UFSAR Section 9.2.4.

Boundary

The Fresh Water System scoping boundary includes the liquid filled portion of the system that is located in proximity to equipment performing a safety-related function. This includes the liquid filled portions of the Fresh Water System located within structures that house safety-related components, such as the Auxiliary Building. Included in this scoping boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this system. For more information, refer to the license renewal boundary drawings for identification of this boundary, shown in red.

Not included in the scope of license renewal is the portion of the Fresh Water System, including pumps and storage tanks, located in structures that do not house safety-related components or have safety-related components which are not in close proximity to Fresh Water System components, such as the Miscellaneous Not In-Scope Structures, Yard Areas, and areas within the Turbine Building Complex. Also not included in the scope of license renewal are components associated with Braidwood plant system “raw and potable water” as these components are not located near any safety-related components or in any structure that house safety-related components. Also not included in the scope of license renewal are Fresh

Water Supply System components located in bathrooms, kitchen areas, and storage rooms in structures that house safety-related components because there are no safety-related components in these rooms. Components that are not required to support the system's leakage boundary intended function are not included in the scope of license renewal.

Reason for Scope Determination

The Fresh Water System is not in scope under 10 CFR 54.4(a)(1) because no portions of the system are safety-related or relied upon to remain functional during and following design basis events. The Fresh Water System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Fresh Water System is not in scope under 10 CFR 54.4(a)(3) because it is not relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Fresh Water System has the potential for spatial interaction (spray or leakage) with safety-related components in structures that house safety-related components. 10 CFR 54.4(a)(2)

UFSAR References

9.2.4

License Renewal Boundary Drawings

Byron Unit 1:
None.

Byron Unit 2:
None.

Byron Common:
LR-BYR-M-49, Sheet 8

Braidwood Unit 1:
None.

Braidwood Unit 2:
None.

Braidwood Common:
LR-BRW-M-49, Sheet 10

Table 2.3.3-13 Fresh Water System
Components Subject to Aging Management Review

Component Type	Intended Function
Piping, piping components, and piping elements	Leakage Boundary
Tanks (Hot Water Tank - Auxiliary Building)	Leakage Boundary
Valve Body	Leakage Boundary

The aging management review results for these components are provided in:

Table 3.3.2-13 Fresh Water System
Summary of Aging Management Evaluation

2.3.3.14 Fuel Handling & Fuel Storage System

Description

The Fuel Handling & Fuel Storage System is a mechanical system designed to manipulate and store new and spent fuel, to control fuel geometry when not in the core, and to move fuel between the reactor core and the spent fuel pool. The Fuel Handling & Fuel Storage System consists of the following plant systems: nuclear fuel handling and transfer and sparging air (inmast sipping equipment). The Fuel Handling & Fuel Storage System is in scope for license renewal. However, portions of the Fuel Handling & Fuel Storage System are not required to perform intended functions and are not in the scope of license renewal.

The purpose of the Fuel Handling & Fuel Storage System is to provide a safe, effective means of storing, transporting and handling fuel from the time it reaches the plant in an unirradiated condition, moved into and out of the reactor core, until it leaves the plant after post-irradiation cooling. The Fuel Handling & Fuel Storage System controls fuel transfer and storage positions to assure a geometrically safe configuration with respect to criticality, ensure adequate shielding of irradiated fuel for plant personnel to accomplish normal operations, prevent mechanical damage to the fuel during fuel moves, prevent mechanical damage to the stored fuel that could result in a significant release of radioactivity from the fuel, and provide means for the safe handling of new and irradiated fuel.

The Fuel Handling & Fuel Storage System accomplishes its purpose by using the refueling machine, the fuel transfer system, the spent fuel bridge crane, the spent fuel storage racks, the new fuel elevator, the new fuel storage racks, the fuel rod storage baskets, the fuel handling building crane, and other special purpose fuel transfer handling tools and equipment to move fuel. The fuel transfer system consists of upending devices, fuel container, transfer cart, and fuel transfer tube. The spent fuel storage racks and the new fuel storage racks are used to safely and securely hold irradiated fuel in the spent fuel pool and new fuel in the new fuel storage area, respectively. The special purpose tools include the spent fuel handling tool, the new fuel handling tool, the irradiated sample handling tool, burnable poison rod assembly handling tool, the thimble plug handling tool, the control rod drive shaft tool, and the portable rod cluster control change tool.

The Fuel Handling & Fuel Storage System is used during fuel movement to, from, or within the reactor vessel or the spent fuel pool, and through the fuel transfer tube to store and move new and spent fuel.

Refueling operations are carried out using the refueling machine which spans the refueling cavity in the Containment Structure. The refueling machine is a rectilinear bridge and trolley system with a vertical mast extending down into the refueling water which is used to transfer fuel within the reactor core and to transfer new and spent fuel between the core and fuel transfer system. The refueling machine is equipped with sipping system hardware to enable the detection of failed fuel assemblies. When desired this equipment is installed and operated during refueling operations. The sipping system hardware consists of suction manifold assemblies, a sparging air system air nozzle manifold, and covers over various mast openings to prevent cross flow. Fuel removed from the reactor core is transported to the spent fuel pool from the Containment Structure through the fuel transfer tube by means of the fuel transfer system.

The fuel transfer system has an upending device at each end of the fuel transfer tube to rotate the fuel container between a vertical position and a horizontal position. The fuel container is rotated to a horizontal position for passage through the fuel transfer tube and then rotated back to a vertical position in the fuel transfer canal or refueling canal for vertical removal or insertion of the fuel assembly. The fuel container is transported by an underwater transfer cart that runs on tracks extending from the refueling canal in the Containment Structure through the fuel transfer tube and into the fuel transfer canal in the Fuel Handling Building. The transfer cart is moved by an electrically-driven cable system. The fuel transfer tube includes an isolation valve on the Fuel Handling Building side and a flanged closure on the Containment Structure side. The isolation valve, fuel transfer tube, Fuel Handling Building penetration sleeve and bellows assembly provide a portion of the Fuel Handling Building leakage boundary. The flanged closure, fuel transfer tube, Containment Structure penetration sleeve, and bellows assembly, with vent and drain valve assemblies for testing integrity, provide a portion of the Containment Structure pressure boundary.

The spent fuel bridge crane is used to transfer fuel assemblies from the fuel transfer canal upending device to the spent fuel pool. Additionally, the spent fuel bridge crane is used to transfer fuel assemblies from the new fuel elevator to the spent fuel storage racks or directly to the fuel transfer canal upending device.

The spent fuel storage racks are located in the spent fuel pool which is separated by a wall with a weir gate, with leak tight seals for isolation of the spent fuel pool from the fuel transfer canal containing the upending device and the fuel transfer tube gate valve. The spent fuel storage racks are made from stainless steel and contain boral, a neutron absorber material. The racks are freestanding structures, which are seismically qualified without depending on neighboring modules or spent fuel pool walls for support. The spent fuel pool is separated from the shipping cask area by a wall with a leak tight gate to allow isolation from the spent fuel pool.

The new fuel elevator is used to lower new fuel into the spent fuel pool and it is also specially designed to support and position fuel assemblies during fuel repairs.

The new fuel storage racks are located in the new fuel storage vault. The new fuel storage racks are normally dry. All surfaces that contact fuel assemblies are stainless steel. The external supporting structure is carbon steel.

The fuel rod storage baskets are designed to accommodate either individual spent or fresh fuel rods in a fixed array of stainless steel tubes. The spacing of the fuel racks and fuel rod storage baskets is designed so as to ensure the reactivity of the fuel rod storage baskets are less than fuel assemblies with the same enrichments as the most limiting fuel rod in the fuel rod storage basket. The fuel rod storage baskets are intended to be used for storage of fuel rods removed from fuel assemblies during reconstitution and are handled and stored just like a fuel assembly.

The fuel handling building crane is located in the Fuel Handling Building and is used to transport new fuel shipping containers to the new fuel unloading area, transport new fuel assemblies from the new fuel unloading area to the new fuel storage vault, transport new fuel assemblies to the new fuel elevator in the spent fuel pool, and transport the spent fuel cask and associated components during dry cask storage operations.

For more detailed information, see UFSAR Section 9.1.

Boundary

Included within the license renewal scoping evaluation boundary of the Fuel Handling & Fuel Storage System are: the vertical mast, auxiliary hoist, and structural support members and components of the refueling machine; the fuel transfer system including the fuel transfer tube along with its flange in the refueling canal, and isolation valve in the fuel transfer canal; two independently operated electrical hoists and structural support members and components of the spent fuel bridge crane; the spent fuel storage racks; the new fuel elevator; the new fuel storage racks; the fuel rod storage baskets; the special purpose tools; and the sparging air system components.

The refueling machine vertical mast and auxiliary hoist are in scope for license renewal because they provide for the safe handling of nuclear fuel. The structural support members and components of the refueling machine are in scope for license renewal because they have the potential to allow physical spatial interaction with safety-related equipment in the Containment Structure and are required to maintain structural integrity during a design basis seismic event.

The fuel transfer tube, associated flange, and local leak rate test vent and drain valves, located in the refueling canal are in scope for license renewal as they provide a portion of the Containment Structure pressure boundary. The fuel transfer tube and its associated isolation valve located in the fuel transfer canal are in scope for license renewal as they provide a portion of the Fuel Handling Building pressure boundary.

The spent fuel bridge crane hoists are in scope for license renewal because they provide for the safe handling of nuclear fuel. The structural support members and components of the spent fuel bridge crane are in scope for license renewal because they have the potential to allow physical spatial interaction with safety-related equipment in the Fuel Handling Building and are required to maintain structural integrity during a design basis seismic event.

The spent fuel storage racks are in scope for license renewal since they perform a safety-related function to maintain fuel storage geometry to prevent criticality.

The new fuel elevator is in scope for license renewal because it provides for the safe handling of nuclear fuel.

The new fuel storage racks are in scope for license renewal since they perform a safety-related function to maintain fuel storage geometry to prevent criticality.

The fuel rod storage baskets are in scope for license renewal since they perform a safety-related function to maintain fuel storage geometry to prevent criticality.

Not included in the Fuel Handling & Fuel Storage System scoping boundary are the refueling cavity, refueling canal, Containment Structure penetration sleeve and associated bellows assembly, Fuel Handling Building penetration sleeve and associated bellows assembly, fuel transfer canal, spent fuel pool, weir gate and seals between the fuel transfer canal and spent fuel pool, new fuel storage vault, shipping cask area, leak tight gate and seals between the spent fuel pool and the shipping cask area, the Containment Structure polar crane, the fuel handling building crane, supports for components and structural members, and spent fuel pool cooling. The refueling cavity, refueling canal, and Containment Structure penetration sleeve and associated bellows assembly are evaluated separately with the Containment Structure.

The Fuel Handling Building penetration sleeve and associated bellows assembly, fuel transfer canal, spent fuel pool, weir gate and seals between the fuel transfer canal and spent fuel pool, new fuel storage vault, the shipping cask area, and the leak tight gate and seals between the spent fuel pool and the shipping cask area are evaluated with the Fuel Handling Building. The Containment Structure polar crane and fuel handling building crane are evaluated with the Cranes and Hoists System. Supports for components and structural members are separately evaluated with the Component Supports Commodity Group. Spent fuel pool cooling is evaluated with the Spent Fuel Cooling System.

Not included in the scope of license renewal are the transfer cart, the fuel container, and the upending devices. A fuel handling accident is defined in the UFSAR as the dropping of a spent fuel assembly onto the spent fuel pool floor or onto the core resulting in the postulated rupture of the cladding of all of the fuel rods in the assembly. Once the fuel bundle is loaded into the fuel container, the conditions do not exist for a fuel handling accident as defined in the UFSAR. The special purpose tools and the sparging air system are also not included in the scope of license renewal. The transfer cart, the fuel container, the upending devices, the special purpose tools and the sparging air system are nonsafety-related components which are not required to perform or support system intended functions, and are, therefore, not included in the scope of license renewal.

Reason for Scope Determination

The Fuel Handling & Fuel Storage System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Fuel Handling & Fuel Storage System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Fuel Handling & Fuel Storage System is not in scope under 10 CFR 54.4(a)(3) because it is not relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provide primary containment boundary. The fuel transfer tube and flanged closure provide a portion of the Containment Structure pressure boundary. 10 CFR 54.4(a)(1)

2. Provides protection for safe storage of new and spent fuel. The new and spent fuel storage racks are classified Seismic Category I, and are designed to maintain subcriticality of the stored fuel. 10 CFR 54.4(a)(1)

3. Ensure adequate cooling in the spent fuel pool to maintain stored fuel within acceptable temperature limits. The fuel storage racks control fuel positions to assure the assemblies are always maintained in a subcritical condition, which facilitates spent fuel cooling. 10 CFR 54.4(a)(1)

4. Prevents criticality of fuel assemblies stored in the spent fuel pool. The spent fuel storage racks are designed to provide for storage of fuel to support and maintain sufficient spacing and physical geometry with boral poison panels to prevent criticality of fuel assemblies stored in the spent fuel pool. 10 CFR 54.4(a)(1)

5. Provides a safe means for handling safety-related components and loads above or near safety-related components. The refueling machine and spent fuel bridge crane are nonsafety-related equipment that operate above or near safety-related components such that their failure could impact the satisfactory accomplishment of a safety related function. 10 CFR 54.4(a)(2)

UFSAR References

6.2.6.2.c
9.1
9.1.1
9.1.2
9.1.4
9.1.5

License Renewal Boundary Drawings

Byron Unit 1:
None.

Byron Unit 2:
None.

Byron Common:
LR-BYR-M-63 Sheet 1A

Braidwood Unit 1:
LR-BRW-M-70 Sheet 1

Braidwood Unit 2:
LR-BRW-M-141 Sheet 1

Braidwood Common:
None.

Table 2.3.3-14 Fuel Handling & Fuel Storage System Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Bolting (Structural)	Structural Support
Crane/Hoist (New Fuel Elevator)	Structural Support
Crane/Hoist (Rail System for Refueling Machine & Spent Fuel Bridge Crane)	Structural Support
Crane/Hoist (Refueling Machine Mast)	Structural Support
Crane/Hoist (Refueling Machine and Spent Fuel Bridge Crane structural support members	Structural Support
Fuel Storage Racks (Fuel Rod Storage Baskets)	Structural Support
Fuel Storage Racks (New Fuel Storage Racks)	Structural Support
Fuel Storage Racks (Spent Fuel Storage Racks)	Absorb Neutrons
	Structural Support
Piping, piping components, and piping elements (Fuel Transfer Tube)	Pressure Boundary
Valve Body	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.3.2-14 Fuel Handling & Fuel Storage System
Summary of Aging Management Evaluation

2.3.3.15 Fuel Oil System

Description

The Fuel Oil System is a normally operating mechanical system designed to receive, store, sample, and condition fuel oil for eventual transfer. The Fuel Oil System consists of the following plant systems: the diesel fuel oil system, the fuel oil system, and the gasoline and diesel oil storage tanks. The Fuel Oil System is in scope for license renewal. However, portions of the Fuel Oil System are not required to perform intended functions and are not in scope.

The purpose of the system is to transfer fuel oil to the following systems: the Emergency Diesel Generator & Auxiliaries System, the Heating Water and Heating Steam System, the Fire Protection System, the Service Water System (Byron only), and the Auxiliary Feedwater System. The Fuel Oil System accomplishes this purpose by providing piping and components necessary to unload fuel oil deliveries and transfer delivered fuel oil to the 125,000 gallon fuel oil storage tank and the 50,000 gallon fuel oil storage tank. The Heating Water and Heating Steam System draw fuel directly from these tanks. The system includes the pumps, strainers, valves, and associated piping and components necessary to distribute the stored fuel oil from these two tanks to separate dedicated storage tanks for each of the following systems: the Emergency Diesel Generator & Auxiliaries System, and the Auxiliary Feedwater System. Fuel Oil for the Fire Protection System and the Service Water System (Byron) is supplied by truck delivery to separate dedicated fuel oil storage tanks.

Of these Fuel Oil System end users, the Emergency Diesel Generator & Auxiliaries System, the Fire Protection System, the Service Water System (Byron only), and the Auxiliary Feedwater System are required to perform license renewal intended functions. The Fuel Oil System provides dedicated fuel storage tanks (independent of the 125,000 gallon and 50,000 gallon fuel oil storage tanks) with sufficient capacity to meet the design basis operating requirements of the emergency diesel generator engines, the auxiliary feedwater diesel driven pump engines, the essential service water diesel driven makeup pump engines (Byron), and the fire protection diesel driven fire pump engine.

The system includes the associated pumps, piping, strainers, valves, and other components necessary to transfer fuel oil from the dedicated storage tanks to the emergency diesel generator engines, auxiliary feedwater diesel driven pump engines, fire protection diesel driven fire pump engine, and essential service water diesel driven makeup pump engines (Byron only). In addition, nonsafety-related portions of the Fuel Oil System located in proximity to components performing safety-related functions have been included in scope for license renewal.

The remaining portions of the Fuel Oil System are not in scope for license renewal. These include the 125,000 gallon and 50,000 gallon fuel oil storage tanks and portions of the system that supply fuel oil to the Heating Water and Heating Steam System and the security diesel generator engine.

Two safety-related emergency diesel generator engines are provided for each unit. Each engine is provided with a 500 gallon fuel oil day tank. At Byron Unit 1 and Braidwood Unit 1 the day tanks are filled from four dedicated 25,000 gallon diesel oil storage tanks (two for each day tank). At Byron Unit 2 and Braidwood Unit 2 the day tanks are filled from two dedicated

50,000 gallon diesel oil storage tanks (one for each day tank). The minimum required fuel oil volume in these dedicated storage tanks ensures sufficient capacity to run each emergency diesel generator engine for seven days during a design basis accident. Procedures are in place to refill these tanks from either onsite or offsite sources to assure continued emergency diesel generator operation beyond seven days.

The auxiliary feedwater diesel driven pump engines (one for each unit) are provided with 500 gallon day tanks. The site fire protection diesel driven fire pump engine is provided with a local 650 gallon storage tank to provide fuel in the event of a fire. At Byron the essential service water diesel driven makeup pump engines are provided with dedicated 2,000 gallon storage tanks.

The security diesel generator engine is provided with a 500 gallon fuel oil tank. The Heating Water and Heating Steam System boiler pumps are supplied directly from the 125,000 gallon and 50,000 gallon fuel oil storage tanks.

For more detailed information, see UFSAR Section 9.5.4.

<u>Boundary</u>

The Fuel Oil System scoping boundary includes the fuel oil fill lines to the diesel generator fuel oil storage tanks, the diesel generator day tanks, and fuel oil supply lines up to, but not including, the diesel generator engines. The scoping boundary also includes the fuel oil fill lines, day tanks, and fuel oil supply lines up to, but not including, the auxiliary feedwater diesel driven pump engines. The scoping boundary also includes the fuel oil fill line, storage tank, and fuel oil supply line up to, but not including, the fire protection diesel driven fire pump engine. Also, for Byron only, the scoping boundary includes the fuel oil fill lines, storage tanks, and fuel oil supply lines up to, but not including the essential service water diesel driven makeup pump engines.

All associated piping, components, and instrumentation contained in the flow path described above are included in the system evaluation boundary.

The Fuel Oil System supports the intended functions of the Emergency Diesel Generator & Auxiliaries System. This portion of the Fuel Oil System scoping boundary begins at the station fuel oil storage tank to diesel oil storage tank filler header isolation valve and includes the four 25,000 gallon fuel oil storage tanks for Unit 1 and two 50,000 gallon diesel fuel oil storage tanks for Unit 2, and attached piping and instrumentation. This includes vent lines, drain lines, and overflow lines. The system continues through the fuel oil transfer pumps to the diesel fuel oil day tanks and associated piping and instrumentation. This includes strainers, vent lines, drain lines, overflow lines, relief valves, and relief valve exhaust lines. The Fuel Oil System scoping boundary continues through the day tank discharge line up to, but not including, the associated diesel engine. Lines which return fuel oil from the diesel engines to the day tanks are also included in the scoping boundary. The diesel generator engines are evaluated as part of the Emergency Diesel Generator & Auxiliaries System.

The Fuel Oil System supports the intended functions of the Auxiliary Feedwater System. This portion of the Fuel Oil System scoping boundary begins at station fuel oil fill line to the auxiliary feedwater diesel driven pump day tank (one for each unit). The system includes the day tank and attached piping and instrumentation. The Fuel Oil System scoping boundary continues through piping and valves up to, but not including, the auxiliary feedwater pump diesel engine.

The system scoping boundary also includes fuel oil day tank drain, vent, and overflow piping; and engine fuel oil return and drain lines. The auxiliary feedwater diesel driven pump engines are evaluated as part of the Auxiliary Feedwater System.

The Fuel Oil System supports the intended functions of the Fire Protection System. This portion of the Fuel Oil System scoping boundary begins at the truck delivery fill connection and continues to the 650 gallon storage tank. The system includes the storage tank attached piping and instrumentation and continues through piping and valves up to, but not including, the fire protection diesel driven fire pump engine. The system scoping boundary also includes fuel oil storage tank drain and vent piping, and engine fuel oil return lines. The fire protection diesel driven fire pump engine is evaluated as part of the Fire Protection System.

At Byron only, the Fuel Oil System supports the intended functions of the Service Water System. This portion of the Fuel Oil System scoping boundary begins at the truck delivery fill connections and continues to two 2,000 gallon storage tanks. The system includes the storage tanks and attached piping and instrumentation. The Fuel Oil System scoping boundary continues through piping and valves up to, but not including, the essential service water diesel driven makeup pump engines. The system flow path also includes fuel oil storage tank drain and vent piping, and engine drain lines. The essential service water diesel driven makeup pump engines are evaluated as part of the Service Water System.

Also included in the license renewal scoping boundary of the Fuel Oil System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the system located within the Auxiliary Building and the River Screen House (Byron). Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Also included in the license renewal scoping boundary of the Fuel Oil System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor. Included in this boundary are components relied upon to preserve the structural support intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included in the scope of license renewal is the portion of the Fuel Oil System associated with fuel oil unloading and storage in the 125,000 gallon fuel oil storage tank and the 50,000 gallon fuel oil storage tank, and fuel oil supply to the Heating Water and Heating Steam System and the security diesel generator, including the engine. These portions of the Fuel Oil System are not required to perform or support system intended functions because they are not safety-related, are not located within an area in proximity of components performing safety-related functions, and do not support regulated events described in 10 CFR 54.4 (a)(3). Fuel Oil System piping and components associated with the 125,000 gallon fuel oil storage tank and the 50,000 gallon fuel oil storage tank, and fuel oil supply to the Heating Water and Heating Steam System and the security diesel generator engine, are normally isolated from in scope portions of the Fuel Oil System by isolation valves.

Reason for Scope Determination

The Fuel Oil System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Fuel Oil System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Fuel Oil System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 48) and Station Blackout (10 CFR 50.63). The Fuel Oil System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provide power to safety-related components. In case of a loss of offsite power, the Fuel Oil System stores and delivers fuel to the Emergency Diesel Generator & Auxiliaries System diesel engines, the auxiliary feedwater diesel driven pump engines, and, at Byron only, the essential service water diesel driven makeup pump engines. 10 CFR 54.4(a)(1)

2. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Fuel Oil system includes nonsafety-related piping and components that contain fuel oil and are located in proximity to equipment that performs safety related functions. These nonsafety-related piping and components are required to maintain leakage boundary integrity to preclude spatial interaction with the safety-related equipment. Also, the Fuel Oil System includes nonsafety-related piping that is directly attached and provides structural support to safety-related piping. 10 CFR 54.4(a)(2)

3. Relied upon in the safety analyses or plant evaluation to perform a function that demonstrates compliance with the Commission’s regulations for Fire Protection (10 CFR 50.48). The Fuel Oil System stores and delivers fuel to the fire protection diesel driven fire pump engine, providing motive power to the fire pump. 10 CFR 54.4(a)(3)

4. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Station Blackout (10 CFR 50.63). The Fuel Oil system stores and delivers fuel to the Emergency Diesel Generator & Auxiliaries System in case of a Station Blackout. 10 CFR 54.4(a)(3)

UFSAR References

8.3.1.1.2
9.2.1.2
9.2.5.2.2
9.5.1
9.5.4
10.4.9
15.2.7

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-50, Sheet 1A, 1B, 1C, 1D

Byron Unit 2:
LR-BYR-M-130, Sheet 1A, 1B, 2

Byron Common:
LR-BYR-M-50, Sheet 3
LR-BYR-M-152, Sheet 10

Braidwood Unit 1:
LR-BRW-M-50, Sheet 1A, 1B, 1C, 1D

Braidwood Unit 2:
LR-BRW-M-130, Sheet 1A, 1B, 2

Braidwood Common:
LR-BRW-M-50, Sheet 3
LR-BRW-M-152, Sheet 10

Table 2.3.3-15 Fuel Oil System
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
	Structural Support
Pump Casing (Fuel Oil Transfer Pumps)	Pressure Boundary
Strainer Body	Pressure Boundary
Tanks (Auxiliary Feedwater Day Tanks)	Pressure Boundary
Tanks (Diesel Generator Day Tanks)	Pressure Boundary
Tanks (Diesel Generator Fuel Oil Storage Tanks)	Pressure Boundary
Tanks (ESW Diesel Pump Storage Tank - Byron only)	Pressure Boundary
Tanks (Fire Protection Fuel Oil Storage Tank)	Pressure Boundary
Valve Body	Leakage Boundary
	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.3.2-15 Fuel Oil System
Summary of Aging Management Evaluation

2.3.3.16 Heating Water and Heating Steam System

Description

The intended function of the Heating Water and Heating Steam System for license renewal is to maintain leakage boundary integrity to preclude system interactions. For this reason, this system's pressure-retaining components located in proximity to other components performing safety-related functions have been included in the scope of license renewal. This system is not required to operate to support license renewal intended functions, and is in scope for license renewal due to potential spatial interaction.

The Heating Water and Heating Steam System is a normally operating, mechanical system designed to provide a source of low pressure, non-contaminated steam for various startup and plant service functions and to provide circulating heated water to ensure equipment reliability and a comfortable working environment year round. The Heating Water and Heating Steam System consists of two plant systems which are the auxiliary steam and station heating systems.

The purpose of the Heating Water and Heating Steam System is to provide a source of low pressure, non-contaminated steam for various startup and plant service functions. The system accomplishes this purpose using either an oil-fired auxiliary boiler or extraction steam from the high pressure turbine of one of the operating units to provide steam to the primary water heat exchanger, the station heating system heat exchanger, the carbon dioxide vaporizer, the boric acid batching tank, and the main turbine gland seals at start-up. The Heating Water and Heating Steam System also provides high energy line break (HELB) isolation for the steam supply to the auxiliary building. The system accomplishes this purpose by actuating specific steam supply valves to close on a HELB signal. The system also provides heated water to unit heaters and equipment heating coils to meet station space heating requirements.

The auxiliary steam system consists of a Unit 1 and Unit 2 train, with each auxiliary steam train comprised of an oil-fired water tube boiler, two (2) boiler feed pumps, a station heating system heat exchanger (shell side), a deaerator, two (2) heating steam boiler (deaerator) make-up pumps, a primary condensate collection tank, a secondary condensate collection tank, and associated piping, valves, controls, and instrumentation. The major steam components of the auxiliary steam system are located in the turbine building.

The auxiliary steam boiler controls are designed for automatic operation, except for cold startup operation of a boiler. The auxiliary steam system contains an integral condensate and feed system that returns condensate from auxiliary steam loads to the boiler.

Condensate recovered from the station heating system heat exchanger (shell side) is returned to the deaerator, which provides feed water supply to the auxiliary boiler. When required, water from the condensate storage tank is pumped by one of two heating steam boiler (deaerator) make-up pumps and is routed to the deaerator.

Common steam loads include a carbon dioxide vaporizer, primary water heat exchanger, boric acid batching tank, and service building hot water tank. Unit steam loads include a Unit 1 and Unit 2 station heating system heat exchanger (shell side). Most auxiliary building steam loads have been permanently isolated. Auxiliary steam provides steam to the main turbine gland seals during unit start-up, and can provide steam to the gland seals during power descension. Relief valves protect the auxiliary steam side from overpressurization.

The station heating system consists of common components dividing to supply the Unit 1 and Unit 2 trains. The common station heating system components are the hot water compression tank, the air separator, and the chemical mix tank. The Unit 1 and Unit 2 station heating system trains are comprised of two circulating pumps, a station heating system heat exchanger (tube side), and multiple heating coils and unit heaters. Station heating water flow is controlled by multiple flow balancing stations in return headers. Heating coils and unit heaters are in the auxiliary building, radwaste building, HVAC equipment rooms, fuel handling building, fuel handling train shed, machine shop, Unit 1 and Unit 2 turbine building, Unit 1 and Unit 2 diesel generator rooms (Byron only), Unit 1 and Unit 2 diesel oil rooms (Byron only), and Unit 1 and Unit 2 main steam safety valve enclosures (Byron only). At Braidwood only, unit heaters are in the lime softeners building.

The Heating Water and Heating Steam System has no safety-related function. The system is designed so that a failure of the system or one of its components does not compromise any safety-related system or component or prevent a safe reactor shutdown.

Portions of the Heating Water and Heating Steam System in areas which include the turbine building, radwaste building, the service building, the fuel handing building train shed, and the lime softeners building (Braidwood only) are not in scope for license renewal.

For more detailed information, see UFSAR Sections 3.6.1, 3.6.2, 3.11.10, and 9.2.8.

Boundary

The Heating Water and Heating Steam System scoping boundary includes those water and steam filled portions of nonsafety-related piping and equipment located in proximity to equipment performing a safety-related function. This includes the fluid filled portions of the Heating Water and Heating Steam System within the auxiliary building, fuel handing building, Unit 1 and Unit 2 diesel generator rooms (Byron only), Unit 1 and Unit 2 diesel oil rooms (Byron only), and Unit 1 and Unit 2 main steam safety valve enclosures (Byron only). This also includes specific fluid filled piping sections that are located in the turbine building in proximity to the safety-related auxiliary building wall HVAC penetrations. Included in this scoping boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license boundary drawings for identification of these boundaries, shown in red.

Not included in the scope of license renewal are portions of the Heating Water and Heating Steam System equipment not located in proximity to equipment performing safety-related functions and not required to support the leakage boundary intended function of this system. These portions of the Heating Water and Heating Steam System are in the radwaste building, the service building, the fuel handing building train shed, and the lime softeners building (Braidwood only). Also not included in the scope of license renewal is the portion of the Heating Water and Heating Steam System located within the turbine building that is not located in proximity to the safety-related auxiliary building wall HVAC penetrations. Components that are not required to support the system's leakage boundary intended function are not included in the scope of license renewal.

Reason for Scope Determination

The Heating Water and Heating Steam System is not in scope under 10 CFR 54.4(a)(1) because no portions of the system are safety-related or relied upon to remain functional during and following design basis events. The Heating Water and Heating Steam System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Heating Water and Heating Steam System is not in scope under 10 CFR 54.4(a)(3) because it is not relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Heating Water and Heating Steam System contains nonsafety-related fluid filled lines within the auxiliary building, fuel handling building, Unit 1 and Unit 2 diesel generator rooms (Byron only), Unit 1 and Unit 2 diesel oil rooms (Byron only), and Unit 1 and Unit 2 main steam safety valve enclosures (Byron only) which have the potential for spatial interaction with safety-related SSCs. 10 CFR 54.4(a)(2)

UFSAR References

3.6.1
3.6.2
3.11.10
Table 3.6-2
9.2.8

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-35, Sheet 5C
LR-BYR-M-72, Sheet 2, 7

Byron Unit 2:
LR-BYR-M-72, Sheet 3, 8
LR-BYR-M-120, Sheet 5C

Byron Common:
LR-BYR-M-48, Sheet 9, 11, 13, 38, 39, 40
LR-BYR-M-56, Sheet 2, 4A, 4C, 5
LR-BYR-M-65, Sheet 3, 5A, 6
LR-BYR-M-72, Sheet 1B, 5, 10

Braidwood Unit 1:
LR-BRW-M-35, Sheet 5C
LR-BRW-M-72, Sheet 2, 7

Braidwood Unit 2:
LR-BRW-M-72, Sheet 3, 8
LR-BRW-M-120, Sheet 5C

Braidwood Common:
LR-BRW-M-48, Sheet 9, 11, 13, 38, 39, 40
LR-BRW-M-56, Sheet 2, 4A, 4C, 6
LR-BRW-M-65, Sheet 3, 5A, 6
LR-BRW-M-72, Sheet 1B, 5, 10

Table 2.3.3-16 <u>Heating Water and Heating Steam System</u>
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Flow Device	Leakage Boundary
Heat Exchanger - (Auxiliary Building Hot Water Heating Coil Bank) Tube Side Components	Leakage Boundary
Heat Exchanger - (Auxiliary Building Hot Water Heating Coil Bank) Tubes	Leakage Boundary
Heat Exchanger - (Feed Preheater) Shell Side Components	Leakage Boundary
Heat Exchanger - (Laboratory Heating Coil) Tube Side Components	Leakage Boundary
Heat Exchanger - (Laboratory Heating Coil) Tubes	Leakage Boundary
Heat Exchanger - (Laboratory Preheat Coil) Tube Side Components	Leakage Boundary
Heat Exchanger - (Laboratory Preheat Coil) Tubes	Leakage Boundary
Heat Exchanger - (Normal Containment Purge Hot Water Heating Coil Bank) Tube Side Components	Leakage Boundary
Heat Exchanger - (Normal Containment Purge Hot Water Heating Coil Bank) Tubes	Leakage Boundary
Heat Exchanger - (Recycle Evaporator) Tube Side Components	Leakage Boundary
Heat Exchanger - (Recycle Feed Preheater) Shell Side Components	Leakage Boundary
Heat Exchanger - (Type 1 thru Type 6 Unit Heaters) Tubes	Leakage Boundary
Heat Exchanger - (Vent Condenser) Shell Side Components	Leakage Boundary
Piping Element	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
Pump Casing (Auxiliary Building Vent System Heating Coil Bank Hot Water Recirculation Pumps 0A, 0B, 0C, and 0D)	Leakage Boundary

Component Type	Intended Function
Pump Casing (Condensate Return Tank Pump)	Leakage Boundary
Pump Casing (Laboratory HVAC System Preheat Coil Hot Water Recirculation)	Leakage Boundary
Pump Casing (Normal Containment Purge Heating Coil Hot Water Recirculation)	Leakage Boundary
Restricting Orifice	Leakage Boundary
Strainer Body	Leakage Boundary
Tanks (Condensate Return Tank)	Leakage Boundary
Valve Body	Leakage Boundary

The aging management review results for these components are provided in:

Table 3.3.2-16	Heating Water and Heating Steam System Summary of Aging Management Evaluation

2.3.3.17 Non-Radioactive Drain System

Description

The license renewal intended function of the Non-Radioactive Drain System is to maintain leakage boundary integrity to preclude system interactions. For this reason, this system's pressure-retaining components located in proximity to other components performing safety-related functions have been included in the scope of license renewal. This system is not required to operate to support license renewal intended functions, and is in scope for license renewal only for potential spatial interaction.

The Non-Radioactive Drain System is a normally operating, mechanical system designed to collect, forward, and as required, treat miscellaneous drainage and waste oil from the Auxiliary Building, Circulating Water Pump House (Byron only), Fuel Handling Building (Byron only), Lake Screen Structures (Braidwood only), River Screen House, Turbine Building Complex, Waste Treatment Building, and other Yard Structures. Collected drainage is recycled back to the plant or released to the environment in compliance with the National Pollutant Discharge Elimination System (NPDES) Permit as approved by the State of Illinois. In addition collected waste oil is disposed of by waste oil disposal contractors. The Non-Radioactive Drain System consists of the following five (5) plant systems: miscellaneous drains system, oil drain disposal system, turbine building floor drains system, turbine building equipment drains system, and waste water treatment system.

The following is a description of each of the five (5) plant systems which make up the Non-Radioactive Drain System.

Miscellaneous Drains System:
The purpose of the miscellaneous drains system is to collect equipment leakage in the form of water generated in the circulating water pump house (Byron only), lake screen house (Braidwood only), River Screen House, Turbine Building Complex, waste treatment building, and other Yard Structures. This is accomplished by a series of floor drains located in these facilities which route water to local sumps. This leakage, which is non-radioactive, is released to the environment. In addition, the system collects rainwater that accumulates on the Auxiliary Building roof, the lake screen house roof (Braidwood only), the River Screen House roof (Byron only), the Turbine Building Complex roof, and the Fuel Handling Building roof. This is accomplished by a series of roof drains which route rainwater to piping headers and risers located inside the Auxiliary Building, lake screen house (Braidwood only), River Screen House (Byron only), Turbine Building Complex and Fuel Handling Building. The risers penetrate Auxiliary Building, Turbine Building Complex and Fuel Handling Building foundations and connect to the yard drainage system or discharge directly to the lake screen house (Braidwood only) and River Screen House (Byron only) intakes. The rain water, which is nonradioactive, is released to the environment. The miscellaneous drains system is nonsafety-related, therefore, this system is not required to remain functional during and following design basis or regulated events.

Those portions of the miscellaneous drains system not located in the Auxiliary Building, the lake screen house (Braidwood only), the River Screen House (Byron only), the Turbine Building Complex, and the Fuel Handling Building do not perform a license renewal intended function and, therefore, are not in scope for license renewal.

Oil Drain Disposal System:
The purpose of the oil drain disposal system is to collect water and oil in the Turbine Building Complex and Auxiliary Building areas that contain equipment that stores and consumes fuel and lubricating oil. This is accomplished by a series of floor and equipment drains located in areas that contain this equipment. These drains route the oil and water to the diesel fuel oil storage tank sumps. Sump pumps in the diesel fuel oil storage tank sumps route the oil and water to the turbine building fire and oil sump. Water and oil collected in the turbine building fire and oil sump is normally discharged to the waste treatment system. If unacceptable radioactive contamination is detected in the turbine building fire and oil sump, the sump pumps are automatically stopped and collected water may be sent to the Radwaste System (Byron only). Also, a portion of the oil drain disposal system collects waste oil at various locations in the Auxiliary Building and Fuel Handling Building (Byron only) and stores it in the auxiliary building waste oil collection tank. Collected waste oil is normally disposed of by waste oil disposal contractors. The volume reduction system is evaluated as part of the Radwaste System. The oil drain disposal system is nonsafety-related, therefore, this system is not required to remain functional during and following design basis or regulated events.

Those portions of the oil drain disposal system not located in the Auxiliary Building or Fuel Handling Building (Byron only) do not perform a license renewal intended function and, therefore, are not in scope for license renewal.

Turbine Building Floor Drains System:
The purpose of the turbine building floor drains system is to collect equipment leakage generated in the Turbine Building Complex and in the Auxiliary Building essential service water sumps. This is accomplished by a series of floor drains that route leakage to local sumps. Sump pumps then transfer leakage to the turbine building floor drain tanks. Collected water is then transferred to the waste water treatment system (via the turbine building fire and oil sump), the Radwaste System, or released via the 30,000 gallon release tanks to the Circulating Water System. The essential service water sumps and associated pumps, piping and valves are evaluated as part of the Radioactive Drain System. The entire turbine building floor drains system is nonsafety-related, therefore, this system is not required to remain functional during and following design basis or regulated events.

Those portions of the turbine building floor drains system not located in the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms do not perform a license renewal intended function and, therefore, are not in scope for license renewal.

Turbine Building Equipment Drains System:
The purpose of the turbine building equipment drains system is to recover condensate grade water generated in the Turbine Building Complex. This is accomplished by a series of drains located in Turbine Building Complex. The drains route collected water to the turbine building equipment drain sumps. Sump pumps then route the water to the turbine building equipment drain tanks. Collected water is then transferred to the waste water treatment system (via the turbine building fire and oil sump), the Radwaste System, or released via the 30,000 gallon release tanks to the Circulating Water System. The turbine building equipment drains system is nonsafety-related, therefore, this system is not required to remain functional during and following design basis or regulated events.

All portions of the turbine building equipment drains system do not perform a license renewal intended function and, therefore, are not in scope for license renewal.

Waste Water Treatment System:
The purpose of the waste water treatment system is to process fluids collected in the turbine building fire and oil sump by removing oil and other impurities so that the resulting effluent can be released to the environment in accordance with the NPDES Permit. This is accomplished by a series of oil separators, collection tanks, equalizations tanks, settling ponds (Byron only), lime sludge lagoons (Braidwood only), quadracell separators, and filters that remove oil and suspended solids. The waste water treatment system is nonsafety-related, therefore, this system is not required to remain functional during and following design basis or regulated events.

All portions of the waste water treatment system do not perform a license renewal intended function and, therefore, are not in scope for license renewal.

For more detailed information, see UFSAR Section 11.2.

Boundary

The Non-Radioactive Drain System scoping boundary includes those water filled portions of nonsafety-related piping and equipment located in proximity to equipment performing a safety-related function. This includes the fluid filled portions of the miscellaneous drains system within the Auxiliary Building, Fuel Handling Building, lake screen house (Braidwood), and the River Screen House (Byron); fluid filled portions of the turbine building floor drains system within the Auxiliary Building and the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms; and fluid filled portions of the oil drain disposal system within the Auxiliary Building, and the Byron Fuel Handling Building. This also includes specific water filled piping sections of the turbine building floor drain system and the miscellaneous drain system located in the turbine building near the Auxiliary Building wall HVAC penetrations. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license boundary drawings for identification of these boundaries, shown in red.

Not included within the Non-Radioactive Drain System scoping boundary are the diesel fuel oil storage tank sumps and the river screen house sump (Byron only). The diesel fuel oil storage tank sump is evaluated with the Auxiliary Building and the river screen house sump (Byron only) is evaluated with the River Screen House.

Not included in the scope of license renewal are the portions of the Non-Radioactive Drain System equipment not located in proximity to equipment performing a safety-related function, and not required to support the leakage boundary intended function of this system. These portions of the Non-Radioactive Drain System are in areas found in the Circulating Water Structure (Byron only), River Screen House (Braidwood only), Turbine Building Complex, Waste Treatment Building, and other Yard Structures and are therefore not included in the scope of license renewal.

Reason for Scope Determination

The Non-Radioactive Drain System is not in scope under 10 CFR 54.4(a)(1) because no portions of the system are safety-related or relied upon to remain functional during and following design basis events. The Non-Radioactive Drain System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Non-Radioactive Drain

System is not in scope under 10 CFR 54.4(a)(3) because it is not relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Non-Radioactive Drain System contains nonsafety-related fluid filled equipment within the Auxiliary Building, the Fuel Handling Building (Byron), the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms, and the River Screen House (Byron) which have the potential for spatial interaction with safety-related SSCs.
10 CFR 54.4(a)(2)

UFSAR References

11.2

License Renewal Boundary Drawings

Byron Unit 1:
None.

Byron Unit 2:
None.

Byron Common:
LR-BYR-M-48, Sheet 16, 19, 25

Braidwood Unit 1:
None.

Braidwood Unit 2:
None.

Braidwood Common:
LR-BRW-M-48, Sheet 16, 19, 25

Table 2.3.3-17 Non-Radioactive Drain System
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Piping, piping components, and piping elements	Leakage Boundary
Pump Casing (Auxiliary Building Waste Oil Collection Tank Pump)	Leakage Boundary
Pump Casing (Diesel Fuel Oil Storage Tank Sump Pump)	Leakage Boundary
Pump Casing (River Screen House Sump Pump - Byron only)	Leakage Boundary
Restricting Orifice	Leakage Boundary
Tanks (1000 Gallon Auxiliary Building Waste Oil Collection Tank)	Leakage Boundary
Valve Body	Leakage Boundary

The aging management review results for these components are provided in:

Table 3.3.2-17 Non-Radioactive Drain System
Summary of Aging Management Evaluation

2.3.3.18 Radiation Monitoring System

Description

The Radiation Monitoring System is a normally operating instrumentation system designed to detect radioactivity in selected plant areas and in process streams which could potentially be contaminated by radioactive substances. In addition, the system provides for the measurement of radioactivity in those streams which discharge to the environs outside the plant boundaries. The Radiation Monitoring System consists of the following two (2) plant systems: the process radiation monitoring system and the area radiation monitoring system. The Radiation Monitoring System is in scope for license renewal. However, portions of the Radiation Monitoring System are not required to perform intended functions and are not in scope for license renewal.

The following is a description of the two (2) plant systems which make up the Radiation Monitoring System.

Process Radiation Monitoring System:
One of the purposes of the process radiation monitoring system is to provide primary containment boundary to assure that radioactive material is not inadvertently transferred out of containment. This is accomplished with qualified containment penetration piping and isolation valves which close on a containment isolation signal. All Radiation Monitoring System piping that penetrates containment and associated isolation valves are safety-related.

Another purpose of the process radiation monitoring system is to monitor for radioactive contamination entering the Control Area Ventilation System, and on high radiation levels provide an initiation signal to isolate the normal outside air intake to the control room supply fans and swap to the make-up filter unit fan and associated filter train which draws air from the turbine building. This is accomplished by radiation monitoring instrumentation which draws air samples from the outside air intake for the normal supply to the control room supply fans. Radiation detectors monitor sample air for radiation and on high radiation aligns the Control Area Ventilation System to the make-up air flow path. All associated valves, sample pumps, detectors, and transmitters are safety-related.

Another purpose of the process radiation monitoring system is to monitor for radioactive contamination in the effluent of the Auxiliary Building vent stack during accident conditions. This is accomplished by radiation monitoring instrumentation which draws air samples from the Auxiliary Building vent stack and provides control room indication. All associated valves, sample pumps, detectors, and transmitters are safety-related.

Another purpose of the process radiation monitoring system is to provide for the measurement, indication, and control of radioactive contamination in those streams which discharge outside the plant boundaries. This is accomplished by the installation of gaseous radiation monitors on the following gaseous effluent streams: fuel handling building ventilation exhausts, radwaste building ventilation exhaust, laundry room ventilation exhaust, lab fume hood exhaust, miscellaneous tank filtered vent exhaust, containment purge effluent, steam jet air ejector/gland steam exhaust, and gas decay tank effluent. This is also accomplished by the installation of liquid radiation monitors in the following liquid effluent streams: station blowdown, steam generator blowdown, boron thermal regeneration chiller surge tank return, component cooling heat exchanger water outlet, reactor containment fan coolers essential service water outlet, radwaste evaporators condensate return, gross failed fuel monitors, condensate cleanup area sumps discharge, and turbine building fire and oil sump discharge. Those portions of the gaseous and liquid process radiation monitoring system associated with this purpose are nonsafety-related.

Another purpose of the process radiation monitoring system is to provide operating personnel with radiological measurements within plant process systems. This is accomplished by continuous radiation monitors, which provide readouts, alarm annunciation, and generate automatic control signals when significant increases occur. This is also accomplished by manual sampling and laboratory analysis. Those portions of the process radiation monitoring system associated with this purpose are nonsafety-related.

Gas filled portions of the process radiation monitoring system that are not associated with the containment integrity function, the control area envelope isolation function, and the Auxiliary Building vent stack wide range gas monitors, do not perform a license renewal intended function and, therefore, are not in scope for license renewal. Liquid filled portions of the process radiation monitoring system located within the Turbine Building Complex and Radwaste and Service Building Complex do not perform a license renewal intended function and, therefore, are not in scope for license renewal.

Area Radiation Monitoring System:
The purpose of the area radiation monitoring system is to detect, indicate, and record area radiation levels, annunciate, and provide appropriate interlock signals. This is accomplished by providing area radiation monitors located in selected locations throughout the plant. The main steam line area radiation monitors are safety-related and provide indication that allows detection of gross secondary side radioactivity and provides a means to identify a ruptured steam generator. The piping penetration area radiation monitors are safety-related and provide indication that allows detection of gross radioactivity and provides a means to identify a ruptured steam generator. The high range containment radiation monitors are safety-related and monitor for the potential of significant radiation releases and provide the readings necessary for release assessment by operators in determining the need to invoke site emergency plans. The fuel handling incident area radiation monitors are safety-related and monitor for radiation levels consistent with postulated fuel handling incidents and will automatically align the fuel handling building exhaust fans through the charcoal filter units. The containment fuel handling incident radiation monitors are safety-related and monitor for radiation levels consistent with postulated fuel handling incidents and isolates the containment purge and mini-purge isolation valves.

The main steam line area radiation monitors, the piping penetration area radiation monitors, the high range containment radiation monitors, the fuel handling incident area radiation monitors, and the containment fuel handling incident radiation monitors are in scope for license renewal.

For more detailed information, see UFSAR Sections 9.4.1 and 11.5.1.

Boundary

The area radiation monitoring system includes only electrical components which are evaluated as Electrical Commodities and will, therefore, not be included in the scoping boundary description of the Radiation Monitoring System.

The Radiation Monitoring System scoping boundary begins at the sample supply isolation valves to the Unit 1 and 2 Control Area Ventilation System. The scoping boundary continues to the eight (8) separate gaseous radiation monitoring units which contain radiation detectors, sample pumps, piping, piping elements, pressure transmitters, and valves. The scoping boundary ends at the return isolation valves to the Control Area Ventilation System.

Also, the Radiation Monitoring System scoping boundary begins at the sample supply isolation valves to the Unit 1 and 2 Auxiliary Building vent stack. The scoping boundary continues to the four (4) separate gaseous radiation monitoring trains which contain radiation detectors, gamma and tritium collectors, sample pumps, piping, piping elements, filters, flow transmitters, and valves. The scoping boundary ends at the return isolation valves to the Unit 1 and 2 Auxiliary Building vent stack.

Also, the Radiation Monitoring System scoping boundary begins at the sample supply isolation valves to: the Unit 1 and 2 Steam Generator System blowdown process sample system, the Unit 1 and 2 Chemical & Volume Control System letdown chiller heat exchangers, the Unit 1 and 2 Component Cooling System heat exchangers, the Steam Generator System blowdown mixed bed demineralizers, and the Radwaste System evaporator condensate pumps. The scoping boundary continues to fourteen (14) separate liquid radiation monitoring units which contain radiation detectors, sample pumps, piping, piping elements, strainers, flow transmitters, and valves. The scoping boundary ends at the return isolation valves to each associated system.

Also, the Radiation Monitoring System scoping boundary begins at the Service Water System sample supply isolation valves downstream of the Unit 1 and 2 essential service water coils. The scoping boundary continues to the four (4) separate liquid radiation monitoring units which contain radiation detectors, sample pumps, piping, strainers, flow transmitters, and valves. The scoping boundary ends at the return isolation valves to the Service Water System.

Also, for Byron only, the Radiation Monitoring System scoping boundary begins at the Unit 2 Auxiliary Building sump and continues to a liquid radiation monitoring unit which contains radiation detectors, sample pumps, piping, strainers, flow transmitters, and valves. The scoping boundary ends at the Unit 2 Auxiliary Building sump.

Also, the Radiation Monitoring System scoping boundary begins at the Chemical & Volume Control System sample supply isolation valves downstream of the Unit 1 and 2 letdown heat exchangers. The scoping boundary continues to the two (2) separate liquid radiation monitoring units which contain radiation detectors, piping, flow transmitters, and valves. The scoping boundary ends at the return isolation valves to the Service Water System.

The Radiation Monitoring System scoping boundary includes containment penetration piping and valves that route gaseous sample flow to and from the containment equipment hatch and personnel hatch air particulate and iodine samplers, and the Unit 1 and 2 containment atmosphere radiation monitors. Also, the Radiation Monitoring System scoping boundary includes piping and valves which drain condensate from the containment atmosphere radiation monitoring refrigerant air dryers.

All associated piping, components, and instrumentation contained within the flow paths described above are included in the system evaluation boundary.

The Radiation Monitoring System interfaces with the Auxiliary Building Ventilation System by supplying air for radiation monitoring. The Auxiliary Building Ventilation System components are included and evaluated in the Auxiliary Building Ventilation System scoping boundary.

The Radiation Monitoring System interfaces with the Chemical &Volume Control System by supplying fluid for radiation monitoring. The Chemical &Volume Control System components are included and evaluated with the Chemical &Volume Control System.

The Radiation Monitoring System interfaces with the Component Cooling System by supplying fluid for radiation monitoring. The Component Cooling System components are included and evaluated with the Component Cooling System.

The Radiation Monitoring System interfaces with the Compressed Air System which supplies control air to various system components such as air operated valves. The Compressed Air System components are included and evaluated with the Compressed Air System.

The Radiation Monitoring System interfaces with the Containment Ventilation System by supplying air for radiation monitoring. The Containment Ventilation System components are included and evaluated with the Containment Ventilation System.

The Radiation Monitoring System interfaces with the Control Area Ventilation System by supplying air for radiation monitoring. The Control Area Ventilation System components are included and evaluated with the Control Area Ventilation System.

The Radiation Monitoring System interfaces with the Steam Generators by supplying fluid for radiation monitoring. The Steam Generators components are included and evaluated with the Steam Generators

The Radiation Monitoring System interfaces with the Service Water System by supplying fluid for radiation monitoring. The Service Water System components are included and evaluated with the Service Water System.

The Radiation Monitoring System interfaces with the Low Voltage Auxiliary Power System which supplies power to various system components such as pumps and valve operators. The Low Voltage Auxiliary Power System commodities are included and evaluated with the Low Voltage Auxiliary Power System.

Also included in the license renewal scoping boundary of the Radiation Monitoring System are those water, oil, and steam filled portions of nonsafety-related piping and equipment located in proximity to equipment performing a safety-related function. This includes the nonsafety-related portions of the system located within the Containment Structure and Auxiliary Building. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawings for identification of this boundary, shown in red.

Also included in the license renewal scoping boundary of the Radiation Monitoring System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor. Included in this boundary are components relied upon to preserve the structural support intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included in the scope of license renewal are those gas filled portions of the Radiation Monitoring System located within the Containment Structure and Auxiliary Building which do not perform the (a)(1) function of containment integrity, Control Area Ventilation System isolation, and Auxiliary Building vent stack wide range gas monitoring. These gas filled portions of the system, which may be located within an area in proximity of components performing a safety-related function, do not pose a potential for water, oil, or steam leakage. Components that are not required to support the system's leakage boundary intended function and do not perform or support system intended functions are not included in the scope of license renewal.

Not included in the scope of license renewal are liquid and gas filled portions of the system located within the Turbine Building Complex or the Radwaste and Service Building Complex as these portions of the system are not located within an area in proximity of components performing a safety-related function. Components that are not required to support the system's leakage boundary intended function and do not perform or support system intended functions are not included in the scope of license renewal.

Reason for Scope Determination

The Radiation Monitoring System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Radiation Monitoring System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Radiation Monitoring System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Radiation Monitoring System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provide primary containment boundary. The Radiation Monitoring System has containment isolation valves that actuate upon a containment isolation signal. 10 CFR 54.4(a)(1)

2. Sense process conditions and generate signals for reactor trip or engineered safety features actuation. The Radiation Monitoring System monitors for radioactive contamination entering the Control Area Ventilation System and on high radiation levels provides an initiation signal to isolate and pressurize the control area envelope. 10 CFR 54.4(a)(1)

3. Maintain the dose consequences within the guidelines of 10 CFR 50.67 or 10 CFR 100. The Auxiliary Building vent stack wide range gas monitors provide control room indication of Auxiliary Building vent stack radiation discharges during accident conditions. 10 CFR 54.4(a)(1)

4. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety related function. The Radiation Monitoring System contains nonsafety-related water-filled lines in the Containment Structure and the Auxiliary Building that have the potential for spatial interactions (spray or leakage) with safety-related SSCs. Also, the Radiation

Monitoring System includes nonsafety-related piping that is directly attached and provides structural support to safety-related piping. (10 CFR 54.4 (a)(2))

5. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Equipment Qualification (10 CFR 50.49). System solenoid valves and position switches associated with containment isolation valves and main steam line radiations monitors are included in the scope of the Environmental Qualification Program. (10 CFR 54.4(a)(3)

6. Maintain the dose consequences within the guidelines of 10 CFR 50.67 or 10 CFR 100. The Fuel Building Fuel Handling Incident radiation monitor sends a signal to realign the Fuel Handling Building HVAC system during a drop fuel rod accident condition. 10 CFR 54.4(a)(1)

7. Maintain the dose consequences within the guidelines of 10 CFR 50.67 or 10 CFR 100. The main steam line radiation monitors and the penetration area radiation monitors serve to detect a steam generator tube rupture event. 10 CFR 54.4(a)(1)

UFSAR References

9.4.1
9.4.8
9.4.9
11.5.1
12.2.2
12.3.4.
Appendix E, Section E-30

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-42, Sheet 3, 5A, 5B
LR-BYR-M-48, Sheet 3B
LR-BYR-M-64, Sheet 5
LR-BYR-M-78, Sheet 10

Byron Unit 2:
LR-BYR-M-126, Sheet 1, 3
LR-BYR-M-138, Sheet 5A, 8
LR-BYR-M-151, Sheet 1, 4

Byron Common:
LR-BYR-M-48, Sheet 3A, 6C, 9, 11, 13, 20A, 20B
LR-BYR-M-56, Sheet 4C
LR-BYR-M-64, Sheet 8
LR-BYR-M-68, Sheet 2A
LR-BYR-M-78, Sheet 2, 6, 7, 12, 14
LR-BYR-M-95, Sheet 14
LR-BYR-M-96, Sheet 1, 2

Braidwood Unit 1:
LR-BRW-M-42, Sheet 3, 5A, 5B
LR-BRW-M-48, Sheet 3B
LR-BRW-M-64, Sheet 5
LR-BRW-M-78, Sheet 10

Braidwood Unit 2:
LR-BRW-M-126, Sheet 1, 3
LR-BRW-M-138, Sheet 5A, 5B, 8
LR-BRW-M-151, Sheet 1

Braidwood Common:
LR-BRW-M-48, Sheet 3A, 9, 11, 13, 20A, 20B
LR-BRW-M-56, Sheet 4C
LR-BRW-M-64, Sheet 8
LR-BRW-M-66, Sheet 4D
LR-BRW-M-68, Sheet 2
LR-BRW-M-78, Sheet 2, 6, 7, 12, 14
LR-BRW-M-95, Sheet 14
LR-BRW-M-96, Sheet 1, 2

Table 2.3.3-18 Radiation Monitoring System
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Filter Housing	Pressure Boundary
	Structural Support
Flow Device	Leakage Boundary
	Pressure Boundary
Piping Element	Pressure Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
	Structural Support
Pump Casing (Auxiliary Building Sump Radiation Monitoring Sample Pumps - Byron only)	Leakage Boundary
Pump Casing (Auxiliary Building Vent Stack Radiation Monitor Bypass Pumps)	Pressure Boundary
Pump Casing (Auxiliary Building Vent Stack Radiation Monitoring Sample Pumps)	Pressure Boundary
Pump Casing (Blowdown Afterfilter Radiation Monitoring Sample Pumps)	Leakage Boundary
Pump Casing (Component Cooling Outlet Radiation Monitoring Sample Pumps)	Leakage Boundary
Pump Casing (Control Area Ventilation Radiation Monitoring Sample Pumps)	Pressure Boundary
Pump Casing (Essential Service Water Radiation Monitoring Sample Pumps)	Leakage Boundary
Pump Casing (Radwaste Evaporator Condensate Radiation Monitoring Sample Pumps)	Leakage Boundary
Strainer Body	Leakage Boundary
Valve Body	Leakage Boundary
	Pressure Boundary
	Structural Support

The aging management review results for these components are provided in:

Table 3.3.2-18 Radiation Monitoring System
Summary of Aging Management Evaluation

2.3.3.19 Radioactive Drain System

Description

The Radioactive Drain System is a normally operating, mechanical system designed to provide contaminated drainage control and management for the Containment Structure, Auxiliary Building, Fuel Handling Building, and Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms. The Radioactive Drain System consists of the following plant systems: the leak detection system; reactor building and containment equipment drains system; reactor building and containment floor drains system, auxiliary building equipment drain radwaste system; auxiliary building floor drain radwaste system; laundry and floor drains system; laundry equipment/floor drain radwaste system; and chemical radwaste disposal system. The Radioactive Drain System is in scope for license renewal.

The purpose of the system is to collect and analyze drainage from equipment and the floor drains in the Containment Structure, Auxiliary Building, and Fuel Handling Building. Collected fluids are transferred to the Radwaste System for suitable treatment. The Radioactive Drain System includes piping that penetrates containment and containment isolation valves to assure that radioactive material is not inadvertently transferred out of containment. The system prevents accumulated discharged fire water from impacting safety-related components in the Containment Structure and the Auxiliary Building. Also, the system collects and safely stores lubricating oil from potential reactor coolant pump leakage sources. The system also supports in the protection of safety-related components in the Auxiliary Building by providing adequate drainage for flooding as a result of high and moderate energy line breaks to ensure safe shutdown capability of the plant is not adversely affected.

The system accomplishes this purpose by providing floor drains and sumps located throughout the Containment Building, Auxiliary Building, and Fuel Handling Building. Collected drainage is routed either by gravity or by pumps to collection storage tanks which interface with the Sampling System so that collected fluids can be analyzed. Collected fluid is then routed to the Radwaste System. Containment isolation is accomplished with qualified containment penetration piping and isolation valves which close on a containment isolation signal. The system prevents discharged fire water from adversely affecting the accomplishment of a safety-related function by providing adequate drainage capacity to prevent flooding in areas which contain safety-related components.

Collecting and safely storing reactor coolant pump lubricating oil leakage is accomplished by routing all the oil leaks to closed reservoirs located in the containment. These reservoirs are sized to collect the amount of oil expected to be collected between refueling outages. In the event of a major leak, an overflow line from the reservoirs will transfer the oil directly into the containment oil collection vault and the containment floor drain sump.

The system provides adequate piping flow capacity to the Auxiliary Building, and turbine building sumps such that leakage resulting from high and moderate energy line breaks will not result in flooding of areas which contain safety-related components, and, therefore potentially prevent the accomplishment of a safety-related function.

The Radioactive Drain System is comprised of tanks, sumps, pumps, valves, piping, and piping components. Fluids collected in the Containment Structure floor and equipment drains flow by gravity to sumps located in containment. The Radioactive Drain System transfers collected drainage to tanks located in the Auxiliary Building and then to the Radwaste System. In the event of a Fire Protection System actuation, discharged fire water is collected in Containment Structure floor drains and routed to the containment sumps away from safety-related components.

Fluid collected in the Auxiliary Building floor, instrumentation panels, and equipment drains flow by gravity to sumps located in the Auxiliary Building or the turbine building. The Radioactive Drain System collects potentially contaminated drainage in tanks located in the Auxiliary Building. After sampling, the collected water is routed to the Radwaste System. In the event of a Fire Protection System actuation, a high energy line break, or a moderate energy line break, discharged water is collected in Auxiliary Building floor drains and routed to the sumps away from safety-related components

For more detailed information, see UFSAR Sections 9.3.3 and 11.2.2.2.

Boundary

The Radioactive Drain System scoping boundary begins at floor drains, trenches, and collection pits located throughout the Containment Structure. This includes all piping that routes fluids collected from these areas to the reactor cavity sump or the containment floor drain sump. This also includes equipment that collects condensation from the reactor containment fan coolers and piping that routes the condensation to the containment floor drain sump. The system continues out of the Containment Structure to auxiliary building floor drain tanks and includes pumps, containment penetrations, and containment isolation valves. The Radioactive Drain System boundary also runs from the floor drains in the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms and includes piping that route fluid collected from these areas to the Non-Radioactive Drain System tendon tunnel sump.

The Radioactive Drain System scoping boundary also includes components which collect fluid from the reactor coolant pump seal and reactor vessel head leakoffs, safety injection accumulator drains, excess letdown and regenerative heat exchangers drains, loop drain headers, refueling cavity leakage, and the pressurizer relief tank. This includes piping which routes collected fluid to the reactor coolant drain tank and continues out of containment and terminates at either the auxiliary building equipment drain system, the Safety Injection System refueling water storage tank, or the Radwaste System recycle evaporator feed demineralizer.

Also included in the Radioactive Drain System scoping boundary are the reactor coolant pump oil drip pans, collection piping, oil reservoirs, oil overflow piping, and oil storage vault.

In the Auxiliary Building the Radioactive Drain System scoping boundary begins at the floor drains located throughout all elevations of the Auxiliary Building. This includes components which capture condensation from ventilation components located in the Auxiliary Building and includes piping that routes condensation to the auxiliary building sump. This also includes components and piping which transfers fluid from the essential service water sump and the radwaste drumming station sump to the auxiliary building sump. The scoping boundary continues from the auxiliary building sump to the auxiliary building floor drain tanks and terminates at the Sampling System return line isolation valves, the Radwaste System evaporator isolation valves, the Containment Ventilation System exhaust filter lines, and the Non-Radioactive Drain System turbine building sumps.

Also in the Auxiliary Building, the Radioactive Drain System scoping boundary includes components that collect fluid from the auxiliary building equipment drain collection tanks, various valve leakoffs, instrumentation panels, reactor coolant drain pumps, low conductivity regenerations waste, and the Sampling System. This includes piping which routes collected fluids to the auxiliary building equipment drain tanks and terminates at the Radwaste System evaporator isolation valves and Containment Ventilation System vent header.

Also in the Auxiliary Building, the Radioactive Drain System scoping boundary includes components and piping that collect fluid from the high and low level labs, the decontamination room sink drains, the fuel handling building decontamination sump, steam generators, primary water storage tanks, the recycle system, the radwaste drumming station sump, and the Sampling System. This includes piping which routes collected fluids to the chemical drain tanks and terminates at the Radwaste System evaporator isolation valves.

In the Fuel Handling Building, the Radioactive Drain System scoping boundary begins at floor drains located throughout all elevations of the building. This includes piping which route collected drainage to the fuel handling building floor drain sump and piping and components which transfer collected fluid to the auxiliary building floor drain tanks. Also included is piping that routes collected drainage from the spent fuel pool leak detection drains directly to the auxiliary building sump.

In addition, the scoping boundary includes components which collect and route fluid to the laundry drain tank and on to the laundry waste storage tanks and terminates at the Radwaste System release tank isolation valves.

All associated piping, components, and instrumentation contained within the flow path described above are included in the system evaluation boundary.

A portion of the Radioactive Drain System which interfaces with the Chemical & Volume Control System is provided with electrical heat tracing and thermal insulation to ensure boric acid remains in solution.

Not included within the Radioactive Drain System scoping boundary are the reactor cavity sumps and containment floor drain sumps. The reactor cavity sumps and containment floor drain sumps are evaluated with the Containment Structure.

Not included within the Radioactive Drain System scoping boundary are the auxiliary building floor drains sumps, auxiliary building equipment drain collection sumps, essential service water sumps, radwaste drumming station sump, fuel handling building decontamination sump, fuel handling building floor drain sumps, and the turbine building floor drain sumps. The auxiliary building floor drains sumps, auxiliary building equipment drain collection sumps, essential service water sumps, radwaste drumming station sump, fuel handling building decontamination sump, fuel handling building floor drain sumps, and the turbine building floor drain sumps are evaluated with the Auxiliary Building, the Fuel Handling Building, or the Turbine Building Complex.

Also included in the license renewal scoping boundary of the Radioactive Drain System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the system located within the

Auxiliary Building. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Also included in the license renewal scoping boundary of the Radioactive Drains System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor. Included in this boundary are components relied upon to preserve the structural support intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included in the scope of license renewal are portions of the Radioactive Drain System which are spare floor drain lines or capped and abandoned floor drain lines. These portions of the system are not required to perform or support system intended functions because they are not safety-related; do not contain water, steam, or oil; and do not support regulated events described in 10 CFR 54.4(a)(3). These lines are isolated from in scope portions of the Radioactive Drain System by piping caps.

Reason for Scope Determination

The Radioactive Drain System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Radioactive Drain System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Radioactive Drain System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48) and Environmental Qualification (10 CFR 50.49). The Radioactive Drain System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provide primary containment boundary. The Radioactive Drain System includes piping that penetrates the primary containment. The containment penetrations include containment isolation valves to assure that radioactive material is not inadvertently transferred out of containment. 10 CFR 54.4(a)(1)

2. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Radioactive Drain System includes water filled components in the Auxiliary Building, Containment Structure, and Fuel Handling Building that have the potential for spatial interaction with safety-related components. It provides functional support to preclude flooding due to High Energy and Medium energy line breaks in rooms of the Auxiliary Building that contain safety-related equipment. The system also includes nonsafety-related piping that is directly attached and provides structural support to safety-related piping. 10 CFR 54.4(a)(2)

3. Relied upon in the safety analyses or plant evaluation to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48) The Radioactive Drain System provides adequate drainage to protect safety-related equipment during internal flooding caused by a fire protection system discharge. Also, the system collects and safely stores lube oil from potential reactor coolant pump leakage sources. 10 CFR 54.4(a)(3)

4. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). Solenoid valves and position switches associated with Radioactive Drain System air operated containment isolation valves are included in the scope of the Environmental Qualification Program. 10 CFR 54.4(a)(3)

UFSAR References

9.3.3
9.4.7.2.2
11.2.2.2
6.2.4

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-60, Sheet 1B, 4, 6
LR-BYR-M-61, Sheet 5, 6
LR-BYR-M-62, Sheet 1
LR-BYR-M-63, Sheet 1C
LR-BYR-M-64, Sheet 1, 2, 4A
LR-BYR-M-65, Sheet 2C, 4
LR-BYR-M-66, Sheet 4A, 4B
LR-BYR-M-68, Sheet 1A, 2, 2A, 6
LR-BYR-M-69, Sheet 2
LR-BYR-M-70, Sheet 1, 2

Byron Unit 2:
LR-BYR-M-63, Sheet 1B
LR-BYR-M-135, Sheet 1B, 4, 6
LR-BYR-M-136, Sheet 5, 6
LR-BYR-M-137, Sheet 1
LR-BYR-M-138, Sheet 1, 2, 4
LR-BYR-M-140, Sheet 1, 5
LR-BYR-M-141, Sheet 1

Byron Common:
LR-BYR-M-48, Sheet 2, 6A, 6B, 6C, 7, 8, 16, 17, 19, 23, 29, 44, 54
LR-BYR-M-70, Sheet 3

Braidwood Unit 1:
LR-BRW-M-60, Sheet 1B, 4, 6
LR-BRW-M-61, Sheet 5, 6
LR-BRW-M-62, Sheet 1

LR-BRW-M-63, Sheet 1C
LR-BRW-M-64, Sheet 1, 2, 4A
LR-BRW-M-65, Sheet 2C, 4
LR-BRW-M-68, Sheet 1A, 6
LR-BRW-M-70, Sheet 1, 2

Braidwood Unit 2:
LR-BRW-M-63, Sheet 1B
LR-BRW-M-135, Sheet 1B, 4, 6
LR-BRW-M-136, Sheet 5, 6
LR-BRW-M-137, Sheet 1
LR-BRW-M-138, Sheet 1, 2, 4B
LR-BRW-M-140, Sheet 1A, 5
LR-BRW-M-141, Sheet 1

Braidwood Common:
LR-BRW-M-48, Sheet 6A, 6B, 6C, 7, 8, 16, 17, 19, 23, 29, 44, 54
LR-BRW-M-66, Sheet 4A, 4B
LR-BRW-M-70, Sheet 3

Table 2.3.3-19 Radioactive Drain System Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Filter Housing	Leakage Boundary
Piping Element	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
	Structural Support
Pump Casing (Auxiliary Building Borated Equipment Drain Tank Pump)	Leakage Boundary
Pump Casing (Auxiliary Building Equipment Drain Tank Pumps)	Leakage Boundary
Pump Casing (Auxiliary Building Floor Drain Tank Pump)	Leakage Boundary
Pump Casing (Blowdown Sample Collection and Chromated Drain Tank Pumps)	Leakage Boundary
Pump Casing (Chemical Drain Tank Pump)	Leakage Boundary
Pump Casing (Laundry Drain Tank Pump)	Leakage Boundary
Pump Casing (Laundry Waste Storage Tank Pump)	Leakage Boundary
Pump Casing (Reactor Coolant Drain Pumps)	Leakage Boundary
Restricting Orifice	Leakage Boundary
Strainer Body	Leakage Boundary
Tanks (2000 Gallon Laundry Waste Storage Tanks)	Leakage Boundary
Tanks (4000 Gallon Laundry Drain Tanks)	Leakage Boundary
Tanks (6000 Gallon Chemical Drain Tanks)	Leakage Boundary
Tanks (8,000 Gallon Auxiliary Building Equipment Drain Tanks)	Leakage Boundary
Tanks (8,000 Gallon Auxiliary Building Floor Drain Tanks)	Leakage Boundary
Tanks (Auxiliary Building Borated Equipment Drain Tanks)	Leakage Boundary
Tanks (Blowdown Sample Collection and Chromated Drain Tanks)	Leakage Boundary
Tanks (Containment Lube Oil Leakage Reservoirs)	Pressure Boundary
Tanks (Reactor Coolant Drain Tanks)	Leakage Boundary
Valve Body	Leakage Boundary
	Pressure Boundary
	Structural Support

The aging management review results for these components are provided in:

Table 3.3.2-19	Radioactive Drain System Summary of Aging Management Evaluation

2.3.3.20 Radwaste System

Description

The Radwaste System is a normally operating, mechanical system designed to collect, process, and prepare radioactive liquid, gaseous, and solid wastes for disposal or release. This system also provides nitrogen, helium, argon, carbon dioxide, methane, caustic acid, and sulfuric acid to various plant equipment. The Radwaste System consists of the following seven (7) plant systems: the radioactive waste gas system, the solid radwaste disposal system, the nitrogen system, the bottled gas system, the volume reduction system, the acid feed and handling system, and the caustic handling system. The Radwaste System is designed to meet or exceed the applicable federal and state regulations for containment, control, and release or disposal of radioactive liquids, gases, and solids generated as a result of normal and emergency plant operation. The Radwaste System is in scope for license renewal. However, portions of the Radwaste System that are not required to perform intended functions are not in scope.

The following is a description of each of the seven (7) plant systems which make up the Radwaste System.

Radioactive Waste Gas System:
The purpose of the radioactive waste gas system is to collect, store, and process radioactive gaseous waste from the Chemical & Volume Control System, Radioactive Drain System, Radwaste System, Reactor Coolant System, and the Sampling System. This is accomplished by collecting gaseous waste from the boron recycle evaporators, the volume control tank, the recycle holdup tanks, the reactor coolant drain tank, the spent resin storage tank, the pressurizer relief tank, and the HRSS (High Radiation Sample System) waste drain tank during normal and emergency plant operation. The radioactive waste gas system contains the gaseous vent header, waste gas compressors, waste gas decay tanks, and associated piping and valves. These portions of the system provide for short-term storage of the waste gas until the short-lived fission products decay to an acceptable level for release to the plant vent. System instrumentation, particularly hydrogen and oxygen monitors allow operations personnel to preclude the buildup of an explosive mixture to ensure compliance with the license conditions. The radioactive waste gas system also supplies makeup nitrogen to the recycle hold up tanks.

Another purpose of the radioactive waste gas system is to have adequate capacity, redundancy, and monitoring capability to meet gaseous discharge concentration limits during periods of design basis fuel leakage. This is accomplished by providing long term waste gas holdup capacity via the waste gas decay tanks, thus precluding the release of radioactive effluents during unfavorable environmental conditions. The portions of the system that include the waste gas decay tanks, associated inlet isolation valves to the waste gas decay tanks, associated outlet isolation valves from the waste gas decay tanks, all associated piping located between the inlet and outlet isolation valves and the waste gas decay tanks, and instrumentation located between the inlet and outlet isolation valves and the waste gas decay tanks are safety-related.

Gas filled portions of the radioactive waste gas system that are not associated with waste gas decay tanks and isolation valves, do not perform a license renewal intended function and, therefore, are not in scope for license renewal.

Solid Radwaste Disposal System:
The purpose of the solid radwaste disposal system is to receive, concentrate, solidify if required, package, handle, and provide temporary storage facilities for radioactive wet solid wastes. This is accomplished by transferring wet solid radwaste to vendor supplied radwaste equipment for processing and disposal. The solid radwaste disposal system also receives, decontaminates and compacts, and provides temporary storage facilities for radioactive dry wastes generated during station operation and maintenance activities. The solid radwaste disposal system is designed to package radioactive solid wastes for offsite shipment and burial in accordance with applicable NRC and DOT regulations including 49 CFR 170 through 178 “Transportation of Radioactive Material” and 10 CFR 71, “Packing and Transportation of Radioactive Material.”

Another purpose of the solid radwaste disposal system is to collect, monitor, and recycle or release, all potentially radioactive liquid wastes generated at the station during normal operation and maintenance, as well as transient conditions. This is accomplished by collecting potentially contaminated liquid wastes from the Radioactive Drain System and the Steam Generator System. In addition, effluent from the Non-Radioactive Drain System condensate polisher sump and from the Non-Radioactive Drain System turbine building floor and equipment drains may be processed. The solid radwaste disposal system processes radioactive liquid waste by various combinations of filtration, evaporation (Braidwood only), and/or demineralization. Vendor radwaste processing equipment may utilize filtration, demineralization, chemical and ultraviolet treatment, and/or reverse osmosis to assist in radioactive liquid waste processing and recycling. After processing and sampling, the purified effluent can be recycled to the plant or released to the environment.

The solid radwaste disposal system is nonsafety-related, therefore, this system is not required to remain functional during and following design basis or regulated events.

All portions of the solid radwaste disposal system located in the Turbine Building Complex or the Radwaste and Service Building Complex do not perform a license renewal intended function and, therefore, are not in scope for license renewal.

Nitrogen System:
The purpose of the nitrogen system is to supply nitrogen to plant equipment. This is accomplished by two (2) nitrogen system supply headers. The first is a low pressure header for normal operation and is supplied by a bulk liquid nitrogen tank. The second is a backup high pressure header supplied by high pressure cylinders. The low pressure header supplies nitrogen to the following components: spent resin storage tank, pressurizer relief tank, volume control tank, spray additive tanks, gas decay tanks, radwaste evaporators, hydrogen recombiners, reactor coolant drain tank, recycle holdup tank, and containment electrical penetrations. At Byron, low pressure nitrogen is also supplied to the primary water storage tanks. In addition to providing a backup nitrogen supply up to the low pressure header, the backup high pressure header supplies nitrogen to the safety injection accumulators.

Another purpose of nitrogen system is to ensure that radioactive material is not inadvertently transferred out of containment. This is accomplished with containment penetration piping and isolation valves, and by maintaining a continuous pressurized nitrogen blanket on the electrical penetrations which is periodically monitored for leakage during periods between 10 CFR 50, Appendix J, Type B Tests. The nitrogen supply line and isolation valve to each electrical containment penetration is safety-related. The remainder of the system is nonsafety-related.

Other than supporting a containment function the gas filled portions of the nitrogen system do not perform a license renewal intended function, and therefore, are not in scope for license renewal.

Bottled Gas System:
The purpose of the bottled gas system is to supply helium, argon, carbon dioxide, and methane to process analysis and laboratory equipment. This is accomplished with local gas cylinders which supply the required gas. The bottled gas system is nonsafety-related, therefore, this system is not required to remain functional during and following design basis or regulated events. The bottled gas system does not perform a license renewal intended function and, therefore, is not in scope for license renewal.

Volume Reduction System:
The purpose of the volume reduction system is to reduce the amount of solid radioactive waste. This is accomplished with trash separators, trash hoppers, drywaste processors, fluid bed dryers, flush water recovery tanks, gas and solid separators, HEPA and charcoal filters, polymer storage tanks, and associated piping, pumps, and valves. This equipment associated with the volume reduction system is not used for processing solid radioactive waste. The volume reduction system is nonsafety-related, therefore, this system is not required to remain functional during and following design basis or regulated events. The volume reduction system does not perform a license renewal intended function and, therefore, is not in scope for license renewal.

Acid Feed And Handling System:
The purpose of the acid feed and handling system is to supply sulfuric acid to the Steam Generator System blowdown mixed bed demineralizers and the Radwaste System mixed bed demineralizers. This is accomplished with day tanks, piping, and valves which supply sulfuric acid at required concentrations to these demineralizers. The acid feed and handling system is nonsafety-related, therefore, this system is not required to remain functional during and following design basis or regulated events. All portions of this system located in the Turbine Building Complex, the Radwaste and Service Building Complex, or outdoors do not perform a license renewal intended function and, therefore, is not in scope for license renewal.

Caustic Handling System:
The purpose of the caustic handling system is to supply caustic acid to the Steam Generator System blowdown mixed bed demineralizers and the Radwaste System mixed bed demineralizers. This is accomplished with day tanks, piping, and valves which supply caustic acid at required concentrations to these demineralizers. The caustic handling system is nonsafety-related, therefore, this system is not required to remain functional during and following design basis or regulated events. All portions of this system located in the Turbine Building Complex, the Radwaste and Service Building Complex, or outdoors do not perform a license renewal intended function and, therefore, is not in scope for license renewal.

For more detailed information, see UFSAR Section 6.2.6.2, 11.2, 11.3, and 11.4.

Boundary

The following is a description of the license renewal scoping boundary of the Radwaste System which as described previously consists of the following seven (7) plant systems: the radioactive waste gas system, the solid radwaste disposal system, the nitrogen system, the bottled gas system, the volume reduction system, the acid feed and handling system, and the caustic handling system.

Radioactive Waste Gas System:
The radioactive waste gas system scoping boundary begins at the gaseous vent header which collects gaseous waste from the Chemical & Volume Control System, Radioactive Drain System, Radwaste System, Reactor Coolant System, and the Sampling System during normal and emergency plant operation. The gaseous vent header continues to the waste gas compressors which then transfer compressed gas to the waste gas decay tanks and the recycle holdup tanks. Downstream of the waste gas decay tanks the system ends at the plant ventilation exhaust stack. Hydrogen, oxygen, and radiation monitors allow operations personnel to preclude the buildup of explosive mixtures and ensure compliance with the license conditions.

Solid Radwaste Disposal System:
The solid radwaste disposal system scoping boundary begins at the interface with the Steam Generator System where condensate is processed by prefilters, blowdown mixed bed demineralizers, and afterfilters and then continues to the 20,000 gallon blowdown monitor tanks. After the contents of these tanks are sampled condensate can be recycled to the condensate storage tanks or the condenser hotwell, or the condensate may be released via the 30,000 gallon release tanks.

Also, the solid radwaste disposal system scoping boundary begins at the evaporator header which takes process liquid from the Radioactive Drain System and the Non-Radioactive Drain System. The evaporator header continues to the evaporators and reboiler/stripping columns. The evaporator distillate pumps take suction from the evaporators and supply fluid to the radwaste mixed bed demineralizers and then ends at the radwaste after filters. The scoping boundary also includes vendor radwaste processing equipment that assist in radioactive liquid waste processing and recycling. Effluent continues to the 20,000 gallon radwaste monitor tanks. After the contents of these tanks are sampled, fluid may be recycled to primary water storage tanks or the 500,000 gallon radwaste storage tank (Braidwood); or transferred to the 30,000 gallon release tanks. The contents of 30,000 gallon release tanks may then be transferred to the turbine building equipment drain tank or the regeneration waste drain tank, or released to the circulating water blowdown line.

The solid radwaste disposal system scoping boundary also begins at the 30,000 gallon regeneration waste drain tank and associated piping, valves, instrumentation, and pumps. The system continues to the spent resin storage tanks, associated piping, valves, instrumentation, and pumps; the evaporator waste seal water tanks and associated piping, valves, instrumentation, filters, and pumps; the carbon filter surge tank, associated piping, valves, instrumentation, and pumps; and the decanting tanks; associated piping, valves, instrumentation, and pumps, cement tanks and equipment. The system ends at the radwaste drum processing stations and associated piping, valves, instrumentation, and pumps.

Nitrogen System:
The nitrogen system scoping boundary begins at the nitrogen system supply headers. These include the bulk liquid nitrogen tank, the low pressure header, and associated piping and valve. The boundary continues to the spent resin storage tank, the pressurizer relief tank, the volume control tank, the spray additive tanks, the gas decay tanks, the radwaste evaporators, the hydrogen recombiners, the reactor coolant drain tank, the recycle holdup tank, and ends at containment electrical penetrations. Also, at Byron, the system provides cover gas for the

primary water storage tanks. Also included in the scoping boundary is the backup high pressure header to the safety injection accumulators.

Bottled Gas System:
The bottled gas system scoping boundary begins at the bottled gas cylinders, continues to the piping and valves, and ends at the process analysis and laboratory equipment.

Volume Reduction System:
The volume reduction system scoping boundary begins at the waste liquid storage tanks and includes the associated piping, valves, instrumentation, and pumps. The system continues with the waste feed scrubber and associated piping, valves, instrumentation, blowers, and pumps; the fluid bed dryer, flush water recovery tank, and bed storage and transfer hopper and associated piping, valves, instrumentation, and pumps; the polymer storage tanks, and associated piping, valves, instrumentation, and pumps; the drywaste processor and associated piping, valves, instrumentation, and pumps; and the gas/solid separator and associated piping, valves, instrumentation, blowers, and pumps. The system ends at the trash hoppers and associated piping, valves, instrumentation, blowers, and pumps.

Acid Feed And Handling System:
The acid feed and handling system scoping boundary begins at the sulfuric acid day tank, continues to the sulfuric acid metering pumps, and ends at the Radwaste System mixed bed demineralizers and the Steam Generator System blowdown mixed bed demineralizers.

Caustic Handling System:
The caustic handling system scoping boundary begins at the caustic acid day tank and continues to the caustic metering pumps and ends at the Radwaste System mixed bed demineralizers and the Steam Generator System blowdown mixed bed demineralizers.

All associated piping, components, and instrumentation contained within the flow paths described above are included in the system evaluation boundary.

The Radwaste System interfaces with the Auxiliary Building Ventilation System which provides dilution and a release path for effluent gaseous releases and provides filtered vent paths for various Radwaste System tanks. The Auxiliary Building Ventilation System ducting, piping, dampers, and other components are included in the Auxiliary Building Ventilation System scoping boundary and are evaluated with the Auxiliary Building Ventilation System.

The Radwaste System interfaces with the Circulating Water System which provides dilution and a release path for liquid releases. The Circulating Water System piping, valves, and other components are included in the Circulating Water System scoping boundary and are evaluated with the Circulating Water System.

The Radwaste System interfaces with the Component Cooling System which cools the waste gas compressor heat exchangers. The Service Water System supply pipe and valves to the heat exchangers and associated heat exchanger components are included in the Service Water System scoping boundary and are evaluated with the Service Water System.

The Radwaste System interfaces with the Compressed Air System which supplies control air to various system components such as air operated valves. The Compressed Air System piping, valves and other components are included in the Compressed Air System scoping boundary and are evaluated with the Compressed Air System.

The Radwaste System interfaces with the Heating Water and Heating Steam System which supplies steam to various system heat exchangers. The Heating Water and Heating Steam System supply pipe and valves to the heat exchangers, associated heat exchanger components, and condensate return piping and valves are included in the Heating Water and Heating Steam System scoping boundary and are evaluated with the Heating Water and Heating Steam System.

The Radwaste System interfaces with the Low Voltage Auxiliary Power System which supplies power to various system components such as pumps and valve operators. The Low Voltage Auxiliary Power System commodities are included in the Low Voltage Auxiliary Power System scoping boundary and are evaluated with the Low Voltage Auxiliary Power System.

The Radwaste System interfaces with the Radioactive Drain System which collects fluids from floor and equipment drains and route the fluids to the Radwaste System. The Radioactive Drain System piping, valves, tanks, pumps, and other components are included in the Radioactive Drain System scoping boundary and are evaluated with the Radioactive Drain System.

The Radwaste System interfaces with the Radiation Monitoring System which monitors radiation levels in the Radwaste System. The Radiation Monitoring System piping, valves, pumps, and other components are included in the Radiation Monitoring System scoping boundary and are evaluated with the Radiation Monitoring System.

The Radwaste System interfaces with the Sampling System which collects process samples from various Radwaste System Tanks. The Sampling System supply and return piping, valves, and other components are included in the Sampling System scoping boundary and are evaluated with the Sampling System.

The Radwaste System interfaces with the Service Water System which cool various system heat exchangers. The Service Water System supply pipe and valves to the heat exchangers and associated heat exchanger components are included in the Service Water System scoping boundary and are evaluated with the Service Water System.

Also included in the license renewal scoping boundary of the Radwaste System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the system located within the Containment Structure and Auxiliary Building. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawings for identification of this boundary, shown in red.

Also included in the license renewal scoping boundary of the Radwaste System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor. Included in this boundary are components relied upon to preserve the structural support intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included in the scope of license renewal are gas filled portions of bottled gas system, the radioactive waste gas system, and the nitrogen system that are located within Containment

Structure and Auxiliary Building and do not perform the (a)(1) function of containment integrity and gaseous waste hold up. These gas filled portions of the system, which may be located within an area in proximity of components performing a safety-related function, do not pose a potential for water, oil, or steam leakage. Components that are not required to support the system's leakage boundary intended function and do not perform or support system intended functions are not included in the scope of license renewal.

Not included in the scope of license renewal are liquid and gas filled portions of the volume reduction system, the solid radwaste disposal system, the acid feed and handling system, and the caustic handling system located within the Turbine Building Complex or the Radwaste and Service Building Complex, as these portions of the system are not located within an area in proximity of components performing a safety-related function. Components that are not required to support the system's leakage boundary intended function and do not perform or support system intended functions are not included in the scope of license renewal.

Reason for Scope Determination

The Radwaste System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Radwaste System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Radwaste System is not in scope under 10 CFR 54.4(a)(3) because it is not relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provide primary containment boundary. The Radwaste System includes containment piping and isolation valves to assure that radioactive material is not inadvertently transferred out of the Containment Structure. In addition, the system maintains a continuous pressurized nitrogen blanket on electrical containment penetrations which are periodically monitored for leakage. 10 CFR 54.4(a)(1)

2. Maintain the dose consequences within the guidelines of 10 CFR 50.67 or 10 CFR 100. This is accomplished by providing long term waste gas holdup capacity via the waste gas decay tanks and associated isolation valves, thus, precluding the release of radioactive effluents during unfavorable environmental conditions. The waste gas decay tanks, associated isolation valves, and instrumentation are safety-related. 10 CFR 54.4(a)(1)

3. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety related function. The Radwaste System contains nonsafety-related water-filled lines in the Auxiliary Building that have the potential for spatial interactions (spray or leakage) with safety-related SSCs. Also, the Radwaste System includes nonsafety-related piping that is directly attached and provides structural support to safety-related piping. 10 CFR 54.4 (a)(2)

UFSAR References

6.2.6.2
11.2
11.3
11.4

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-49, Sheet 1A
LR-BYR-M-59, Sheet 1A, 1B
LR-BYR-M-64, Sheet 6, 7

Byron Unit 2:
LR-BYR-M-138, Sheet 6, 7
LR-BYR-M-149, Sheet 1

Byron Common:
LR-BYR-M-48, Sheet 2, 3A, 3B, 4B, 6A, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 20A, 20B, 21A, 21B, 21C, 26, 27, 31, 37, 38, 39, 40, 47, 48, 49, 52, 54
LR-BYR-M-63, Sheet 1B, 1C
LR-BYR-M-65, Sheet 1A, 1B, 4
LR-BYR-M-69, Sheet 1, 2
LR-BYR-M-74, Sheet 2
LR-BYR-M-82, Sheet 13, 15

Braidwood Unit 1:
LR-BRW-M-59, Sheet 1A, 1B
LR-BRW-M-64, Sheet 6, 7

Braidwood Unit 2:
LR-BRW-M-138, Sheet 6, 7
LR-BRW-M-149, Sheet 1

Braidwood Common:
LR-BRW-M-48, Sheet 2 , 3A, 3B, 4B, 6A, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20A, 20B, 21A, 21B, 21C, 31, 37, 38, 39, 40, 45, 52, 53, 54, 56, 57
LR-BRW-M-49, Sheet 1A
LR-BRW-M-63, Sheet 1B, 1C
LR-BRW-M-65, Sheet 1A, 1B, 4
LR-BRW-M-69, Sheet 1, 2
LR-BRW-M-82, Sheet 13, 15

Table 2.3.3-20 Radwaste System
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Compressor Housing (Waste Gas Compressor)	Leakage Boundary
Electric Heaters (Dilution Water Electric Heaters)	Leakage Boundary
Filter Housing	Leakage Boundary
	Structural Support - (Byron only)
Flow Device - (Byron only)	Structural Support
Heat Exchanger - (Feed Preheater) Tube Side Components	Leakage Boundary
Heat Exchanger - (Overheads Condenser) Shell Side Components	Leakage Boundary
Heat Exchanger - (Radwaste Evaporator Distillate After Cooler) Nozzles	Leakage Boundary
Heat Exchanger - (Radwaste Evaporator Distillate After Cooler) Plates	Leakage Boundary
Heat Exchanger - (Radwaste Evaporator Distillate After Cooler) Tie Bars	Mechanical Closure
Heat Exchanger - (Radwaste Evaporator Heating Element) Shell Side Components	Leakage Boundary
Heat Exchanger - (Radwaste Evaporator Heating Element) Tube Side Components	Leakage Boundary
Heat Exchanger - (Radwaste Evaporator Surface Condenser) Shell Side Components	Leakage Boundary
Heat Exchanger - (Radwaste Evaporator) Shell Side Components	Leakage Boundary
Heat Exchanger - (Radwaste Evaporator) Tube Side Components	Leakage Boundary
Heat Exchanger - (Waste Gas Compressor) Shell Side Components	Leakage Boundary
Piping Element	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
	Structural Support
Pump Casing (Acid Metering Pump - Braidwood only)	Leakage Boundary
Pump Casing (Caustic Metering Pump)	Leakage Boundary
Pump Casing (Chem/Regen Waste Drain Tank Pump)	Leakage Boundary
Pump Casing (Concentrate Piston Pump - Byron only)	Leakage Boundary

Component Type	Intended Function
Pump Casing (Concentrate Transfer Pump – Byron only)	Leakage Boundary
Pump Casing (Decant Pumps - Byron only)	Leakage Boundary
Pump Casing (Decanting Tank Piston Pump - Byron only)	Leakage Boundary
Pump Casing (High Level Spent Resin Pump - Braidwood only)	Leakage Boundary
Pump Casing (Low Level Spent Resin Pump - Braidwood only)	Leakage Boundary
Pump Casing (Radwaste Concentrates Booster Pump – Braidwood only)	Leakage Boundary
Pump Casing (Radwaste Evaporator Concentrate Pump)	Leakage Boundary
Pump Casing (Radwaste Evaporator Condensate Pump)	Leakage Boundary
Pump Casing (Radwaste Evaporator Distillate Pump)	Leakage Boundary
Pump Casing (Radwaste Evaporator Feed Pump)	Leakage Boundary
Pump Casing (Radwaste Evaporator Recycle Pump)	Leakage Boundary
Pump Casing (Radwaste Evaporator Seal Water Tank Pump - Byron only)	Leakage Boundary
Pump Casing (Radwaste Monitoring Pump)	Leakage Boundary
Pump Casing (Regeneration Waste Drain Tank Pump)	Leakage Boundary
Pump Casing (Spent Resin Flushing Pump)	Leakage Boundary
Pump Casing (Spent Resin Pump - Byron only)	Leakage Boundary
Pump Casing (Sulfuric Acid Metering Pump)	Leakage Boundary
Restricting Orifice	Leakage Boundary
Strainer Body	Leakage Boundary
Tanks (10,000 Gallon Chem/Regen Waste Drain Tank)	Leakage Boundary
Tanks (20,000 Gallon Radwaste Monitor Tank)	Leakage Boundary
Tanks (Blowdown Mixed Bed Demineralizer)	Leakage Boundary
Tanks (Caustic Day Tank)	Leakage Boundary
Tanks (Concentrate Holding Tank - Byron only)	Leakage Boundary
Tanks (Decanting Tank - Byron only)	Leakage Boundary

Component Type	Intended Function
Tanks (Decanting Tank Level Control Chamber - Byron only)	Leakage Boundary
Tanks (Drum Processing Unit - Byron only)	Leakage Boundary
Tanks (Gas Decay Tank)	Pressure Boundary
Tanks (High Level Spent Resin Storage Tank - Braidwood only)	Leakage Boundary
Tanks (Low Level Spent Resin Storage Tank - Braidwood only)	Leakage Boundary
Tanks (Radwaste Evaporator Concentrate Receiver)	Leakage Boundary
Tanks (Radwaste Evaporator Seal Water Tank)	Leakage Boundary
Tanks (Radwaste Evaporator Vapor Body Tank)	Leakage Boundary
Tanks (Radwaste Mixed Bed Demineralizers)	Leakage Boundary
Tanks (Regeneration Waste Drain Tank)	Leakage Boundary
Tanks (Spent Resin Storage Tank - Byron only)	Leakage Boundary
Tanks (Sulfuric Acid Day Tank)	Leakage Boundary
Tanks (Waste Gas Compressor Separator)	Leakage Boundary
Valve Body	Leakage Boundary
	Pressure Boundary
	Structural Support

The aging management review results for these components are provided in:

Table 3.3.2-20	Radwaste System Summary of Aging Management Evaluation

2.3.3.21 Sampling System

Description

The Sampling System is a normally operating mechanical system consisting of the primary sampling subsystem and the secondary sampling subsystem. The Sampling System consists of the plant system process sampling. Portions of the Sampling System subsystems for primary sampling and secondary sampling are in scope for license renewal. However, portions of the Sampling System subsystems for primary sampling and secondary sampling are not required to perform intended functions and are not in scope for license renewal.

The Sampling System provides a means for obtaining liquid and gas (for hydrogen monitoring) samples for in-line and laboratory analysis of the chemical and radiochemical conditions of the designated fluid systems during all normal reactor operations and post-accident conditions.

The license renewal intended function of the Sampling System is to provide primary containment boundary by isolating the reactor coolant sample lines, pressurizer sample lines, safety injection accumulator tank sample lines, and post-accident hydrogen monitoring line containment penetrations with redundant air-operated or solenoid operated, primary containment isolation valves. The Sampling System piping and safety-related valves associated with containment penetrations are in scope for license renewal. In addition, the automatic containment isolation valves are environmentally qualified (EQ) and are in scope for license renewal.

The primary sampling subsystem is designed to monitor primary plant chemistry by manual operation on an intermittent basis under conditions ranging from full power operation to cold shutdown and post-accident conditions. Laboratory analysis of the primary sampling subsystem samples provides guidance in the operation of various primary systems including the reactor coolant system, pressurizer, steam generator blowdown system, residual heat removal system, chemical and volume control system, safety injection system, and containment ventilation system.

The purpose of the primary sampling subsystem is to provide a means to obtain liquid and gas samples, to provide in-line or laboratory analysis, to analyze for chemical and radiochemical conditions, and to monitor post-accident hydrogen gas concentrations in containment. The primary sampling subsystem accomplishes this purpose through various flow paths which include sample points from the primary systems.

The secondary sampling subsystem is designed to continuously monitor secondary plant chemistry and detect steam generator tube leaks under conditions ranging from full power operation to cold shutdown. Grab samples for laboratory analysis of the secondary sampling subsystem can also provide guidance in the operation of various plant secondary systems.

The purpose of the secondary sampling subsystem is to provide a means to monitor secondary system chemistry. The secondary sampling subsystem accomplishes this purpose by providing a means to automatically analyze potentially radioactive and non-radioactive liquid samples in-line and the components necessary to acquire grab samples for laboratory analysis.

Primary Sampling Subsystem:
The primary sampling subsystem samples liquid from various primary plant systems and for hydrogen in the containment atmosphere.

The primary sampling subsystem samples liquids from the high radiation sampling systems (HRSS) using the sample cooler panel coolers and the liquid sample panels, located in the auxiliary building and have the capability of sampling the following: pressurizer steam space, pressurizer liquid, reactor coolant hot legs, reactor coolant cold legs, residual heat removal heat exchanger outlets, safety injection accumulators, chemical and volume control demineralizer outlet, boron thermal regeneration demineralizer outlet, reactor coolant filter outlet, reactor coolant letdown heat exchanger outlet, containment floor drain sump, steam generator blowdown, HRSS waste drain tank, auxiliary building floor drain tank, auxiliary building equipment drain tank, and chemical drain tank. At the liquid sample panel, samples can be directed to the purge path or used for a grab sample. Sample flow rates are designed to provide turbulent flow and to supply a representative sample. Sample flow rates are limited to provide sufficient delay time for decay of short lived radioactive isotopes to minimize personnel exposure. Reactor coolant sample points flow through a delay coil designed to extend sample transit time and allow for the decay of short lived radioactive isotopes.

When liquid sample temperatures are too high, the samples are cooled by sample coolers mounted on the sample cooler panel, which is not enclosed, prior to analysis. Cooling water for the sample coolers is provided by the Component Cooling System. The samples are analyzed at the liquid sample panel which is divided into three (3) modules: reactor coolant liquid sample module, demin liquid sample module, and the radwaste liquid sample module. Purging capability ensures representative samples. The purge flow goes to the volume control tank, chemical drain tank, HRSS waste drain tank, or is recirculated back to the system being sampled. The liquid sample panel drains to the HRSS waste drain tank which can be pumped to the chemical drain tank, auxiliary building floor drain tank, or back to the liquid sample panel. There are also spare sample coolers on the sample cooler panel. The sample cooler panel coolers and liquid sample panel components are not required to operate to support license renewal intended functions. The sample cooler panel in the sample room of the auxiliary building is not enclosed and has the potential for spatial interaction with safety-related components. Therefore, the components mounted on the sample cooler panel are in scope for the license renewal. Although the liquid sample panel is located in the sample room of the auxiliary building, the panel enclosure provides physical shielding such that these components do not have the potential for spatial interaction with safety-related components. The panel enclosure prevents leakage or spray from impacting safety-related components. Therefore, the components mounted in the liquid sample panel are not in scope for license renewal. The open sample cooler panel and the enclosed liquid sample panel are evaluated by the Structural Commodity Group.

The primary sampling subsystem post-accident hydrogen monitoring system is capable of analyzing hydrogen concentration in containment atmosphere by drawing samples of containment atmosphere and analyzing the samples for hydrogen concentration during post-accident conditions. Gas samples drawn in from the containment through the post-accident hydrogen monitor panels are returned to the containment. Sample flows are limited to provide sufficient delay time to minimize personnel exposure. Operation of the post-accident hydrogen monitor panels is independent of the hydrogen recombiner analyzers (evaluated by the Combustible Gas Control System). The Sampling System and Combustible Gas Control System each use separate piping and containment penetrations and are not dependent upon the other to operate in any way. The post-accident hydrogen monitoring system consists of two independent, physically separated, and redundant subsystems. Separate piping penetrations of the containment are utilized by each train of this system. A sample of the containment atmosphere is taken at or near one of the containment penetrations and another approximately 180 degrees away on the other side of the containment (approximately 135 degrees away for Byron Unit 2 only). The samples taken are representative of the containment atmosphere due to the mixing system effects. A series of calibration gas bottles are used to ensure proper operation of the hydrogen analyzer. The calibration gas bottles are periodically replaced and are, therefore, considered short-lived components and not subject to aging management review. The post-accident hydrogen monitoring equipment is classified safety-related, and therefore is in scope for license renewal.

Secondary Sampling Subsystem (potentially radioactive):
The secondary sampling subsystem is divided into two (2) portions, a potentially radioactive portion and a non-radioactive portion. The potentially radioactive portion of the secondary sampling subsystem consists of flow paths from the steam generators and the radwaste blowdown mixed bed demineralizers through a common sample conditioning panel located in the auxiliary building inside the hot laboratory. The sample conditioning panel is constructed of stainless steel. The sample conditioning panel inside the hot laboratory contains valves, primary coolers, secondary coolers, flow instruments, pressure instruments, temperature instruments, a sample sink, and allows for radiation monitoring. A continuous sample from each steam generator and radwaste blowdown mixed bed demineralizer is routed through automatic chemical and radiological monitoring instruments. The sample conditioning panel sink drains to the steam generator blowdown condenser or to the auxiliary building floor drain system. This sample conditioning panel is not required to operate to support license renewal intended functions. Although the sample conditioning panel is located in the auxiliary building, the sample conditioning panel is not in an area adjacent to components performing a safety-related function. Additionally, the hot laboratory and sample conditioning panel enclosure provides physical shielding such that the sample conditioning panel does not have the potential for spatial interaction with safety-related components. The room structure and sample conditioning panel enclosure prevents leakage or spray from impacting safety-related components. Therefore, the components mounted in the sample conditioning panel are not in scope for license renewal. The sample conditioning panel enclosure is evaluated by the Structural Commodity Group.

The blowdown sample cooling skid is located in the auxiliary building outside the hot laboratory and serves as the heat sink for the sample conditioning panel. The blowdown sample cooling skid contains a primary cooler heat exchanger, surge tanks, primary cooler pumps, secondary cooler pumps, pressure instruments, and an isolation heat exchanger (Byron only) or a unit with evaporators and condensers (Braidwood only). The blowdown sample cooling skid is not required to operate to support license renewal intended functions. However, the blowdown sample cooling skid is not enclosed and is located in the auxiliary building, an area adjacent to components performing a safety-related function. Therefore, the components mounted on the blowdown sample cooling skid are included in the scope of license renewal due to the potential for spatial interaction.

During shutdown conditions, steam generator samples are pumped to the sample conditioning panel. The piping, pumps, and heat exchangers associated with acquiring steam generator samples during shutdown conditions are in the auxiliary building which is an area adjacent to components performing a safety-related function. Therefore, these components are included in the scope of license renewal due to the potential for spatial interaction.

Secondary Sampling Subsystem (non-radioactive):
The non-radioactive portion of the secondary sampling subsystem consists of flow paths from the various loads through the secondary sample sink and associated secondary sample panel located in the secondary sample room of the turbine building and the common circulating water sample panel located in the river screen house.

The secondary sample sink is located in the turbine building. The secondary sample sink drains to the turbine building equipment drain system. The secondary sample sink is not required to support license renewal intended functions and is not in an area adjacent to components performing a safety-related function. Therefore, the secondary sample sink and associated components are not in the scope of license renewal.

The circulating water sample panel is located in the river screen house and is used to obtain samples of the circulating water header blowdown fluid and the circulating water makeup pump discharge fluid. The circulating water sample panel components are not required to operate to support license renewal intended functions.

At Byron, the river screen house contains safety-related equipment and, therefore, the circulating water sample panel (not enclosed) and associated components at Byron are included in the scope of license renewal due to the potential for spatial interaction.

At Braidwood, the river screen house does not contain any safety related equipment and therefore, the circulating water sample panel and associated components at Braidwood are not in scope for license renewal.

For more detailed information, see UFSAR Sections 6.2.5.2.2 and 9.3.2.

Boundary

Primary Sampling Subsystem:
The Sampling System primary sampling subsystem scoping boundary for gas sampling of the containment atmosphere for hydrogen concentration begins at the sample suction lines inside containment which are threaded pipe caps with holes (Byron) or threaded nipples (Braidwood). The containment atmosphere sample is drawn through containment penetrations and primary containment isolation valves to the post-accident hydrogen monitor panels, through sample discharge lines with primary containment isolation valves, and terminates inside containment at the threaded pipe caps with holes (Byron) or threaded nipples (Braidwood).

The Sampling System primary sampling subsystem scoping boundary for liquid sampling begins at the downstream side of the air-operated isolation valves or manual isolation valves in the primary system sample lines. Liquid sample lines from the Reactor Coolant System, Residual Heat Removal System, Chemical Volume & Control System, Safety Injection System, Radioactive Drain System and Steam Generators continue through sample cooler panel coolers to the liquid sample panel which contains three modules for analysis of demineralized liquid, reactor coolant liquid, and radwaste liquid. Downstream of the demineralized liquid sample module, the subsystem flow continues to the accumulator tank or terminates downstream of an air-operated valve to the chemical drain tank (part of the Radioactive Drain System) or downstream of an air-operated valve to the volume control tank (part of the Chemical Volume & Control System). Downstream of the reactor coolant liquid sample module, the subsystem flow continues to the HRSS (high radiation sampling system) waste drain tank. Downstream of the radwaste liquid sample module, the subsystem flow continues to the HRSS waste drain tank or terminates at multiple points including upstream of a check valve in the inlet piping to the auxiliary building floor drain tank (part of the Radioactive Drain System), upstream of a check valve in the inlet piping to the auxiliary building equipment drain tank (part of the Radioactive Drain System), upstream of a check valve in the inlet piping to the recycle holdup tank (part of the Chemical Volume & Control System), upstream of a check valve in the inlet piping to the chemical drain tank (part of the Radioactive Drain System) or upstream of a check valve in the inlet piping to the regeneration waste drain tank (part of the Radwaste System). Additionally, subsystem flow is pumped out of the HRSS waste drain tank to multiple paths including back to the HRSS waste drain tank, back to be resampled in the radwaste liquid sample module, or the subsystem flow terminates upstream of a plug valve in the inlet piping to the chemical drain tank (part of the Radioactive Drain System) or upstream of a check valve in the inlet piping to the auxiliary building floor drain tank (part of the Radioactive Drain System).

Secondary Sampling Subsystem (potentially radioactive):
The Sampling System secondary sampling subsystem scoping boundary for sampling the steam generators and radwaste blowdown mixed bed demineralizers, which are potentially radioactive liquids, begins downstream of the air operated isolation valves in the steam generator blowdown sample lines of the Steam Generators and downstream of the manually operated ball valve in the radwaste blowdown mixed bed demineralizer sample lines of the Radwaste System, continues through a sample conditioning panel through the tube side of the primary and secondary sample coolers, continues to the grab sample panel for analysis in the hot laboratory, and terminates at the sample sink drains. The Steam Generator samples can be directed to either the secondary sampling subsystem or the primary sampling subsystem. The sample conditioning panel primary and secondary sample coolers are cooled on the shell side by a closed-loop demineralized water system. Included in the potentially radioactive portion of the secondary sampling subsystem is a blowdown sample cooling skid which contains primary cooler pumps, surge tanks, a primary cooler heat exchanger, secondary cooler pumps, and an isolation heat exchanger (Byron only) or a unit with evaporators and condensers (Braidwood only). The primary cooler pumps take suction from a surge tank with demineralized water, discharge through the shell side of the primary coolers, return through the tube side of the primary cooler heat exchanger, and terminate in the surge tank. The shell side of the primary cooler heat exchanger is cooled by non-essential service water and is evaluated by the Service Water System.

For the Byron blowdown sample cooling skid, the secondary cooler pumps take suction from a surge tank with demineralized water, discharge to the process side of the isolation skid cooler plate-type heat exchanger, continue through the shell side of the secondary coolers, and terminate in the surge tank. The cooling side of the isolation skid cooler plate-type heat exchanger is cooled by the Chilled Water System and is evaluated by the Chilled Water System. Makeup to the surge tank of this closed loop is provided by the Demineralized Water System. Demineralized water lines and components upstream of the blowdown sample cooling skid are evaluated by the Demineralized Water System.

For the Braidwood blowdown sample cooling skid, the secondary cooler pumps take suction from a surge tank with demineralized water, discharge to the tube side of evaporators, continues through the shell side of the secondary coolers, and terminate in the surge tank. The shell side of the evaporators contains refrigerant which flows to the shell side of the condensers. The tube side of the condensers is cooled by non-essential service water and is evaluated by the Service Water System. Makeup to the surge tank of this closed loop is provided by the Demineralized Water System. Demineralized water lines and components upstream of the blowdown sample cooling skid are evaluated by the Demineralized Water System

Secondary Sampling Subsystem (non-radioactive):
The Sampling System secondary sampling subsystem scoping boundary for the non-radioactive secondary plant systems begins at sample lines of the following: condensate makeup pump discharge, condensers, condensate pump discharge, condensate booster pump discharge, feedwater pump discharge, main steam, drain cooler outlets, heater drain pump discharge, auxiliary boiler feedwater, auxiliary boiler blowdown, and essential service water (Byron only). The samples continue through a sample conditioning panel, through the tube side of the primary and secondary sample coolers, through analysis instrumentation, and terminate at the sample sink drains. All components associated with the non-radioactive portion of the secondary sampling subsystem are located in the turbine building, and therefore this part of the system of the secondary sampling subsystem is not in the scope of license renewal.

Sampling of circulating water makeup and circulating water blowdown is performed at a sample panel in the river screen house. These sample flows begin at the inlet to the circulating water sample panel, continue through the circulating water sample panel, into the circulating water sample panel sink, and terminate in the river screen house floor drain system.

All associated piping, components and instrumentation contained within the flow path described above are included in the system evaluation boundary.

The tube side of the sample coolers on the sample cooler panel is evaluated by the Sampling System. The shell side of the sample coolers, including the shell side of the spare sample coolers, is evaluated with the Component Cooling System.

The tube side of the primary cooler heat exchanger is evaluated by the Sampling System. The shell side of the primary cooler heat exchanger is evaluated with the Service Water System.

At Byron, the process side of the cooling water isolation skid plate-type heat exchanger on the blowdown sample cooling skid is evaluated by the Sampling System. The cooling side of the isolation skid cooler plate-type heat exchanger is evaluated with the Chilled Water System.

At Braidwood, the shell side of the refrigeration condenser on the blowdown sample cooling skid is evaluated by the Sampling System and is not in scope for license renewal. The tube side of the refrigeration condenser is evaluated with the Service Water System.

The process side of the steam generator blowdown (SGBD) sample coolers, a plate-type heat exchanger, is evaluated by the Sampling System. The cooling side of the SGBD sample coolers is evaluated with the Service Water System.

The process radiation monitoring plant system, which interfaces with the Sampling System, is evaluated with the Radiation Monitoring System.

Also included in the license renewal scoping boundary of the Sampling System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the system located within the

Containment Structure, the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms, the Auxiliary Building, and the Byron River Screen House. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included in the scope of license renewal are piping and components associated with the primary sampling subsystem enclosed liquid sample panel, the tube side of the spare sample coolers, the nitrogen and waste gas piping and components associated with the HRSS tank, the circulating water sample panel in the Braidwood river screen house, and the secondary sampling subsystem located in the hot laboratory and turbine building. These portions of the Sampling System are nonsafety-related, do not have the potential for spatial interaction with safety-related components, do not support the system's leakage boundary intended function, and do not perform or support system intended functions. Therefore, these portions of the Sampling System are not included in the scope of license renewal.

Reason for Scope Determination

The Sampling System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Sampling System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Sampling System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Sampling System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provide primary containment boundary. The Sampling System hydrogen monitoring, reactor coolant samples, pressurizer samples, and safety injection accumulator tank samples contain valves and components that provide the primary containment isolation function to confine radioactive materials. 10 CFR 54.4(a)(1)

2. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Sampling System contains nonsafety-related water filled lines in the Containment Structure, the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms, the Auxiliary Building, and the Byron River Screen House that have the potential for spatial interactions (spray or leakage) with safety-related SSCs. The Sampling System contains water filled portions of nonsafety-related piping and components located in proximity to equipment performing a safety-related function. 10 CFR 54.4 (a)(2)

3. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Environmental Qualification (10 CFR 50.49). The Sampling System primary containment isolation valves and associated equipment and instrumentation that is used for automatic actuation of its protective functions following a design basis accident and are part of the EQ program. 10 CFR 54.4(a)(3)

UFSAR References

6.2.5.2.2
9.3.2

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-68, Sheet 1A, 1B, 4, 6, 7, 8

Byron Unit 2:
LR-BYR-M-48, Sheet 5B
LR-BYR-M-140, Sheet 1, 5, 6, 7

Byron Common:
LR-BYR-M-48, Sheet 4B, 6A, 7, 17, 54
LR-BYR-M-65, Sheet 2A, 2B
LR-BYR-M-68, Sheet 2, 2A
LR-BYR-M-74, Sheet 1

Braidwood Unit 1:
LR-BRW-M-68, Sheet 1A, 1B, 6, 7, 8

Braidwood Unit 2:
LR-BRW-M-48, Sheet 5B
LR-BRW-M-140, Sheet 1A, 1B, 5, 6, 7

Braidwood Common:
LR-BRW-M-48, Sheet 2, 4B, 6A, 7, 17, 54
LR-BRW-M-65, Sheet 2A, 2B
LR-BRW-M-68, Sheet 2, 2A

Table 2.3.3-21 Sampling System
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Heat Exchanger - (Blowdown Sample Cooling Skid Evaporator - Braidwood only) Tube Side Components	Leakage Boundary
Heat Exchanger - (Blowdown Sample Cooling Skid Evaporator - Braidwood only) Tubes	Leakage Boundary
Heat Exchanger - (Blowdown Sample Cooling Skid Primary Cooler) Tube Side Components	Leakage Boundary
Heat Exchanger - (Cooling Water Isolation Skid - Byron only) Nozzles	Leakage Boundary
Heat Exchanger - (Cooling Water Isolation Skid - Byron only) Plates	Leakage Boundary
Heat Exchanger - (Cooling Water Isolation Skid - Byron only) Tie Bars	Mechanical Closure
Heat Exchanger - (SGBD Sample Cooler) Nozzles	Leakage Boundary
Heat Exchanger - (SGBD Sample Cooler) Plates	Leakage Boundary
Heat Exchanger - (SGBD Sample Cooler) Tie Bars	Mechanical Closure
Heat Exchanger - (Sample Cooler Panel Coolers) Tube Side Components	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
Pump Casing (Accumulator Tank Transfer Pump)	Leakage Boundary
Pump Casing (HRSS Waste Drain Tank Pump)	Leakage Boundary
Pump Casing (Positive Displacement Sample Pump)	Leakage Boundary
Pump Casing (Primary Cooler Pump)	Leakage Boundary
Pump Casing (Secondary Cooler Pump)	Leakage Boundary
Sensor Element (Post-Accident Hydrogen Monitor Panel)	Pressure Boundary
Tanks (Accumulator Tank)	Leakage Boundary
Tanks (Blowdown Sample Cooling Skid Surge Tank)	Leakage Boundary
Tanks (HRSS Waste Drain Tank)	Leakage Boundary
Tanks (Pulsation Dampener)	Leakage Boundary
Tanks (Sample Reboiler - Braidwood only)	Leakage Boundary

Component Type	Intended Function
Valve Body	Leakage Boundary
	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.3.2-21	Sampling System Summary of Aging Management Evaluation

2.3.3.22 Service Water System

Description

The Service Water System is a normally operating, mechanical system designed to provide cooling water to safety-related and nonsafety-related plant components during normal operation and design basis accident conditions. The Service Water System consists of five plant systems: essential service water system, non-essential service water system, screen wash system (Braidwood only), lake cooling (Braidwood only), and portions of the chemical feed and handling system. The Service Water System is in scope for license renewal. However, portions of the Service Water System, specifically, the non-essential service water system in the Turbine Building Complex and Circulating Water Pump House (Byron) are not required to perform any intended functions and are not in scope. Similarly, portions of the non-essential service water, the screenwash system, and lake cooling system in the Turbine Building Complex, River Screen House (Braidwood) and lake screen house (Braidwood) are not required to perform any intended functions and are not in scope for license renewal.

The purpose of the Service Water System (essential service water portion) is to provide cooling water to safety-related components and equipment essential to the safe shutdown of the reactor and transfer heat back to the ultimate heat sink. The main difference between the Service Water Systems at the two sites is the source of water for essential and non-essential service water, which is discussed below. The Service Water System also provides cooling for the reactor containment fan coolers to remove heat from the Containment Structure during normal and accident conditions. The essential service water portion of the Service Water System also provides a safety-related, backup source of water to the auxiliary feedwater pumps in the event that the condensate storage tank is not available and provides a source of water to the Fire Protection System in the event of a loss of the fire protection pumps. Essential service water also provides a safety-related makeup source of water to the Component Cooling System, and provides a safety-related spent fuel pool makeup through the Fire Protection System. Each of the two essential service water trains (loops) consists of three parallel paths downstream of each pump strainer: two essential service water flow paths through its own train of components and one cross-train service water flow path.

Each unit has a cross-train flow path through normally-open valves used to satisfy the single failure criteria. In the event of a passive component failure (leak), these valves can be closed to isolate one train from the other to ensure system availability. Essential service water to the common component cooling heat exchanger is normally aligned through the unit which was last shutdown. There is also a capability to establish a cross-tie between the two units through the use of normally-closed valves to satisfy specific abnormal operating conditions.

The essential service water portion of the Service Water System accomplishes this purpose by providing screened water to the service water pump suctions and then circulating that water through each essential service water train, which includes at least one component cooling heat exchanger, lube oil and gear oil coolers for the ECCS pumps, motor-driven auxiliary feedwater pump lube oil cooler, cubicle coolers for various pumps, reactor containment fan coolers, containment ventilation refrigeration unit condenser, and control room ventilation refrigeration unit condenser. In an emergency, essential service water can also be provided to the following loads: diesel generator heat exchangers and suction of the auxiliary feedwater shaft-driven essential service water booster pump. The essential service water pumps are automatically sequenced onto the diesel generators following an ECCS actuation with loss of offsite power for a design basis event or undervoltage on the associated safety-related bus. Radiation monitors are provided in each reactor containment fan cooler line to provide the operator indication of leakage from containment into one of the essential service water cooling outlet lines during a design basis event.

The purpose of the non-essential service water portion of the Service Water System is to provide cooling water to several nonsafety-related heat exchangers in the Auxiliary Building and turbine building. In the Auxiliary Building, the non-essential service water system provides cooling water to the following loads: steam generator blowdown condensers and sample coolers, auxiliary steam vent condenser, computer room HVAC, Auxiliary Building HVAC refrigeration unit, and radwaste and remote shutdown control room HVAC condensing units. In the Main Steam & Auxiliary Feedwater and Isolation Valve Rooms, non-essential service water provides cooling flow to the main steam and feedwater penetration cooling coils. The non-essential service water system loads in the Auxiliary Building are in scope for license renewal since they have the potential for spatial interaction with safety-related components. In the turbine building, the non-essential service water system provides cooling water to the following loads: station air compressors, main turbine lube oil coolers, various secondary pump oil coolers, and various main generator system coolers. Most of the non-essential service water system loads in the turbine building are not in scope for license renewal since they do not have the potential for spatial interaction with safety-related components. The non-essential service water loads are powered from nonsafety-related buses and are not required to mitigate the consequences of a design basis accident. Sodium hypochlorite is added to both the non-essential and essential service water systems at the intake structures to control microbiologically-induced corrosion. Portions of the chlorination system are also included in the scope of the Service Water System.

At Byron Station, the essential service water cooling water towers provide the water source and the ultimate heat sink for the essential service water portion of the Service Water System. Each of the towers is provided with continuous makeup to offset the blowdown and evaporative losses. The primary source of nonsafety-related makeup water for these towers during normal operation is through the circulating water makeup line from the circulating water makeup pumps located at the river screen house. These circulating water makeup pumps and the associated piping are included in the scope of license renewal due to potential spatial interaction with safety-related equipment. The secondary source of nonsafety-related makeup water is the deep wells located on-site. These pumps and associated piping are in scope for license renewal and are evaluated with the Demineralized Water System. The safety-related source of makeup water is from the diesel-driven essential service water makeup pumps located at the river screen house on the Rock River. The diesel-driven essential service water makeup pumps and associated piping to the essential cooling water towers are safety-related and are in scope for license renewal. The Circulating Water Pump House provides the water source and the heat sink for the non-essential service water portion of the Service Water System. The Circulating Water Pump House components are not in scope for license renewal since they do not have the potential for spatial interaction with safety-related components.

At Braidwood Station, the Service Water System draws its water from the cooling pond. The safety-related water source and the ultimate heat sink for the essential service water portion of the Service Water System is the essential service cooling pond which is a rectangular excavated area within the cooling pond, adjacent to the lake screen house at a depth approximately six feet lower than the rest of the cooling pond. The essential service water and non-essential service water portions of the Service Water system take suction from the cooling pond, circulate water through the safety-related and nonsafety-related loads, and discharge back into the cooling pond. Adjacent to the Lake Screen Structures, the Braidwood cooling pond, also referred to as the Braidwood Lake, is a water-filled former strip-mined area, which has nonsafety-related makeup from the Kankakee River. The Braidwood cooling pond has an average depth of approximately five feet and normal water level is about five feet below plant grade. The purpose of the Braidwood cooling pond is to provide a source of cooling water for the Circulating Water System and other nonsafety-related cooling systems. The cooling pond has an internal dike system intended to direct the warm water flow from the circulating water discharge around the perimeter of the pond and back to the lake screen house. The essential service water cooling pond portion of the Braidwood cooling pond is designed to provide an adequate cooling water volume for a minimum of thirty days operation with no makeup during a design basis LOCA on one unit with the other unit being shutdown.

The Service Water System has several interfaces with other systems that are not in the scope of license renewal which include the Circulating Water System, Condensate and Feedwater Auxiliaries System, Main Condenser and Air Removal System, Main Generator and Auxiliaries System, Main Turbine and Auxiliaries System, and Compressed Air System.

For more detailed information, see UFSAR Sections 2.4.1.1 (Byron), 2.4.1.1 (Braidwood), 9.2.1, 9.2.5 (Byron), and 9.2.5 (Braidwood).

Boundary

The scoping boundary for the essential service water portion of the Service Water System begins at the intake structures which are the essential service water cooling towers at Byron and the essential service cooling pond at Braidwood. At Byron and Braidwood, the essential service water portion of the Service Water System flow paths are similar starting at the essential service water pumps in the Auxiliary Building through the various safety-related heat loads. The major difference between the Byron and Braidwood sites is the source of water for the essential service water and non-essential service water portions of the Service Water System and the makeup water to the essential service water system. Therefore, the scoping boundary flow paths starting at the essential service water pumps in the Auxiliary Building and through the safety-related heat loads will be discussed first, followed by the scoping boundary differences due to the different makeup water sources to the essential service water system at Byron and Braidwood.

At Byron and Braidwood, the scoping boundary for the suction of essential service water pumps begins at the intake structures, through the two underground pipes, and continues into two essential service water pump rooms in the Auxiliary Building. One room contains the Unit 1 and Unit 2 "A" train pumps, while the other room contains the Unit 1 and Unit 2 "B" train pumps. The scoping boundary continues through the essential service water pumps and strainers into three potential parallel flow paths (the same train components, the opposite train components, and the other unit essential service water loads). The specific heat exchangers included in each essential service water train are: component cooling heat exchanger, lube oil and gear oil coolers for the ECCS pumps, cubicle coolers for various pumps, reactor containment fan coolers cooling coils, containment ventilation refrigeration unit condenser, diesel generator heat exchangers, motor-driven auxiliary feedwater pump lube oil cooler, and control room ventilation refrigeration unit condenser. This scoping boundary includes these heat exchangers in the Auxiliary Building and Containment Structure, and the piping back to the essential service water cooling towers at Byron and the cooling pond at Braidwood. Also included in the scoping boundary are the alternate supply lines to the Auxiliary Feedwater System on the upstream side of the auxiliary feedwater pump suction motor-operated isolation valve. The scoping boundary also includes the piping to the Fire Protection System which ends on the downstream side of the essential service water supply to fire protection manual isolation valve. The scoping boundary includes the piping and valves to align essential service water to the common component cooling heat exchanger.

At Byron, the scoping boundary for the essential service water portion of the Service Water System begins at the essential service water cooling tower basins and continues into the Auxiliary Building to the suction of the essential service water pumps. The scoping boundary for the safety-related makeup water supply to the essential service water system begins at the Rock River, continues into the River Screen House through circulating water traveling screens, through the suction strainer of each diesel-driven essential service water makeup pump, through the pump, to the discharge line, and terminating in the essential service water cooling tower basins. This scoping boundary for the makeup water supply includes the piping and valves from the River Screen House to the essential service water cooling tower basins. Also included in the scoping boundary of the water source are essential service water cooling towers, which are constructed (0A & 0B) with four cooling cells each. One suction line draws water from each tower and each line goes to a separate essential service water pump room in the Auxiliary Building. The 0A tower supplies water to pumps 1A and 2A, and the 0B tower supplies water to pumps 1B and 2B. The scoping boundary also includes the piping from the outlet of the essential service water loads, and terminates at the essential service water cooling towers.

At Braidwood, the scoping boundary for the makeup water source to the essential service water portion of the Service Water System begins at the essential service cooling pond (located in the main cooling pond), continues through the circulating water traveling screen in the lake screen house, and into the Auxiliary Building to the suction of the essential service water pumps. Makeup water to the essential service water system is provided by water in the cooling pond. The scoping boundary includes the three suction lines for each unit that draws suction from the essential service water cooling pond and converges into a single line for each train. This scoping boundary includes each line, which goes to each separate pump room in the Auxiliary Building. From the lake screen house, the piping to the first room provides water to the Unit 1 and Unit 2 "A" train pumps, and piping to the second room provides water to the Unit 1 and Unit 2 "B" train pumps. The scoping boundary also includes the piping from the outlet of the essential service water loads, continues to the essential service discharge structure, and terminates slightly above the surface of the cooling pond.

The scoping boundary for the non-essential service water portion of the Service Water System begins at the circulating water pump house at Byron and lake screen house at Braidwood. Water is pumped from the non-essential service water pumps through the underground piping to the Turbine Building Complex. At Byron, there is no screenwash system at the Circulating Water Pump House, however, there is a screenwash subsystem at the River Screen House where the circulating water makeup source is screened for large debris. At Braidwood, the screen wash system is part of the discharge flow of the non-essential screenwash pump strainers, but this system is not in the scope of license renewal since there are no intended functions. The non-essential service water system continues through the nonsafety-related heat exchangers and coolers for the various loads in the turbine building. Portions of the non-essential service water system in the turbine building are in scope for license renewal due to the proximity to the Auxiliary Building wall HVAC penetrations. The scoping boundary for this part of the Service Water System begins at the entrance of the Turbine Building Complex, continues into the Auxiliary Building and Main Steam & Auxiliary Feedwater Tunnels and

Isolation Valve Rooms, and ends where the piping exits from the tunnel and re-enters the Turbine Building Complex.

The chlorination system is in scope for those portions of the system in the intake structures (Essential Service Water Cooling Towers (Byron), lake screen house (Braidwood), Auxiliary Building) for potential spatial interaction with other safety-related equipment in that structure.

All associated piping, components, and instrumentation contained in the above described flow paths necessary for performance of their design function are included in the system evaluation boundary.

Not included in the Service Water System scoping boundary are the portions of the Service Water System components that are part of the diesel-driven auxiliary feedwater pump, which are evaluated with the Auxiliary Feedwater System. The Service Water System provides cooling water for the various ECCS and other pump room coolers, which are evaluated in the Auxiliary Building Ventilation System. The Service Water System provides cooling water for the centrifugal charging pumps bearing oil and gear oil, as well as the bearing oil for the safety injection pumps. These coolers are evaluated with the Chemical & Volume Control System and Safety Injection System, respectively. The Service Water system provides cooling water for the control room refrigeration unit condensers, which are evaluated with the Chilled Water System. The jacket water heat exchangers on the emergency diesel generators are cooled by the Service Water System, and are evaluated as part of the Emergency Diesel Generator & Auxiliaries System. The Service Water System provides cooling for the component cooling heat exchangers, which are evaluated in the Component Cooling System. The Service Water System provides cooling for the reactor containment fan coolers, which are evaluated in the Containment Ventilation System. Not included in the scoping boundary of the Service Water System is the deep well makeup to the essential service water supply (Byron only) which is evaluated in the Demineralized Water System.

Also included in the license renewal scoping boundary of the Service Water System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the system located within the Auxiliary Building and Containment Structure. This also includes specific water, steam, or oil filled piping sections that are located in the turbine building in proximity to the safety-related Auxiliary Building wall HVAC penetrations. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawings for identification of this boundary, shown in red.

Also included in the license renewal scoping boundary of the Service Water System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor. Included in this boundary are components relied upon to preserve the structural support intended function. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included in the scope of license renewal is the non-essential service water system portion of Service Water System located outdoors or underground and outside of the Auxiliary Building, as this portion of the system is not located within an area in proximity of components performing a safety-related function. These components (non-essential service water pumps and strainers, underground piping, and certain piping in the turbine building) that are not required to support the system's leakage boundary intended functions are not included in the scope of license renewal. Also not included in the scope of license renewal is the nonsafety-related screenwash system (Braidwood only), because it is located in the lake screen house where there are no safety-related components in proximity to this system. These pumps and associated piping components do not perform or support system intended functions.

Not included in the scope of license renewal is the circulating water makeup to the essential service cooling pond. This nonsafety-related makeup water is provided by the makeup line from the circulating water makeup pumps at the River Screen House (Braidwood only). These pumps and associated piping components do not perform or support system intended functions and are not in the scope of license renewal.

Reason for Scope Determination

The Service Water System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Service Water System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Service Water System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 48), Environmental Qualification (10 CFR 49), and Station Blackout (10 CFR 50.63). The Service Water System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61) and Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provide heat removal from safety-related equipment. The Service Water System provides heat removal from the ECCS pumps lube oil and gear oil coolers, the component cooling heat exchangers, and other safety-related heat exchangers. 10 CFR 54.4(a)(1)

2. Provide primary containment boundary. The Service Water System contains valves that provide manual containment isolation to the reactor containment fan coolers for isolation in the event of a service water leak inside containment. 10 CFR 54.4(a)(1)

3. Provide secondary heat sink. The Service Water System provides the safety-related source of water for the Auxiliary Feedwater System, when the condensate storage tank is not available. 10 CFR 54.4(a)(1)

4. Provide heat removal for primary containment and provide primary containment pressure control. The Service Water System provides cooling for the reactor containment fan coolers to remove heat from containment during normal and accident conditions. 10 CFR 54.4(a)(1)

5. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Service Water System includes nonsafety-related discharge piping that supports the safety-related function of the Service Water System at Braidwood Station only by providing protection from internal flooding if the safety-related service water piping breaks in the Auxiliary Building. The Service Water System contains nonsafety-related

components that provide structural support and water-filled lines which have the potential for spatial interactions with safety-related equipment. 10 CFR 54.4(a)(2)

6. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The Service Water System provides an alternate source of water for the Fire Protection System in the event of a loss of the fire protection pumps. 10 CFR 54.4(a)(3)

7. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The Service Water System contains containment isolation motor-operated valves that are qualified for Equipment Qualification. 10 CFR 54.4(a)(3)

8. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). The Service Water System provides cooling water to support emergency diesel generator operation. 10 CFR 54.4(a)(3)

UFSAR References

2.3.2.2 (Byron)
2.3.2.2 (Braidwood)
2.4.1.1 (Byron)
2.4.1.1 (Braidwood)
6.2.2.1
9.2.1
9.2.1.1
9.2.1.2
9.2.5 (Byron)
9.2.5 (Braidwood)

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-37, Sheet 1
LR-BYR-M-42, Sheet 1A, 1B, 2A, 2B, 3, 4, 5A, 5B
LR-BYR-M-43, Sheet 2A, 2B, 3, 6
LR-BYR-M-64 Sheet 3A

Byron Unit 2:
LR-BYR-M-122, Sheet 1
LR-BYR-M-126, Sheet 1, 2, 3
LR-BYR-M-127, Sheet 1B, 2, 3
LR-BYR-M-138, Sheet 3A

Byron Common:
LR-BYR-M-42, Sheet 6, 7
LR-BYR-M-43, Sheet 4, 7
LR-BYR-M-48, Sheet 9, 10, 11, 12, 13, 14, 38, 39, 40
LR-BYR-M-50, Sheet 3
LR-BYR-M-51, Sheet 3A, 4

LR-BYR-M-56, Sheet 5
LR-BYR-M-64, Sheet 8
LR-BYR-M-65, Sheet 2B
LR-BYR-M-66, Sheet 3B
LR-BYR-M-68, Sheet 2
LR-BYR-M-82, Sheet 15
LR-BYR-M-93, Sheet 3
LR-BYR-M-118, Sheet 16
LR-BYR-M-138, Sheet 8

Braidwood Unit 1:
LR-BRW-M-37, Sheet 1
LR-BRW-M-42, Sheet 1A, 1B, 2A, 2B, 3, 4, 5A, 5B
LR-BRW-M-43, Sheet 2A, 2B, 3, 6
LR-BRW-M-64, Sheet 3A

Braidwood Unit 2:
LR-BRW-M-122, Sheet 1
LR-BRW-M-126, Sheet 1, 2, 3
LR-BRW-M-127, Sheet 1B, 2, 3
LR-BRW-M-138, Sheet 3A

Braidwood Common:
LR-BRW-M-42, Sheet 6
LR-BRW-M-43, Sheet 4, 7, 8
LR-BRW-M-48, Sheet 9, 10, 11, 12, 13, 14, 38, 39, 40
LR-BRW-M-51, Sheet 3A, 3B, 6
LR-BRW-M-56, Sheet 6
LR-BRW-M-64, Sheet 8
LR-BRW-M-65, Sheet 2B
LR-BRW-M-66, Sheet 3B
LR-BRW-M-68, Sheet 2
LR-BRW-M-82, Sheet 15
LR-BRW-M-93, Sheet 3
LR-BRW-M-118, Sheet 16
LR-BRW-M-138, Sheet 8
LR-BRW-M-152, Sheet 43

Table 2.3.3-22 Service Water System Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Filter Housing (Essential Service Water Makeup Fuel Oil - Byron only)	Pressure Boundary
Flow Device	Leakage Boundary
	Pressure Boundary
Gearbox (SX Cooling Tower - Byron only)	Pressure Boundary
Heat Exchanger - (AFW Motor-Driven Pump Lube Oil Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (AFW Motor-Driven Pump Lube Oil Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (AFW Motor-Driven Pump Lube Oil Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Auxiliary Building HVAC Refrigeration Unit Condenser) Tube Side Components	Leakage Boundary
Heat Exchanger - (Auxiliary Building HVAC Refrigeration Unit Condenser) Tubes	Leakage Boundary
Heat Exchanger - (Blowdown Sample Cooling Skid Condenser - Braidwood only) Tube Side Components	Leakage Boundary
Heat Exchanger - (Blowdown Sample Cooling Skid Condenser - Braidwood only) Tubes	Leakage Boundary
Heat Exchanger - (Blowdown Sample Cooling Skid Primary Cooler) Shell Side Components	Leakage Boundary
Heat Exchanger - (Boron Thermal Regeneration Chiller Condenser) Tube Side Components	Leakage Boundary
Heat Exchanger - (Charging Pump Bearing Oil Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (Charging Pump Bearing Oil Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (Charging Pump Bearing Oil Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Charging Pump Gear Oil Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (Charging Pump Gear Oil Cooler) Tube Side Components	Pressure Boundary

Component Type	Intended Function
Heat Exchanger - (Charging Pump Gear Oil Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Chilled Water Primary Containment Refrigeration Unit Condenser) Tube Side Components	Leakage Boundary
Heat Exchanger - (Chilled Water Primary Containment Refrigeration Unit Condenser) Tubes	Leakage Boundary
Heat Exchanger - (Component Cooling) Tube Sheet	Pressure Boundary
Heat Exchanger - (Component Cooling) Tube Side Components	Pressure Boundary
Heat Exchanger - (Component Cooling) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Computer Room AC Condenser Coil) Tube Side Components	Leakage Boundary
Heat Exchanger - (Computer Room AC Condenser Coil) Tubes	Leakage Boundary
Heat Exchanger - (Control Room Refrigeration Unit Condenser) Tube Sheet	Pressure Boundary
Heat Exchanger - (Control Room Refrigeration Unit Condenser) Tube Side Components	Pressure Boundary
Heat Exchanger - (Control Room Refrigeration Unit Condenser) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Diesel-Driven SX Makeup Pump Engine Lube Oil - Byron only) Nozzles	Pressure Boundary
Heat Exchanger - (Diesel-Driven SX Makeup Pump Engine Lube Oil - Byron only) Plates	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Diesel-Driven SX Makeup Pump Engine Lube Oil - Byron only) Tie Bars	Mechanical Closure
Heat Exchanger - (Diesel-Driven SX Makeup Pump Jacket Water - Byron only) Shell Side Components	Pressure Boundary
Heat Exchanger - (Diesel-Driven SX Makeup Pump Jacket Water - Byron only) Tube Sheet	Pressure Boundary

Component Type	Intended Function
Heat Exchanger - (Diesel-Driven SX Makeup Pump Jacket Water - Byron only) Tube Side Components	Pressure Boundary
Heat Exchanger - (Diesel-Driven SX Makeup Pump Jacket Water - Byron only) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Diesel-Driven SX Makeup Pump Right Angle Gear Box Lube Oil - Byron only) Shell Side Components	Pressure Boundary
Heat Exchanger - (Diesel-Driven SX Makeup Pump Right Angle Gear Box Lube Oil - Byron only) Tube Sheet	Pressure Boundary
Heat Exchanger - (Diesel-Driven SX Makeup Pump Right Angle Gear Box Lube Oil - Byron only) Tube Side Components	Pressure Boundary
Heat Exchanger - (Diesel-Driven SX Makeup Pump Right Angle Gear Box Lube Oil - Byron only) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (EDG Jacket Water Upper/Lower Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (EDG Jacket Water Upper/Lower Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (EDG Jacket Water Upper/Lower Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Essential Service Water Pump Oil Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (Essential Service Water Pump Oil Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (Essential Service Water Pump Oil Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (Essential Service Water Pump Oil Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Mask Cleaning Room Condenser Unit - Braidwood only) Tube Side Components	Leakage Boundary
Heat Exchanger - (Mask Cleaning Room Condenser Unit - Braidwood only) Tubes	Leakage Boundary

Component Type	Intended Function
Heat Exchanger - (Overheads Condenser) Tube Side Components	Leakage Boundary
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (RCFC Essential Service Water Coils) Tube Sheet	Pressure Boundary
Heat Exchanger - (RCFC Essential Service Water Coils) Tube Side Components	Pressure Boundary
Heat Exchanger - (RCFC Essential Service Water Coils) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Radwaste & RSD Control Room HVAC Condenser) Tube Side Components	Leakage Boundary
Heat Exchanger - (Radwaste & RSD Control Room HVAC Condenser) Tubes	Leakage Boundary
Heat Exchanger - (Radwaste & RSD Control Room HVAC Condensing Unit) Tube Side Components	Leakage Boundary
Heat Exchanger - (Radwaste & RSD Control Room HVAC Condensing Unit) Tubes	Leakage Boundary
Heat Exchanger - (Radwaste Evaporator Distillate After Cooler) Nozzles	Leakage Boundary
Heat Exchanger - (Radwaste Evaporator Distillate After Cooler) Plates	Leakage Boundary
Heat Exchanger - (Radwaste Evaporator Surface Condenser) Tube Side Components	Leakage Boundary
Heat Exchanger - (Recycle Evaporator Sample Cooler) Shell Side Components	Leakage Boundary
Heat Exchanger - (SGBD Sample Cooler) Nozzles	Leakage Boundary
Heat Exchanger - (SGBD Sample Cooler) Plates	Leakage Boundary
Heat Exchanger - (SI Pump Bearing Oil Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (SI Pump Bearing Oil Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (SI Pump Bearing Oil Cooler) Tubes	Heat Transfer

Component Type	Intended Function
Heat Exchanger - (SI Pump Bearing Oil Cooler) Tubes	Pressure Boundary
Heat Exchanger - (Security Control Room Condenser Unit) Tube Side Components	Leakage Boundary
Heat Exchanger - (Security Control Room Condenser Unit) Tubes	Leakage Boundary
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (Steam Generator Blowdown Condenser) Tube Side Components	Leakage Boundary
Heat Exchanger - (Vent Condenser) Tube Side Components	Leakage Boundary
Heat Exchanger - ([CV, SI, RH, CS, SX] Pump Cubicle Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - ([CV, SI, RH, CS, SX] Pump Cubicle Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - ([CV, SI, RH, CS, SX] Pump Cubicle Cooler) Tubes	Heat Transfer
	Pressure Boundary
Piping Element	Pressure Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
	Structural Support - (Byron only)
Pump Casing (Corrosion Monitoring Sample Return - Braidwood only)	Leakage Boundary
Pump Casing (Essential Service Water Lube Oil)	Pressure Boundary
Pump Casing (Essential Service Water Makeup - Byron only)	Pressure Boundary
Pump Casing (Essential Service Water Makeup Fuel Oil - Byron only)	Pressure Boundary
Pump Casing (Essential Service Water)	Pressure Boundary
Pump Casing (Inline Booster - Byron only)	Leakage Boundary
Restricting Orifice	Pressure Boundary
	Throttle
Silencer/Muffler - (Byron only)	Pressure Boundary
Spray Nozzles (SX Cooling Tower - Byron only)	Spray

Component Type	Intended Function
Strainer Body	Leakage Boundary
	Pressure Boundary
Strainer Element	Filter
Tanks (Corrosion Monitoring Sample Return - Braidwood only)	Leakage Boundary
Tanks (Diesel-Driven SX Makeup Pump Expansion - Byron only)	Pressure Boundary
Tanks (Essential Service Water Lube Oil Reservoir)	Pressure Boundary
Tanks (Essential Service Water Make-Up Fuel Oil - Byron only)	Pressure Boundary
Valve Body	Leakage Boundary
	Pressure Boundary
	Structural Support - (Byron only)

The aging management review results for these components are provided in:

Table 3.3.2-22	Service Water System Summary of Aging Management Evaluation

2.3.3.23 Spent Fuel Cooling System

Description

The Spent Fuel Cooling System is a normally operating, mechanical system designed to remove decay heat generated by stored spent fuel assemblies from the spent fuel pool, also known as the spent fuel pit. The Spent Fuel Cooling System serves the spent fuel pool located in the Fuel Handling Building. The Spent Fuel Cooling System is capable of maintaining spent fuel pool temperatures within design limits. The Spent Fuel Cooling System consists of the fuel pool cooling and cleanup system including the following three loops: the pool cooling loop, the purification loop, and the skimmer loop. The Spent Fuel Cooling System is common to both units. The Spent Fuel Cooling System is in scope for license renewal.

The purpose of the pool cooling loop of the Spent Fuel Cooling System is to remove decay heat from the spent fuel pool. The Spent Fuel Cooling System accomplishes this purpose by forced circulation of spent fuel pool water through a heat exchanger, where decay heat is transferred to the Component Cooling System. The cooled water is then returned to the spent fuel pool.

The purpose of the purification loop of the Spent Fuel Cooling System is to purify spent fuel pool water. The purification loop accomplishes this purpose by drawing water from the spent fuel pool, pumping water through a demineralizer and a filter, and returning the water back to the spent fuel pool. The purification loop can also be aligned to purify water from refueling water storage tank (RWST) or the refueling cavity of either unit through the same demineralizer and filter.

The purpose of the skimmer loop of the Spent Fuel Cooling System is to clarify spent fuel pool water by removing particles floating on the surface of the water. The skimmer loop accomplishes this purpose by pumping spent fuel pool water from surface skimmers, through a filter, and returning the filtered water back to the spent fuel pool surface at two locations remote from the skimmers.

The Spent Fuel Cooling System accomplishes the primary containment boundary function through the use of qualified piping and valves which ensure primary containment integrity.

The Spent Fuel Cooling System ensures adequate cooling in the spent fuel pool to maintain stored fuel within acceptable temperature limits through the use of piping, valves, pumps, and heat exchangers which transfer decay heat from the spent fuel pool to the Component Cooling System. Make-up water supplies to the spent fuel pool are provided to maintain spent fuel pool inventory in order to ensure adequate cooling of the stored fuel. The Safety Injection System supports this function by providing make-up water from the refueling water storage tank to the Spent Fuel Cooling System. The Fire Protection System can also be used to maintain inventory in the spent fuel pool through the use of seismically qualified fire suppression equipment located in the Fuel Handling Building. For evaporative losses, the Chemical & Volume Control System provides the primary make-up water supply source by providing a flowpath from the primary water storage tank to the Spent Fuel Cooling System.

For more detailed information, see UFSAR Section 9.1.3.

Boundary

The Spent Fuel Cooling System scoping boundary for the pool cooling loop begins at the spent fuel pit strainers. The pool cooling loop continues through the spent fuel pit pumps, through the spent fuel pit heat exchangers, and terminates at the return line to the spent fuel pool.

The Spent Fuel Cooling System scoping boundary for the purification loop begins at the spent fuel pit pump discharge line and continues through the spent fuel pit filter. The purification loop continues through the spent fuel pit demineralizer and spent fuel pit demineralizer filter and terminates at the return line of the spent fuel pool cooling loop. Also included in the scoping boundary are the lines from each RWST beginning at the refueling water purification pump suction valves and continuing through the refueling water purification pumps to the spent fuel pit demineralizer, the spent fuel pit demineralizer filter, and terminating at the spent fuel pit demineralizer loop RWST return isolation valves. Also included in the scoping boundary is the connection between both spent fuel pit demineralizers. Also included in the scoping boundary are the lines from the refueling cavities continuing to the refueling water purification pumps, through the spent fuel pit demineralizers and filters, and continuing through the return line terminating at the refueling cavity return isolation valves.

The Spent Fuel Cooling System scoping boundary for the skimmer loop begins at the spent fuel pit skimmers and continues through the spent fuel pit skimmer pump and spent fuel pit skimmer filter, terminating at the discharge of the return line to the spent fuel pool.

All associated piping, components, and instrumentation contained within the flow paths described above are included in the system evaluation boundary.

Also included in the Spent Fuel Cooling System scoping boundary are the tube side components of the spent fuel pit heat exchangers. The shell side components are evaluated with the Component Cooling System.

Not included in the Spent Fuel Cooling System scoping boundary are the spent fuel pool and liner, cask loading pit and liner, fuel transfer canal, and sluice gates which are separately evaluated with the Fuel Handling Building. Also not included within the Spent Fuel Cooling System scoping boundary are the spent fuel storage racks which are evaluated with the Fuel Handling & Fuel Storage System.

Also included in the license renewal scoping boundary of the Spent Fuel Cooling System are those water filled portions of nonsafety-related piping and equipment located in proximity to equipment performing a safety-related function. This includes the nonsafety-related portions of the system located within the Auxiliary Building and the Fuel Handling Building. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Reason for Scope Determination

The Spent Fuel Cooling System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Spent Fuel Cooling System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for

10 CFR 54.4(a)(1). The Spent Fuel Cooling System is not in scope under 10 CFR 54.4(a)(3) because it is not relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provide primary containment boundary. The refueling water purification pump supply and discharge lines to and from the refueling cavities penetrate containment. 10 CFR 54.4(a)(1)

2. Ensure adequate cooling in the spent fuel pool to maintain stored fuel within acceptable temperature limits. The Spent Fuel Cooling System is designed to remove the decay heat generated by stored spent fuel assemblies from the spent fuel pool water. The Spent Fuel Cooling System also maintains the integrity of the pressure boundary and the inventory for the spent fuel pool. The Spent Fuel Cooling suction and return lines are designed so that the pool cannot be gravity-drained. 10 CFR 54.4(a)(1)

3. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Spent Fuel Cooling System includes nonsafety-related piping and equipment that has the potential for spatial interaction with safety-related components. 10 CFR 54.4(a)(2)

UFSAR References

6.2.1
9.1.2
9.1.3

License Renewal Boundary Drawings

Byron Unit 1:
None.

Byron Unit 2:
None.

Byron Common:
LR-BYR-M-61, Sheet 1B
LR-BYR-M-63, Sheet 1A, 1B, 1C
LR-BYR-M-65, Sheet 2B
LR-BYR-M-70, Sheet 1
LR-BYR-M-74, Sheet 2
LR-BYR-M-136, Sheet 1
LR-BYR-M-141, Sheet 1

Braidwood Unit 1:
None.

Braidwood Unit 2:
None.

Braidwood Common:
LR-BRW-M-61, Sheet 1B
LR-BRW-M-63, Sheet 1A, 1B, 1C
LR-BRW-M-65, Sheet 2B
LR-BRW-M-70, Sheet 1
LR-BRW-M-74, Sheet 2
LR-BRW-M-136, Sheet 1
LR-BRW-M-141, Sheet 1

Table 2.3.3-23 Spent Fuel Cooling System Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Filter Housing	Leakage Boundary
Heat Exchanger - (Spent Fuel Cooling) Tube Sheet	Pressure Boundary
Heat Exchanger - (Spent Fuel Cooling) Tube Side Components	Pressure Boundary
Heat Exchanger - (Spent Fuel Cooling) Tubes	Heat Transfer
	Pressure Boundary
Piping Element	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
Pump Casing (Purification Pump A)	Pressure Boundary
Pump Casing (Purification Pump B)	Leakage Boundary
Pump Casing (Skimmer Pump)	Leakage Boundary
Pump Casing (Spent Fuel Pit Pump)	Pressure Boundary
Strainer Element (Spent Fuel Pit Strainer)	Filter
Tanks (Spent Fuel Pit Demineralizer)	Leakage Boundary
Valve Body	Leakage Boundary
	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.3.2-23 Spent Fuel Cooling System
Summary of Aging Management Evaluation

2.3.4 STEAM AND POWER CONVERSION SYSTEM

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

The following systems are addressed in this section:

- Auxiliary Feedwater System (2.3.4.1)
- Condensate and Feedwater Auxiliaries System (2.3.4.2)
- Main Condensate and Feedwater System (2.3.4.3)
- Main Steam System (2.3.4.4)
- Main Turbine and Auxiliaries System (2.3.4.5)

2.3.4.1 Auxiliary Feedwater System

Description

The Auxiliary Feedwater System is a standby, mechanical system designed to provide adequate cooling to the steam generators in the event of a loss of offsite power coupled with design basis accident conditions. These conditions include the loss of normal feedwater, steam generator tube rupture, main steam or feedwater line break, and small break loss of cooling accident (LOCA). The Auxiliary Feedwater System consists of the following plant systems: auxiliary feedwater system and portions of the essential service water system associated with the diesel-driven auxiliary feedwater pump. The Auxiliary Feedwater System is in scope for license renewal.

The purpose of the Auxiliary Feedwater System is to remove decay heat from the Reactor Coolant System by providing cooling water to the secondary side of the steam generators under normal, shutdown, and accident conditions. When activated, the Auxiliary Feedwater System provides a heat sink to cool the Reactor Coolant System to the appropriate temperature and allow the Residual Heat Removal System to take over long term core cooling.

The Auxiliary Feedwater System accomplishes this purpose by providing a cooling water supply from either the condensate storage tank or the essential service water system to the secondary side of the steam generators during accident conditions. Portions of the Auxiliary Feedwater System provide a primary containment boundary. The Auxiliary Feedwater System is also relied upon for Anticipated Transient Without Scram (ATWS) and Station Blackout (SBO) events. This system provides heat removal from safety-related equipment.

The normal water source for the Auxiliary Feedwater System is the condensate storage tank with essential service water (Service Water System) as the emergency water source. There are two auxiliary feedwater pumps per unit. One auxiliary feedwater pump is a motor-driven pump. The other auxiliary feedwater pump is a diesel-driven pump. The combustion air intake line for the diesel engine, located in the turbine building, is routed such that flooding in the turbine building cannot impact safety-related SSCs in the Auxiliary Building and is evaluated with the Auxiliary Building. Either of the two full capacity auxiliary feedwater pumps is capable of supplying all four steam generators enough feedwater to cool the unit down safely to the temperature at which the residual heat removal system can be utilized.

Flow orifices in each of the auxiliary feed flow lines limit break flow to provide pump runout protection and maintain the ability to achieve a minimum required flow rate for each intact steam generator in addition to a minimum recirculation flow. Additionally, there is the capability to cross-tie the motor-driven auxiliary feedwater pumps such that the motor-driven auxiliary feedwater pump on the opposite unit serves as an additional water supply, but is not approved for use at this time pending NRC approval.

The motor-driven and diesel-driven auxiliary feedwater pumps automatically start on the following signals: low-low water level on any steam generator, undervoltage on non-ESF busses, ATWS Mitigation System actuation, and any safety injection signal. Additionally, the motor-driven auxiliary feedwater pump automatically starts on undervoltage of an ESF Bus after the diesel generator is started and loaded on that bus. The Auxiliary Feedwater System is not used for normal start-up, normal shutdown, or normal operation. The two redundant trains are required so that a single active failure in the Auxiliary Feedwater System will not prevent operation of the system or reduce its heat removal capacity below that required during a design basis event.

There are a total of seven heat exchangers associated with the Auxiliary Feedwater System. These heat exchangers include the cubicle, right angle gear oil, jacket water, gearbox/speed increaser lube oil, diesel engine lube oil, diesel-driven pump lube oil, and the motor-driven pump lube oil coolers. The cubicle coolers are designed to cool equipment in the diesel-driven auxiliary feedwater pump cubicle. The air side (shell side) of the cubicle coolers is not included in this system evaluation boundary but is evaluated with the Auxiliary Building Ventilation System. The cooling side (tube side) of the cubicle coolers is supplied with essential service water and is evaluated with the Auxiliary Feedwater System.

There is a difference between the Unit 1 and Unit 2 feedwater lines to the steam generators. For Byron and Braidwood Unit 1, the Auxiliary Feedwater line ties into the main feedwater line. For Byron and Braidwood Unit 2, the auxiliary feedwater line ties into upper nozzle feedwater line to the steam generators.

For more detailed information, see UFSAR Sections 7.3.1.1.6, 10.4.9, 15.2.6, 15.2.7, and 15.2.8.

Boundary

The Auxiliary Feedwater System scoping boundary normal water source flow path begins upstream of the auxiliary feedwater pump suction check valves. The emergency water source flow path begins upstream of the auxiliary feedwater pump essential service water isolation valves. The normal and emergency flow paths combine and auxiliary feedwater flow continues through each operating pump to the auxiliary feedwater pump discharge line which divides into four (4) headers. The Auxiliary Feedwater System terminates downstream of the auxiliary feedwater to steam generator check valves which are upstream of the four main feedwater lines to the four steam generators.

Each pump discharge also has a recirculation flow path to the condensate storage tank (normal path) or to the Service Water System (emergency path) through a common line. The normal path terminates downstream of the auxiliary feedwater pump discharge to condensate storage tank recirculation isolation valves. The emergency path terminates downstream of the auxiliary feedwater air-operated valve discharge to essential service water recirculation on the common line.

Included in Auxiliary Feedwater System scoping boundary is a cross-tie for the motor-driven auxiliary feedwater pumps that are physically connected and isolated between Unit 1 and Unit 2.

Included in Auxiliary Feedwater System scoping boundary is the shaft-driven essential service water booster pump for the diesel-driven auxiliary feedwater pump, the heat exchangers provided with essential service water flow, and associated valves. Auxiliary Feedwater System essential service water is an open-loop subsystem of the diesel-driven pump which begins upstream of the diesel-driven pump cooling essential service water supply valve and continues through the shaft-driven essential service water booster pump. The shaft-driven essential service water booster pump discharges through the tube side of the following five heat exchangers: the right angle gear oil, the gearbox/speed increaser lube oil, the cubicle, the jacket water, and the diesel-driven pump lube oil. The open-loop service water subsystem terminates downstream of the diesel-driven pump cooling essential service water return valve.

The Auxiliary Feedwater System includes the essential service water side (tube side) of the cubicle coolers. The air side (shell side) of the cubicle coolers is evaluated with the Auxiliary Building Ventilation System.

The Auxiliary Feedwater System includes the oil side (shell side) of the motor-driven pump lube oil cooler. The essential service water side (tube side) of the motor-driven pump lube oil cooler is evaluated with the Service Water System.

The Auxiliary Feedwater System scoping boundary includes a closed-loop jacket water cooling subsystem which begins at the solenoid valve upstream of the jacket water head tank, continues through a shaft-driven diesel-driven jacket water pump, discharges through two lube oil coolers, continues through the engine cooling water jackets, continues through the shell side of the jacket water cooler, and returns to the suction of the shaft-driven diesel-driven jacket water pump. The Auxiliary Feedwater System evaluates the shaft-driven diesel-driven jacket water pump, the diesel engine lube oil coolers, the jacket water cooler, and the jacket water head tank.

The Auxiliary Feedwater System scoping boundary includes a diesel-driven gearbox/speed increaser with an independent lube oil system comprised of a shaft-driven lube oil pump, an auxiliary lube oil pump and a lube oil cooler. Both auxiliary feedwater pumps have a shaft-driven lube oil pump and an auxiliary lube oil pump. Both auxiliary feedwater pumps have skid-mounted oil reservoirs.

The Auxiliary Feedwater System scoping boundary includes compressed air accumulators, piping, and valves required to operate air-operated safety-related valves which control auxiliary feedwater injection to the steam generators.

All associated piping, components, and instrumentation contained in the flow path described above are included in the system evaluation boundary.

Not included in the Auxiliary Feedwater System scoping boundary is the DC power system for the diesel engine which includes the battery banks, battery chargers, and starter motors. This portion of the system supports an auxiliary feedwater intended function and is in scope for license renewal. The components of the DC power system for the diesel engine are evaluated as electrical commodities.

Not included in the Auxiliary Feedwater System scoping boundary is the piping upstream of the pump suction check valves, the piping downstream of the auxiliary feedwater to steam generator check valves, and the piping downstream of the auxiliary feedwater pump discharge to condensate storage tank recirculation isolation valve to the condensate storage tank. This piping is evaluated with the Main Condensate and Feedwater System.

Not included in the Auxiliary Feedwater System scoping boundary is the piping upstream of the essential service water isolation valves and downstream of the auxiliary feedwater air-operated valve discharge to essential service water recirculation to the essential service water system. This piping is evaluated with the Service Water System.

Also included in the license renewal scoping boundary of the Auxiliary Feedwater System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes the nonsafety-related portions of the system located within the Auxiliary Building. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawings for identification of these boundaries, shown in red.

Also included in the license renewal scoping boundary of the Auxiliary Feedwater System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor. Included in this boundary are components relied upon to preserve the structural support intended function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Reason for Scope Determination

The Auxiliary Feedwater System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Auxiliary Feedwater System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Auxiliary Feedwater System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Anticipated Transient Without Scram (10 CFR 50.62), and Station Blackout (10 CFR 50.63). The Auxiliary Feedwater System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49) or Pressurized Thermal Shock (10 CFR 50.61).

Intended Functions

1. Remove residual heat from the reactor coolant system. The Auxiliary Feedwater System provides heat removal from the Reactor Coolant System through the Steam Generators during accident conditions. 10 CFR 54.4(a)(1)

2. Provide primary containment boundary. The Auxiliary Feedwater System contains valves that provide the containment isolation function to confine radioactive materials. 10 CFR 54.4(a)(1)

3. Provide secondary heat sink. The Auxiliary Feedwater System provides a heat sink for heat removal from the Reactor Coolant System through the Steam Generators during accident conditions. 10 CFR 54.4(a)(1)

4. Provide heat removal from safety-related equipment. The Auxiliary Feedwater System has a shaft-driven pump which provides cooling to the safety-related diesel engine and diesel-driven pump and maintains the equipment cubicle temperature within design limits required for operation. 10 CFR 54.4(a)(1)

5. Provide power to safety-related components. The Auxiliary Feedwater System includes compressed air components such as accumulators required to operate air-operated safety-related valves. 10 CFR 54.4(a)(1)

6. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Auxiliary Feedwater System contains nonsafety-related water-filled drain lines which have the potential for spatial interactions (spray or leakage) with safety-related equipment. The Auxiliary Feedwater System also contains nonsafety-related instrument air piping that is directly attached and provides structural support to safety-related piping. 10 CFR 54.4(a)(2)

7. Relied upon in the safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The Auxiliary Feedwater System is designed to provide a safe shutdown function. 10 CFR 54.4(a)(3)

8. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Anticipated Transients Without Scram (10 CFR 50.62). The Auxiliary Feedwater System receives actuation signals from the ATWS Mitigation System (AMS) to start the auxiliary feedwater pumps if a reactor trip fails to occur. 10 CFR 54.4(a)(3)

9. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Station Blackout (10 CFR 50.63). The Auxiliary Feedwater System provides water from a stored source for secondary heat removal. 10 CFR 54.4(a)(3)

UFSAR References

7.3.1.1.6
7.7.1.21
9.2.6
10.4.9
15.2.6
15.2.7
15.2.8
Attachment 10.D

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-37, Sheet 1
LR-BYR-M-42, Sheet 3
LR-BYR-M-50, Sheet 3
LR-BYR-M-55, Sheet 9

Byron Unit 2:
LR-BYR-M-55, Sheet 7E
LR-BYR-M-122, Sheet 1
LR-BYR-M-126, Sheet 1
LR-BYR-M-130, Sheet 2

Byron Common:
LR-BYR-M-49, Sheet 1B

Braidwood Unit 1:
LR-BRW-M-37, Sheet 1
LR-BRW-M-42, Sheet 3
LR-BRW-M-50, Sheet 3

Braidwood Unit 2:
LR-BRW-M-122, Sheet 1
LR-BRW-M-126, Sheet 1
LR-BRW-M-130, Sheet 2

Braidwood Common:
LR-BRW-M-49, Sheet 1A, 1B
LR-BRW-M-55, Sheet 8

Table 2.3.4-1 Auxiliary Feedwater System Components Subject to Aging Management Review

Component Type	Intended Function
Accumulator	Pressure Boundary
Bolting	Mechanical Closure
Electric Heaters	Pressure Boundary
Filter Housing	Pressure Boundary
Gearbox (Speed Increaser)	Pressure Boundary
Heat Exchanger - (AFW Cubicle Coolers) Tube Sheet	Pressure Boundary
Heat Exchanger - (AFW Cubicle Coolers) Tube Side Components	Pressure Boundary
Heat Exchanger - (AFW Cubicle Coolers) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (AFW Diesel Engine Lube Oil Coolers) Nozzles	Pressure Boundary
Heat Exchanger - (AFW Diesel Engine Lube Oil Coolers) Plates	Heat Transfer
	Pressure Boundary
Heat Exchanger - (AFW Diesel Engine Lube Oil Coolers) Tie Bars	Mechanical Closure
Heat Exchanger - (AFW Diesel-Driven Pump Lube Oil Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (AFW Diesel-Driven Pump Lube Oil Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (AFW Diesel-Driven Pump Lube Oil Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (AFW Diesel-Driven Pump Lube Oil Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (AFW Gearbox / Speed Increaser Lube Oil Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (AFW Gearbox / Speed Increaser Lube Oil Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (AFW Gearbox / Speed Increaser Lube Oil Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (AFW Gearbox / Speed Increaser Lube Oil Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (AFW Jacket Water Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (AFW Jacket Water Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (AFW Jacket Water Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (AFW Jacket Water Cooler) Tubes	Heat Transfer
	Pressure Boundary

Component Type	Intended Function
Heat Exchanger - (AFW Motor-Driven Pump Lube Oil Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (AFW Motor-Driven Pump Lube Oil Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (AFW Motor-Driven Pump Lube Oil Cooler) Tubes	Heat Transfer
	Pressure Boundary
Heat Exchanger - (AFW Right Angle Gear Oil Cooler) Shell Side Components	Pressure Boundary
Heat Exchanger - (AFW Right Angle Gear Oil Cooler) Tube Sheet	Pressure Boundary
Heat Exchanger - (AFW Right Angle Gear Oil Cooler) Tube Side Components	Pressure Boundary
Heat Exchanger - (AFW Right Angle Gear Oil Cooler) Tubes	Heat Transfer
	Pressure Boundary
Piping Element	Leakage Boundary
	Pressure Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
	Structural Support
Pump Casing (AFW Diesel Engine Gearbox / Speed Increaser Auxiliary Lube Oil Pump)	Pressure Boundary
Pump Casing (AFW Diesel Engine Gearbox / Speed Increaser Shaft-Driven Lube Oil Pump)	Pressure Boundary
Pump Casing (AFW Diesel Engine Shaft-Driven Essential Service Water Booster Pump)	Pressure Boundary
Pump Casing (AFW Diesel Engine Shaft-Driven Fuel Oil Pump)	Pressure Boundary
Pump Casing (AFW Diesel Engine Shaft-Driven Jacket Water Pump)	Pressure Boundary
Pump Casing (AFW Diesel Engine Shaft-Driven Lube Oil Pump)	Pressure Boundary
Pump Casing (AFW Diesel-Driven Pump Auxiliary Lube Oil Pump)	Pressure Boundary
Pump Casing (AFW Diesel-Driven Pump Shaft-Driven Lube Oil Pump)	Pressure Boundary
Pump Casing (AFW Diesel-Driven Pump)	Pressure Boundary
Pump Casing (AFW Motor-Driven Pump Auxiliary Lube Oil Pump)	Pressure Boundary
Pump Casing (AFW Motor-Driven Pump Shaft-Driven Lube Oil Pump)	Pressure Boundary
Pump Casing (AFW Motor-Driven Pump)	Pressure Boundary
Restricting Orifice	Pressure Boundary
	Throttle

Component Type	Intended Function
Tanks (AFW Diesel Engine Jacket Water Head Tank)	Pressure Boundary
Tanks (Lube Oil Reservoirs)	Pressure Boundary
Valve Body	Leakage Boundary
	Pressure Boundary
	Structural Support - (Braidwood Unit 2 only)

The aging management review results for these components are provided in:

Table 3.4.2-1 Auxiliary Feedwater System
Summary of Aging Management Evaluation

2.3.4.2 Condensate and Feedwater Auxiliaries System

Description

The intended function of the Condensate and Feedwater Auxiliaries System for license renewal is to maintain leakage boundary integrity to preclude system interactions. For this reason, this system's pressure-retaining components located in proximity to other components performing safety-related functions have been included in the scope of license renewal. This system is not required to operate to support license renewal intended functions, and is in scope for potential spatial interaction.

The Condensate and Feedwater Auxiliaries System is a normally operating, mechanical system designed to support the operation of the Main Condensate and Feedwater System by improving thermal cycle efficiency, minimizing corrosion and biological fouling through chemistry control, and providing gland sealing water to system pumps and valves. The Condensate and Feedwater Auxiliaries System consists of the following plant systems: condensate polishing, feedwater heater miscellaneous drains and vents, feedwater drains-turbine cycle, chemical feed and handling, and gland water.

The purpose of the system is to allow for greater thermal efficiency of the overall heat cycle, maintain secondary water chemistry as well as the raw water system chemistry to minimize corrosion and biological fouling through chemistry controls, and to supply gland sealing water to the system pump and valves.

The Condensate and Feedwater Auxiliaries System accomplishes its purpose using pumps, valves, piping, piping components, demineralizer vessels and associated resin traps, steam jet air ejectors, feedwater heaters, heater drain tanks, bulk chemical storage tanks, and solution tanks.

The portions of the Condensate and Feedwater Auxiliaries System that are included within the scope of license renewal are those components located within the turbine building in proximity to the Auxiliary Building wall HVAC penetrations due to the potential for spatial interaction with safety-related systems and components located in the Auxiliary Building. The Condensate and Feedwater Auxiliaries System components that are not in scope are those components located in areas that are not in proximity to safety-related systems and components located in the Auxiliary Building. The Condensate and Feedwater Auxiliaries System has no safety-related function.

For more detailed information, see UFSAR Sections 10.2.2, 10.3.5, 10.4.6, 10.4.7.

Boundary

The Condensate and Feedwater Auxiliaries System scoping boundary includes the liquid filled portion of the system that is located in proximity to equipment performing a safety-related function. This includes specific water, steam or oil filled piping sections that are located in the turbine building in proximity to the safety-related Auxiliary Building wall HVAC penetrations. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this system. For more information, refer to the license renewal boundary drawings for identification of this boundary, shown in red.

Not included in the scope of license renewal is the portion of the Condensate and Feedwater Auxiliaries System, including pumps, piping, and tanks located within the turbine building and not located in proximity to safety-related Auxiliary Building wall HVAC penetrations, as these portions of the system are not located within an area in proximity of components performing a safety-related function.

Reason for Scope Determination

The Condensate and Feedwater Auxiliaries System is not in scope under 10 CFR 54.4(a)(1) because no portions of the system are safety-related or relied upon to remain functional during and following design basis events. The Condensate and Feedwater Auxiliaries System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Condensate and Feedwater Auxiliaries System is not in scope under 10 CFR 54.4(a)(3) because it is not relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Condensate and Feedwater Auxiliaries System has the potential for spatial interaction (spray or leakage) with safety-related components due to the systems proximity to Auxiliary Building wall HVAC penetrations. 10 CFR 54.4(a)(2)

UFSAR References

10.2.2
10.3.5
10.4.6
10.4.7

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-41, Sheet 3, 4, 7, 8
LR-BYR-M-47, Sheet 1B, 1C
LR-BYR-M-51, Sheet 8

Byron Unit 2:
LR-BYR-M-125, Sheet 3B, 4A, 7, 8
LR-BYR-M-131, Sheet 3
LR-BYR-M-150, Sheet 1A, 1B

Byron Common:
None.

Braidwood Unit 1:
LR-BRW-M-41, Sheet 3, 4, 7, 8
LR-BRW-M-47, Sheet 1B, 1C

Braidwood Unit 2:
LR-BRW-M-125, Sheet 3B, 4A, 7, 8
LR-BRW-M-150, Sheet 1

Braidwood Common:
None.

Table 2.3.4-2 **Condensate and Feedwater Auxiliaries System**
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Flow Device - (Byron only)	Leakage Boundary
Piping Element	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
Restricting Orifice - (Byron only)	Leakage Boundary
Strainer Body - (Byron only)	Leakage Boundary
Tanks (Hydrazine and ETA Day Tanks - Byron only)	Leakage Boundary
Tanks (MSR Shell and Reheater Drain Tanks)	Leakage Boundary
Valve Body	Leakage Boundary

The aging management review results for these components are provided in:

Table 3.4.2-2 Condensate and Feedwater Auxiliaries System
Summary of Aging Management Evaluation

2.3.4.3 Main Condensate and Feedwater System

Description

The Main Condensate and Feedwater System is a normally operating, mechanical system designed to maintain water level in the steam generators throughout all modes of normal plant operation. The Main Condensate and Feedwater System consists of the following plant systems: condensate, condensate booster, and feedwater. The Main Condensate and Feedwater System is in scope for license renewal. However, portions of the Main Condensate and Feedwater System are not required to perform intended functions and are not in scope.

The purpose of the Main Condensate and Feedwater System is to provide feedwater from the condenser to the steam generators and maintain the water level in each steam generator within a specific range under all normal operating conditions. It also has the purpose to isolate the flow of feedwater under specific conditions and provide a flow path for the Auxiliary Feedwater System. The Auxiliary Feedwater System draws water from the condensate storage tank and piping system as its normal water source.

The Main Condensate and Feedwater System accomplishes its purpose with the use of the piping, valves, pumps, heat exchangers, controls, instrumentation, and the associated equipment and subsystems that supply the steam generators with heated feedwater in a closed steam cycle using regenerative feedwater heating. There are four 33% capacity centrifugal condensate pumps per unit with motor drives and common suction and common discharge headers and four 33% capacity condensate booster pumps per unit with common suction and discharge headers. Each condensate and condensate booster pump set is driven by a single motor. Three sets of pumps are normally in operation. The fourth set of pumps start automatically on low pressure at the feedwater pump suction to assure adequate flow to the feedwater pumps.

The feedwater system is a closed loop system, with deaeration of the feedwater accomplished in the condenser. The condensate pumps take suction from the condenser hotwell and pump condensate through the air ejector and gland steam condensers to the suction of the condensate booster pumps. The booster pumps discharge the condensate through six stages of low-pressure feedwater heating to the feedwater pumps. The water discharges from the feedwater pumps flows through one stage of high-pressure heating into the steam generators.

Low-pressure feedwater heaters 1st through 4th stage are 33% capacity units arranged in three strings. Each string of low-pressure feedwater heaters is provided with motor-operated isolation valves. The three strings discharge to a common header and flow through two 50% capacity strings of drain coolers and low pressure heaters 5th and 6th stage. Each of the two strings is provided with motor-operated isolation valves. There are two strings of high-pressure feedwater heaters. Each string is also provided with motor-operated isolation valves.

Drains from the moisture separators and the 5th through 7th stage feedwater heaters are cascaded to a single common heater drain tank. Three 50% capacity heater drain pumps take their suction from the single common heater drain tank header and discharge into a common header. This discharge header divides up into two lines going to each feedwater header between the 5th stage feedwater heater drain cooler and the 5th stage feedwater heater. Drains from the 1st through 4th stage feedwater heaters are cascaded back to the condenser.

Three 60% capacity main feedwater pumps are provided with common suction and discharge headers. Two main feedwater pumps are turbine-driven and use steam provided by the main steam and extraction steam systems; the third main feedwater pump is motor-driven. The motor-driven pump is used as a reserve or standby pump. During unit startup and shutdown, water is normally supplied to the steam generators by the startup feedwater pump. Discharge from the pumps is automatically recirculated back to the condenser whenever flow to the high-pressure feedwater heaters falls below a predetermined point or on a reactor trip signal.

Feedwater flow to each steam generator is controlled by a feedwater regulator valve in each feedwater line. The regulator valve is controlled by steam generator level, steam flow, and feedwater flow. Feedwater isolation is provided to each steam generator by a hydraulically-operated gate valve and a check valve outside the containment. Feedwater piping including these valves and up to the steam generators is safety-related. This portion of the Main Condensate and Feedwater System is included in the scope of license renewal.

Not included in the scope of license renewal are those portions of the Main Condensate and Feedwater System which include the condensate main and booster pumps, feedwater heaters, feedwater pumps and associated drivers and supporting subsystems.

For more detailed information, see UFSAR Section 10.4.

Boundary

The Main Condensate and Feedwater System scoping boundary begins at the suction valve of the four (4) motor-driven condensate pumps and continues through separate discharge lines into a common header. From this header, feedwater continues through steam jet air ejector and gland steam condensers into the four (4) motor-driven condensate booster pumps. The flow path continues through six stages of low pressure feedwater heating to a common suction header for the main feed pumps. Two (2) normally operating steam driven feed pumps, along with the standby motor-driven main feed pump, increase feedwater pressure supplying two (2) parallel high pressure feedwater heaters which discharge into a common high pressure feedwater header. Four (4) feedwater lines are attached to this header, one to each of the steam generators, each line containing feedwater isolation valves, feedwater regulator valves, tempering valves, and containment isolation valves. The license scoping boundary ends at the inlet nozzles to each of the steam generators. All feedwater instrumentation associated with steam generator level is evaluated with the Steam Generators.

Also included in the Main Condensate and Feedwater System scoping boundary are those portions of nonsafety-related piping and equipment that are found outboard of the feedwater containment isolation valves. The Main Condensate and Feedwater System utilizes nonsafety-related valves to support the engineered safety feature to provide redundant isolation of the feedwater supply to each steam generator. For more information, refer to the license renewal boundary drawings.

All associated piping, components, and instrumentation contained in the flow paths described above are included in the Main Condensate and Feedwater System evaluation boundary.

The Main Condensate and Feedwater System interfaces with the Steam Generators and the Auxiliary Feedwater System. Main Condensate and Feedwater System supports the intended functions of the Steam Generator and Auxiliary Feedwater Systems by providing a water source for the auxiliary feed pump suction as well as providing a flow path to allow injection into each of the steam generators.

Also included in the license renewal scoping boundary of the Main Condensate and Feedwater System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, which ever extends the furthest. This includes specific water, steam, or oil filled piping sections that are located in the turbine building in proximity to safety-related Auxiliary Building wall HVAC penetrations. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intend function of this portion of the system. For more information, refer to the license renewal boundary drawing for identification of this boundary, shown in red.

Not included in the scope of license renewal is the portion of the Main Condensate and Feedwater System including the condensate main and booster pumps, feedwater heaters, feedwater pumps and associated drivers and supporting subsystems located within the turbine building, as these portions of the system are not located within an area in proximity to components performing a safety-related function. Also not included in the scope of license renewal is the portion of the Main Condensate and Feedwater System located within the turbine building that is not located in proximity to the safety-related Auxiliary Building wall HVAC penetrations. Components that are not required to support the system's leakage boundary intended function and do not perform or support system intended functions are not included in the scope of license renewal.

Reason for Scope Determination

The Main Condensate and Feedwater System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Main Condensate and Feedwater System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Main Condensate and Feedwater System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49) and Station Blackout (10 CFR 50.63). The Main Condensate and Feedwater System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Pressurized Thermal Shock (10 CFR 50.61), or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provide primary containment boundary. In the unlikely event of an accident which releases radioactive material inside the containment, the containment atmosphere is isolated from the environment by the use of isolation valves and other barriers for all pipelines which penetrate the containment unless such lines are required for service during the accident. The Main Condensate and Feedwater System includes feedwater isolation valves and piping up to the steam generators to support this function. 10 CFR 54.4(a)(1)

2. Provide a secondary heat sink. The Main Condensate and Feedwater System provides a flowpath for the Auxiliary Feedwater System. Maintaining a water level inventory in the

secondary side of the steam generators provides a heat sink for removing decay heat and establishes the capacity for providing a buoyant head for natural circulation. 10 CFR 54.4(a)(1)

3. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Main Condensate and Feedwater System utilizes nonsafety-related valves to support the engineered safety feature to provide redundant isolation of the feedwater supply to each steam generator. In addition, the Main Condensate and Feedwater System contains nonsafety-related water-filled piping and components located in the turbine building in proximity to safety-related Auxiliary Building wall HVAC penetrations. This piping and components have the potential for spatial interactions (spray or leakage) with safety-related SSCs. 10 CFR 54.4(a)(2)

4. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Environmental Qualification (10 CFR 50.49). The feedwater containment isolation valve motors as well as solenoid valves found on various feedwater isolation valves are rated for a harsh environment. 10 CFR 54.4(a)(3)

5. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Station Blackout (10 CFR 50.63). The Main Condensate and Feedwater System piping provides a flow path for auxiliary feedwater and credit is taken for the feedwater isolation function. The condensate storage tank is the normal source of water for the auxiliary feedwater pumps. 10 CFR 54.4(a)(3)

UFSAR References

Table 3.2-1
3.11
6.2.4.1
10.3.6
10.4
15.1.5.1

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-36, Sheet 1A, 1B, 1C, 1D, 2
LR-BYR-M-37, Sheet 1
LR-BYR-M-39, Sheet 1, 2, 3
LR-BYR-M-41, Sheet 8

Byron Unit 2:
LR-BYR-M-121, Sheet 1A, 1B, 1C, 1D, 2
LR-BYR-M-122, Sheet 1
LR-BYR-M-124, Sheet 1, 2, 3
LR-BYR-M-125, Sheet 8

Byron Common:
LR-BYR-M-152, Sheet 53

Braidwood Unit 1:
LR-BRW-M-36, Sheet 1A, 1B, 1C, 1D, 2
LR-BRW-M-37, Sheet 1
LR-BRW-M-39, Sheet 1, 2, 3
LR-BRW-M-41, Sheet 8

Braidwood Unit 2:
LR-BRW-M-121, Sheet 1A, 1B, 1C, 1D, 2
LR-BRW-M-122, Sheet 1
LR-BRW-M-124, Sheet 1, 2, 3
LR-BRW-M-125, Sheet 8

Braidwood Common:
None.

Table 2.3.4-3 Main Condensate and Feedwater System Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Heat Exchanger - (Gland Steam Condenser) Tube Side Components	Leakage Boundary
Heat Exchanger - (Main Steam Sample Cooler - Byron only) Shell Side Components	Leakage Boundary
Heater Well	Pressure Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Boundary
Tanks (Condensate Storage Tanks)	Pressure Boundary
Valve Body	Leakage Boundary
	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.4.2-3 Main Condensate and Feedwater System
Summary of Aging Management Evaluation

2.3.4.4 Main Steam System

Description

The Main Steam System is a normally operating, mechanical system designed to provide a flow path for saturated steam from the steam generator outlets to main steam components. The Main Steam System consists of the main steam plant system. The Main Steam System is in scope for license renewal. However, portions of the Main Steam System are not required to perform intended functions, and are not in scope for license renewal.

Main steam components associated with the steam supply to the high and low pressure turbines, moisture separator reheaters, main condenser air ejectors, steam dumps, turbine-driven feedwater pumps, turbine gland seals, and process sampling coolers are portions of the Main Steam System not in scope for license renewal.

The purpose of the Main Steam System is to provide a containment pressure boundary, remove residual heat from the reactor coolant, and serve as a steam distribution system. It accomplishes the containment pressure boundary function by automatically closing the main steam isolation valves on an isolation signal from the engineered safety features plant system. It accomplishes the residual heat removal function by the operation of the atmospheric relief valves (power-operated relief valves) and steam dump valves. The atmospheric relief valves (power-operated relief valves) provide remote pressure control of the steam generator secondary side. The steam dump valves remove heat from the reactor coolant by directing steam from the steam generators to the main condenser. It accomplishes the steam distribution function by directing saturated steam from the four steam generators to the high pressure turbine and appropriate system components based on plant conditions.

The Main Steam System supplies steam to the high pressure turbine, moisture separator reheaters, main condenser air ejectors, steam dumps, turbine-driven feedwater pumps, turbine gland seals, and process sampling coolers.

The Main Steam System is comprised of four main steam lines originating from the four steam generators with each steam line containing one steam flow restrictor, one atmospheric relief valve (power-operated relief valve), five safety valves, and one main steam isolation valve (MSIV). The Main Steam System also contains MSIV bypass lines and main steam line drains. The Main Steam System is also comprised of the necessary piping, valves, and instrumentation designed to provide steam to the appropriate system components. The Main Steam System delivers steam from each of the four steam generators through containment penetrations, the main steam isolation valve rooms, the main steam tunnel, and ultimately to the system components in the turbine building. The four steam flow restrictors are integral to the four steam generator outlet nozzles and are designed to limit steam flow in the event of a main steamline break.

The four atmospheric relief valves (power-operated relief valves) and the twenty safety valves provide over-pressure protection for the steam generators and the steam piping upstream of the main steam isolation valves, and they provide alternate controllable plant cooldown capability by discharging steam to atmosphere when the steam dumps or condensers are not available. The atmospheric relief valves (power-operated relief valves) also prevent safety valve actuations during minor transients. If any safety valves lift, atmospheric relief valves can also be used to reduce pressure, allowing the safety valves to reseat.

The four hydraulically-actuated MSIVs are installed in each of the four main steam lines downstream of each steam generator in the main steam isolation valve rooms. Two MSIVs are located in each of two main steam isolation valve rooms outside of containment and downstream of the safety valve manifold. The MSIVs close automatically on the initiation of a steamline low pressure, high negative rate of steam pressure change, or high-high containment pressure signal. The main steam isolation bypass valves are used to equalize steam pressure across the MSIVs prior to opening the MSIVs.

The Main Steam System provides steam to components up to the inlet isolation valves of the following components: high pressure turbine, moisture separator reheaters, main condenser air ejectors, steam dumps, turbine-driven feedwater pumps, turbine gland seals, and process sampling coolers. The components downstream of the Main Steam System inlet isolation valves are not in scope for license renewal. There are also provisions to drain the main steam lines through piping routed to the flash tank.

For more detailed information, see UFSAR Sections 5.4.4 and 10.3.

Boundary

The Main Steam System scoping boundary begins at the four steam generator outlet nozzles and continues through the containment structure to the MSIVs in the two main steam isolation valve rooms. The Main Steam System continues from the main steam isolation valve rooms into the main steam tunnel. In the main steam tunnel the four main steam lines combine to form two main steam lines which enter the turbine building. In the turbine building, the Main Steam System terminates at the inlet isolation valves upstream of main steam components associated with the high pressure turbine, moisture separator reheaters, main condenser air ejectors, steam dumps, turbine-driven feedwater pumps, turbine gland seals, and process sampling coolers.

The Main Steam System scoping boundary includes the steam flow restrictors, atmospheric relief valves (power-operated relief valves), safety valves, main steam isolation valves, the main steam drains, and the nonsafety-related pipes used to direct steam from the safety and relief valves through the roof. At Byron, the scoping boundary includes the main steam sample coolers located in the main steam tunnel.

The Main Steam System scoping boundary also includes main steam components in the turbine building up to the inlet isolation valves associated with the high pressure turbine, moisture separator reheaters, main condenser air ejectors, steam dumps, turbine-driven feedwater pumps, and the turbine gland seals.

In the turbine building, each of the main steam lines branch off to alternate flow paths to supply steam to multiple loads in the Main Steam System scoping boundary.

The Main Steam System scoping boundary includes the steam supply to the turbine throttle valves upstream of the high pressure turbine, the steam dump valves and the associated piping up to the main condenser, the steam supply to the inlet manual isolation valves upstream of moisture separator reheaters, main condenser air ejectors, and steam dumps, and the steam supply to the inlet manual isolation valves upstream of the turbine-driven feedwater pumps and turbine gland seals.

All associated piping, components and instrumentation contained within the flow path described above are included in the system evaluation boundary.

Not included in the Main Steam System scoping boundary are the high pressure turbine, moisture separator reheaters, and turbine gland seals, which are evaluated with the Main Turbine and Auxiliaries System. Also not included in the scoping boundary are the turbine-driven feedwater pumps, which are evaluated with the Main Condensate and Feedwater System.

Also included in the license renewal scoping boundary of the Main Steam System are those portions of nonsafety-related piping and equipment that extend beyond the safety-related/nonsafety-related interface up to the location of the first seismic anchor, or to a point no longer in proximity to equipment performing a safety-related function, whichever extends the furthest. This includes nonsafety-related portions of the system located within the main steam tunnel. This also includes specific water and steam filled piping sections that are located in the turbine building in proximity to the safety-related auxiliary building wall HVAC penetrations. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this portion of the system. For more information, refer to the license renewal boundary drawings for identification of these boundaries, shown in red.

Not included in the scope of license renewal is the portion of the Main Steam System including main condenser air ejectors, intercondensers, aftercondensers, secondary sampling room panel components, flash tank and other components located within the turbine building, as these portions of the system are not located within an area in proximity of components performing a safety-related function. Also not included in the scope of license renewal is the portion of the Main Steam System located within the turbine building that is not located in proximity to the safety-related auxiliary building wall HVAC penetrations. Components that are not required to support the system's leakage boundary intended function and do not perform or support system intended functions are not included in the scope of license renewal.

Reason for Scope Determination

The Main Steam System meets 10 CFR 54.4(a)(1) because it is a safety-related system that is relied upon to remain functional during and following design basis events. The Main Steam System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Main Steam System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Anticipated Transient Without Scram (10 CFR 50.62), and Station Blackout (10 CFR 50.63). The Main Steam System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61).

Intended Functions

1. Sense process conditions and generate signals for containment isolation. The main steam line includes instrumentation that detects, mitigates, and actuates automatic safety functions. 10 CFR 54.4(a)(1)

2. Remove residual heat from the reactor coolant system. The Main Steam System provides heat removal from the Reactor Coolant System. The atmospheric relief valves (power-operated relief valves) provide remote pressure control of the steam generator secondary side. The main steam safety valves provide pressure relief to prevent steam generator overpressurization. 10 CFR 54.4(a)(1)

3. Provide primary containment boundary. The main steam isolation valves close automatically on isolation signals from the engineered safety features plant system. 10 CFR 54.4(a)(1)

4. Provide secondary heat sink. The Main Steam System provides a heat sink for heat removal from the Reactor Coolant System through the Steam Generators during normal and accident conditions. The condenser steam dump acts as a supplemental heat sink for a load reduction without a reactor trip. Should the condenser not be available as a heat sink, the main steam safety valves and atmospheric relief valves open to dump steam to the atmosphere. 10 CFR 54.4(a)(1)

5. Resist nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety related function. Nonsafety-related piping and components, located downstream of the main steam isolation valves and in proximity to equipment that performs safety-related functions, are required to maintain leakage boundary integrity to preclude spatial interaction with the safety-related equipment. 10 CFR 54.4(a)(2)

6. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The main steam isolation valves and main steam safety valves are relied upon in the Post Fire Safe Shutdown Analysis. 10 CFR 54.4(a)(3)

7. Relied upon in the safety analysis or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). The low steamline pressure instrumentation is expected to operate in a harsh environment. Included are the nonsafety-related pipes used to direct steam from the safety and relief valves through the roof. 10 CFR 54.4(a)(3)

8. Relied upon in the safety analysis or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Anticipated Transients Without Scram (10 CFR 50.62). Provides turbine inlet steam pressure input to the ATWS mitigation system. 10 CFR 54.4(a)(3)

9. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). The main steam isolation valves closure function and the main steam safety valves being available for pressure control are credited in the SBO analysis. 10 CFR 54.4(a)(3)

UFSAR References

1.2.2
5.4.4
10.3
10.3.1
10.3.2
10.3.3
15.1.5

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-35, Sheet 1, 2, 3, 4, 5C, 7
LR-BYR-M-41, Sheet 4

Byron Unit 2:
LR-BYR-M-120, Sheet 1, 2A, 2B, 3, 4A, 5C, 7

Byron Common:
LR-BYR-M-152, Sheet 53

Braidwood Unit 1:
LR-BRW-M-35, Sheet 1, 2, 3, 4, 5C, 7
LR-BRW-M-41, Sheet 4
LR-BRW-M-68, Sheet 8

Braidwood Unit 2:
LR-BRW-M-120, Sheet 1, 2A, 2B, 3, 4A, 5C, 7

Braidwood Common:
None.

Table 2.3.4-4 **Main Steam System**
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Condensing Chamber	Pressure Boundary
Flow Device	Throttle
Heat Exchanger - (Main Steam Sample Cooler - Byron only) Tube Side Components	Leakage Boundary
Piping, piping components, and piping elements	Direct Flow
	Leakage Boundary
	Pressure Boundary
Valve Body	Leakage Boundary
	Pressure Boundary

The aging management review results for these components are provided in:

Table 3.4.2-4 Main Steam System
Summary of Aging Management Evaluation

2.3.4.5 Main Turbine and Auxiliaries System

Description

The Main Turbine and Auxiliaries System is a normally operating, mechanical system designed to utilize steam from the Main Steam System to provide motive force for the main generator to generate electrical power for distribution to the grid. The Main Turbine and Auxiliaries System consists of the main turbine, the moisture separator reheater, and the following plant systems: turbine Electro-Hydraulic Control (EHC), cold reheat steam, hot reheat steam, extraction steam, turbine gland seal steam, turbine oil, bearing oil transfer and purification, turbine drains, and turbine generator auxiliaries and miscellaneous devices.

The Main Turbine and Auxiliaries System is in scope for License Renewal. However, major portions of the Main Turbine and Auxiliaries System associated with the main turbine, moisture separator reheater steam supply, gland sealing steam, turbine drains, turbine oil, bearing oil transfer and purification, and turbine generator auxiliaries and miscellaneous devices are not required to perform intended functions and are not in scope.

The overall purpose of the Main Turbine and Auxiliaries System is to provide motive force for the main generator to generate electrical power for use on the system grid.

The purpose of the main turbine is to convert thermal energy of the Main Steam System into mechanical energy to drive the main generator. The main turbine accomplishes this purpose with a double flow high pressure turbine and three double flow low pressure turbines.

The purpose of the turbine EHC system is to control turbine valve movement, which in turn controls main steam flow at the inlet to the main turbine. This system also provides trip functions for the main turbine and provides a trip signal to the engineered safety features plant system. The EHC system accomplishes this purpose with pumps, reservoirs, heat exchangers, piping, and valves.

The purpose of the moisture separator reheater steam supply is to remove moisture and to reheat exhausted steam from the outlet of the high pressure turbine (cold reheat steam) and supply it to the low pressure turbines (hot reheat steam) to increase cycle efficiency. The moisture separator reheater steam system accomplishes this purpose with moisture separator chevrons, heat exchangers, piping, and valves.

The purpose of the extraction steam is to supply the feedwater heaters with various pressure sources of steam to increase the enthalpy of the feedwater being supplied to the steam generators. This improves the overall cycle efficiency. In order to prevent a turbine overspeed caused by the backflow of steam from extraction lines to the turbine following a turbine trip, feedwater heaters have air-operated check valves in each extraction steam supply line which close upon a turbine trip. The extraction steam system accomplishes these functions with piping and valves.

The purpose of the gland sealing steam system is to utilize main steam to seal the annular openings where the main turbine and steam generator feed pump turbine shafts emerge from their casings, preventing steam leakage and air intrusion along the shaft. It is also used to seal turbine valve stems. The gland sealing steam system accomplishes this purpose with piping and valves.

The purpose of the turbine oil system is to provide an oil supply to the turbine and generator bearings for lubrication and cooling. It provides lubrication to the main turbine turning gear assembly. In addition, the turbine oil system provides a back-up supply of oil to the generator hydrogen seal oil system, which is assessed as part of the Main Generator and Auxiliaries System. The turbine oil system accomplishes its purpose with pumps, filters, tanks, heat exchangers, piping, and valves.

The purpose of the bearing oil transfer and purification system is to store and transfer both clean and dirty lube oil. It also recovers dirty oil through a purification system to support reuse as clean oil for the main turbine and steam generator feed water pumps. The purification system accomplishes its purpose with pumps, filters, tanks, piping, and valves.

The purpose of the turbine drain system is to collect condensation from each of the main steam lines, gland sealing steam lines, and steam generator feed pump turbines and direct it to the main condenser. The turbine drains system accomplishes this purpose with piping and valves.

The purpose of the turbine generator auxiliaries and miscellaneous devices is to protect the turbine by actuating trips causing closure of all turbine steam admission valves. Trips are generated on sensing low bearing oil pressure, low condenser vacuum, excessive rotor axial movement at the turbine thrust bearing, and manual trip features. The turbine generator auxiliaries and miscellaneous devices accomplish this function with piping, piping components, and instrumentation.

The Main Turbine and Auxiliaries System has interfaces with several other systems and components that are not within the license renewal boundary of the Main Turbine and Auxiliaries System, and are evaluated separately. These include the Main Condensate and Feedwater System, Main Condenser and Air Removal System, Main Generator and Auxiliaries System, Main Steam System, Reactor Protection System, Compressed Air System, and the Service Water System.

The Main Turbine and Auxiliaries System contains the electro-hydraulic control system (EHC), portions of which are relied upon to perform a function that demonstrates compliance with the commission’s regulations for Anticipated Transient Without Scram. No portions of the Main Turbine and Auxiliaries System are safety-related and are relied upon to remain functional during and following design-basis events.

For more detailed information, see UFSAR Sections 7.7.1.21, 10.1, 10.2, 10.4.3, and 10.4.4.

Boundary

The Main Turbine and Auxiliaries System scoping boundary begins at the high pressure turbine throttle valve assembly. The scoping boundary continues through the high pressure turbine, the moisture separator reheater, and then the low pressure turbines. The scoping boundary ends at the inlet to the condenser. The scoping boundary also includes the EHC system components which begin at the EHC reservoir. The scoping boundary continues through the system supply piping, the hydraulic valve actuators on the main turbine and main feedwater pumps, and the system return piping. The scoping boundary ends where the system return piping returns to the EHC reservoir. The scoping boundary also includes the components associated with the turbine oil system. The scoping boundary begins at the main turbine oil reservoir. The scoping boundary continues through the system supply piping to various components including the main turbine bearings, and the system return piping. The scoping boundary ends where the system return piping enters the main turbine oil reservoir. The scoping boundary also includes the extraction steam piping. The scoping boundary begins at various extraction steam outlets on the main turbine. The scoping boundary continues through the extraction steam system piping. Extraction steam is supplied to various components including the moisture separator reheater, as well as feedwater heaters. The scoping boundary continues through the extraction system return piping to the condenser. The scoping boundary ends where the extraction drain piping enters the condenser.

The Main Turbine and Auxiliaries System supports the Anticipated Transient Without Scram intended function. This portion of the electro-hydraulic control system (EHC) begins at the inlets of "A" and "B" EHC trip manifolds that contain eight (8) EHC trip solenoid valves in the electro-hydraulic control system, and ends at the drain line entering the EHC reservoir.

All associated piping, components, and instrumentation contained within the flow path described above are included in the system evaluation boundary.

Also included in the license renewal scoping boundary of the Main Turbine and Auxiliaries System are those water, steam or oil filled portions of the nonsafety-related piping and equipment located in proximity to equipment performing a safety-related function. This includes the nonsafety-related portions of the system located in the turbine building. This includes specific water, steam or oil filled piping sections that are located in the turbine building in proximity to the safety-related Auxiliary Building wall HVAC penetrations. Included in this boundary are pressure-retaining components relied upon to preserve the leakage boundary intended function of this system. For more information, refer to the license renewal boundary drawings for identification of this boundary, shown in red.

Not included in the scope of license renewal is the portion of the Main Turbine and Auxiliaries System including turbines, pumps, heat exchangers and lube oil equipment located within the turbine building, as these portions of the system are not located within an area in proximity of components performing a safety-related function. Also not included in the scope of license renewal are the portions of the Main Turbine and Auxiliaries System located within the turbine building that are not located in proximity to the safety-related Auxiliary Building wall HVAC penetrations. Components that are not required to perform or support system intended functions are not included in the scope of license renewal.

Reason for Scope Determination

The Main Turbine and Auxiliaries System is not in scope under 10 CFR 54.4(a)(1) because no portions of the system are safety-related and are relied upon to remain functional during and following design basis events. The Main Turbine and Auxiliaries System meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the system could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Main Turbine and Auxiliaries System also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Anticipated Transient Without Scram (10 CFR 50.62). The Main Turbine and Auxiliaries System is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Resists nonsafety-related SSC failure that could prevent satisfactory accomplishment of a safety-related function. The Main Turbine and Auxiliaries System has the potential for spatial interaction, spray or leakage, with safety-related components due to the system proximity to Auxiliary Building wall HVAC penetrations. 10 CFR 54.4(a)(2)

2. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Anticipated Transients Without Scram (10 CFR 50.62). The turbine electro-hydraulic control system of the Main Turbine and Auxiliaries System contains valves that actuate upon receipt of an ATWS signal. 10 CFR 54.4(a)(3).

UFSAR References

7.7.1.21
10.1
10.2
10.4.3
10.4.4

License Renewal Boundary Drawings

Byron Unit 1:
LR-BYR-M-35, Sheet 3, 4, 5A, 5B, 5C, 6, 7
LR-BYR-M-38, Sheet 3A, 3B
LR-BYR-M-41, Sheet 7, 8
LR-BYR-M-47, Sheet 1B
LR-BYR-M-152, Sheet 2A, 2B, 2C, 2D

Byron Unit 2:
LR-BYR-M-120, Sheet 3, 4A, 4B, 5A, 5B, 5C, 6, 7
LR-BYR-M-123, Sheet 3A, 3B
LR-BYR-M-125, Sheet 7, 8
LR-BYR-M-150, Sheet 1B
LR-BYR-M-152, Sheet 2E, 2F, 2G, 2H

Byron Common:
None.

Braidwood Unit 1:
LR-BRW-M-35, Sheet 3, 4, 5A, 5B, 5C, 6, 7
LR-BRW-M-38, Sheet 3A, 3B
LR-BRW-M-41, Sheet 7, 8
LR-BRW-M-152, Sheet 2B

Braidwood Unit 2:
LR-BRW-M-120, Sheet 3, 4A, 4B, 5A, 5B, 5C, 6, 7
LR-BRW-M-123, Sheet 3A, 3B
LR-BRW-M-125, Sheet 7, 8
LR-BRW-M-152, Sheet 2E

Braidwood Common:
None.

Table 2.3.4-5 Main Turbine and Auxiliaries System
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting	Mechanical Closure
Flow Device	Leakage Boundary
Heat Exchanger - (Gland Steam Condenser) Shell Side Components	Leakage Boundary
Heat Exchanger - (Moisture Separator Reheater) Shell Side Components	Leakage Boundary
Heat Exchanger - (Moisture Separator Reheater) Tube Side Components	Leakage Boundary
Piping, piping components, and piping elements	Leakage Boundary
	Pressure Relief
Restricting Orifice	Leakage Boundary
	Pressure Boundary
	Throttle
Rupture Disks	Leakage Boundary
Strainer Body	Leakage Boundary
Valve Body	Leakage Boundary

The aging management review results for these components are provided in:

Table 3.4.2-5	Main Turbine and Auxiliaries System Summary of Aging Management Evaluation

2.4 SCOPING AND SCREENING RESULTS: STRUCTURES

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

The following structural components are addressed in this section:

- Auxiliary Building (2.4.1)
- Circulating Water Pump House (Byron) (2.4.2)
- Component Supports Commodity Group (2.4.3)
- Containment Structure (2.4.4)
- Deep Well Enclosures (Byron) (2.4.5)
- Essential Service Cooling Pond (Braidwood) (2.4.6)
- Essential Service Water Cooling Towers (Byron) (2.4.7)
- Fuel Handling Building (2.4.8)
- Lake Screen Structures (Braidwood) (2.4.9)
- Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms (2.4.10)
- Natural Draft Cooling Towers (Byron) (2.4.11)
- Refueling Water Storage Tank (RWST) Foundation and Tunnel (2.4.12)
- Radwaste and Service Building Complex (2.4.13)
- River Screen House (Byron) (2.4.14)
- Structural Commodity Group (2.4.15)
- Switchyard Structures (2.4.16)
- Turbine Building Complex (2.4.17)
- Yard Structures (2.4.18)

2.4.1 Auxiliary Building

Description

The Auxiliary Building, at Byron and Braidwood Stations, is a steel and reinforced concrete structure that is located between the Turbine Building Complex, Fuel Handling Building, and the Unit 1 and Unit 2 containment structures. The Auxiliary Building is classified as a safety-related structure designed to maintain its structural integrity during and following postulated design basis accidents and extreme environmental conditions.

The Auxiliary Building is “T-shaped” and consists of six main levels and additional levels when considering smaller plant areas. The building is comprised of reinforced concrete walls, slabs, foundation mat, roof, masonry walls, and structural steel. The Auxiliary Building is supported on a continuous, multilevel, reinforced concrete mat foundation founded on bedrock. The thickness of the mat varies, and is generally from 3 feet to 6 feet thick. The Auxiliary Building is continuous with the Fuel Handling Building, which is safety-related, and the Turbine Building Complex, which is nonsafety-related. Because of the continuity and interconnection of the floors and walls of the various buildings, the buildings are modeled as a unit for the seismic analysis. The Fuel Handling Building and Turbine Building Complex are evaluated separately under their respective license renewal structures.

The Auxiliary Building roof consists of a built-up roofing system over a reinforced concrete slab on metal decking. The building roof supports concrete penthouses and missile shields for diesel intake, exhaust, and building ventilation. The building roof also supports penthouses for safety valves and an elevator shaft extension.

The Auxiliary Building shares common walls with both the Fuel Handling Building and Turbine Building Complex, which are evaluated with the Auxiliary Building. Various openings are provided in the wall between the Auxiliary Building and the Turbine Building Complex. Where required by various design requirements, barriers such as fire dampers and fire doors are provided at the various openings in the wall between the Auxiliary Building and the Turbine Building Complex. The common wall between the Auxiliary Building and the Turbine Building Complex extends above the Auxiliary Building roof at which point the siding only provides shelter and protection for components inside the Turbine Building Complex. Structural steel buttresses are provided to support the common wall between the Auxiliary Building and the Turbine Building Complex. The plant vent stack exits the roof of the Auxiliary Building and extends up the outside of the common wall between the Auxiliary Building and the Turbine Building Complex.

The Auxiliary Building is sealed below grade except where connected to below grade tunnels, which are evaluated as part of the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms, the RWST Foundation and Tunnel, and the Radwaste and Service Building Complex. Portions of the main steam and auxiliary feedwater tunnels are underneath the Auxiliary Building and are integral to the Auxiliary Building. The main steam and auxiliary feedwater tunnels are sealed and isolated from the Auxiliary Building and do not open into the Auxiliary Building. The refueling water storage tank (RWST) tunnels are routed around either side of the Fuel Handling Building and house piping and components running between each Unit 1 and Unit 2 RWST and the Auxiliary Building. The RWST tunnels are a reinforced concrete box section, which are integrally connected at the Auxiliary Building and open to the safety injection pump rooms inside the Auxiliary Building. The RWST tunnels are watertight.

The radwaste tunnel is a below grade, reinforced concrete, box structure connecting the Auxiliary Building and the radwaste building. The boundary of the radwaste tunnel, evaluated with the Radwaste and Service Building Complex, begins at the radwaste building and ends at the entrance to the Auxiliary Building, at the exterior surface of the Auxiliary Building exterior wall. Areas inside the Auxiliary Building, which are considered an extension of the radwaste tunnel, are separately evaluated with the Auxiliary Building.

Sumps, equipped with leak detection, are provided in the following locations in the Auxiliary Building: residual heat removal pump areas, containment spray pump areas, residual heat removal heat exchanger rooms, component cooling pump and heat exchanger area, auxiliary feedwater pump areas, and essential service water pump cubicles.

The guard pipe for the recirculation sump effluent piping extends from the recirculation sump, inside the Containment Structure, to the sump suction valve protection chamber, inside the Auxiliary Building. The sump suction valve protection chamber and the section of guard pipe that extends beyond the containment boundary provides a controlled leakage housing and are evaluated as part of the Auxiliary Building as an encapsulation component/valve chamber.

Structural steel includes the columns and floor framing steel for the reinforced concrete floors on steel decking and for the galleries with steel grating. Hatches provide personnel access and allow for equipment removal.

The Auxiliary Building is divided into compartments designed to protect safety-related systems and components, and provide physical separation for redundant mechanical and electrical components. Among these compartments are the containment penetration areas that wrap around the Containment Structures, the control room envelope, emergency diesel generator rooms, diesel oil storage tank rooms, pump rooms, rooms for electrical equipment and chillers, the radwaste area, other general plant equipment areas, and miscellaneous operational support areas. Watertight doors provide flood protection, where required, between compartments.

The containment penetration area for each unit is located adjacent to and seismically separated from its respective Containment Structure. The containment penetration area for each unit is partitioned into compartments for electrical and mechanical penetrations into the containment. There are additional compartments below grade that contain the following redundant equipment: essential service water pumps, residual heat removal pumps, safety injection pumps, containment spray pumps, and centrifugal charging pumps.

The common control room consists of the main control room, plant computer rooms, auxiliary electric equipment rooms, upper cable spreading rooms, HVAC equipment rooms, security control center, Shift Manager’s office/records room and miscellaneous locker room, toilets, kitchen (Braidwood only), and storage rooms. The main control room contains controls and instrumentation necessary for operation under normal and abnormal conditions. The main control room is common to both Units 1 and 2 and contains separate control boards at opposite ends of the room. The facilities located within the control room envelope are shielded and designed to be habitable throughout the course of a design basis accident and the resulting radiological condition. The Control Area Ventilation system is designed to maintain the control room envelope at a positive pressure with respect to adjacent areas to minimize unfiltered inleakage into the control room envelope areas. The remote shutdown panel is located on a different level of the Auxiliary Building.

The Auxiliary Building includes separate rooms for the emergency diesel generators (EDGs) for each unit and their auxiliary systems. The EDGs housed in the Auxiliary Building are accessed from the Turbine Building Complex. The diesel generators are isolated from each other and from other equipment in the area by firewalls and fire doors. The fuel oil tanks for each unit are located on the floor below the emergency diesel generators in rooms accessed through watertight doors. Atmospheric vents for the fuel oil tank rooms penetrate through the auxiliary building wall into the turbine building and terminate above the design flood level. The diesel-generator combustion and cooling air intakes are separated and located on the roof of the Auxiliary Building and are missile protected. The louvered air intakes for each diesel-engine generator set are located on a vertical wall on the roof of the Auxiliary Building. The diesel generator exhausts and silencers are protected up to the point where the exhausts penetrate the tornado proof concrete enclosure on the Auxiliary Building roof. Above this point, the exhausts are exposed for approximately 35 feet as they travel vertically up the outside of the common wall between the Auxiliary Building and the Turbine Building Complex, which extends above the Auxiliary Building roof. The concrete penthouses and missile shields, for the diesel intake and exhaust, are included within the boundary of the Auxiliary Building. Diesel exhausts and air intake components are evaluated separately with the Emergency Diesel Generator & Auxiliaries System.

The Auxiliary Building includes rooms and compartments which contain Radwaste System components designed to collect, process, store, and prepare for disposal liquid, gaseous, and solid waste. The 125,000-gallon recycle holdup tanks are located in separate compartments below grade in the Auxiliary Building. Storage areas are shielded to protect personnel in accessible portions of the solid radwaste areas. The Auxiliary Building Ventilation system is designed to maintain the Auxiliary Building and Fuel Handling Building at a negative pressure with respect to the outside air.

The other general plant equipment areas include areas for mechanical, electrical, and HVAC equipment, including water and HVAC filters, and chillers for the control room, auxiliary building, and containment HVAC systems. The component cooling water pumps and heat exchangers and the auxiliary feedwater pumps and diesel engines are located in general areas in the Auxiliary Building. Atmospheric vents for the air intake for the diesel driven auxiliary feedwater pumps penetrate through the auxiliary building wall into the turbine building and terminate above the design flood level. The volume control tanks are located in separate rooms in the Auxiliary Building. The redundant ESF switchgear, Class 1E batteries, and associated electrical equipment are located in separate rooms in the Auxiliary Building.

The other miscellaneous operational support areas in the Auxiliary Building include areas such as the laboratory complex, locker room facility, and maintenance areas. These areas provide support for miscellaneous plant and personnel operations and maintenance activities, which do not perform license renewal intended functions.

The purpose of the Auxiliary Building is to provide physical support, shelter, and protection to systems, structures, and components (SSCs) housed within the building during normal plant operation, and during and following postulated design basis accidents and extreme environmental conditions. These functions are provided to portions of engineered safety features systems, auxiliary systems, steam and power conversion systems, and control systems. The building also contains the control room, which is the main operation center for the plant providing a centralized area for control and monitoring of safety-related equipment. The control room, in conjunction with Control Area Ventilation System, provides a habitable environment for plant operators so that the plant can be safely operated and shut down under design basis accident conditions. The Auxiliary Building also supports and protects nonsafety-related equipment including chemistry lab equipment.

Included within the boundary of the Auxiliary Building are bolting for the structure, reinforced concrete elements of the building, concrete embedments for the structure, encapsulation components/valve chamber, hatches, masonry walls, metal components such as the control room ceiling, structural steel components including missile shields, spray shields, and sump pits and liners. Also included within the boundary of this structure are the plant vent stack, atmospheric vents for the fuel oil tank rooms and air intake for the diesel driven auxiliary feedwater pumps, roof missile shields for diesel intake, exhaust, and building ventilation, and the other penthouses. Also included within the boundary is structural bolting associated with specific in scope components evaluated as part of the Auxiliary Building. Assessment of the Auxiliary Building boundary concluded that the building structure is within the scope of license renewal in its entirety, except as noted below. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Auxiliary Building.

Included within the boundary of the Auxiliary Building and determined not to be within the scope of license renewal are the architectural elements in the miscellaneous operational support areas that include furniture, drywall partitions and soffits, and suspended ceilings. These components and structures are nonsafety-related, and are provided to facilitate miscellaneous operational support. These components and structures do not perform a license renewal intended function, such that their failure will not prevent satisfactory accomplishment of a safety-related function.

Not included within the boundary of the Auxiliary Building are cranes and hoists, fire barriers, mechanical and electrical containment penetrations, diesel exhaust and air intake components, component supports, and structural commodities. Cranes and hoists are evaluated separately with the Cranes and Hoists system. Mechanical and electrical penetrations into the containment are evaluated separately with the Containment Structure. Diesel exhausts and air intake components are evaluated separately with the Emergency Diesel Generator & Auxiliaries System. Fire barriers, including fire doors, fire seals, fire dampers, and fire resistant covering of structural steel, are evaluated separately with the Fire Protection System. Component supports, including their respective bolting, are evaluated with the Component Supports Commodity Group. Structural commodities, including their respective bolting, are evaluated with the Structural Commodity Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track.

For more detailed information, see UFSAR Sections 3.6, 3.7, 3.8, 3.11, and 9.5.

Reason for Scope Determination

The Auxiliary Building meets 10 CFR 54.4(a)(1) because the Auxiliary Building is a safety-related structure that is relied upon to remain functional during and following design basis events. The Auxiliary Building meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the building could prevent satisfactory accomplishment of function(s) identified for

10 CFR 54.4(a)(1). The Auxiliary Building also meets 10 CFR 54.4(a)(3) because the Auxiliary Building is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Anticipated Transient Without Scram (10 CFR 50.62), and Station Blackout (10 CFR 50.63). The Auxiliary Building is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61).

Intended Functions

1. Provides physical support, shelter, and protection for safety-related systems, structures, and components. 10 CFR 54.4(a)(1)

2. Controls the potential release of fission products to the external environment so that offsite consequences of design basis events are within acceptable limits. 10 CFR 54.4(a)(1)

3. Provides for the discharge of treated gaseous waste to meet the requirements of 10 CFR 50.67 or 10 CFR 100. 10 CFR 54.4(a)(1)

4. Provide centralized area for control and monitoring of nuclear safety related equipment. 10 CFR 54.4(a)(1)

5. Provides physical support, shelter, and protection for nonsafety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). 10 CFR 54.4(a)(2)

6. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulation for Fire Protection (10 CFR 50.48). 10 CFR 54.4(a)(3)

7. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulation for Environmental Qualification (10 CFR 50.49). 10 CFR 54.4(a)(3)

8. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulation for Anticipated Transients Without Scram (10 CFR 50.62). 10 CFR 54.4(a)(3)

9. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulation for Station Blackout (10 CFR 50.63). 10 CFR 54.4(a)(3)

UFSAR References

3.4
3.5
3.6

3.7.2
3.8.4
3.8.5
3.11
6.2.4
6.4
8.3.1.2
9.3
9.4
9.5.8.2

License Renewal Boundary Drawings

Byron Common:
LR-BYR-S-01A

Braidwood Common:
LR-BRW-S-01A

Table 2.4-1 Auxiliary Building
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting (Structural)	Structural Support
Concrete Anchors	Structural Support
Concrete Curbs	Direct Flow
Concrete Embedments	Structural Support
Concrete: Above-grade exterior (accessible areas)	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Structural Pressure Barrier
	Structural Support
Concrete: Above-grade exterior (inaccessible areas)	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Structural Pressure Barrier
	Structural Support
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Structural Pressure Barrier
	Structural Support
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support
Concrete: Interior	Flood Barrier
	HELB Shielding
	Missile Barrier
	Shelter, Protection
	Shielding
	Structural Pressure Barrier
	Structural Support
	Water retaining boundary
Encapsulation Components/Valve Chambers	Structural Pressure Barrier
Encapsulation Components/Valve Chambers (Bellows)	Structural Pressure Barrier
Hatches/Plugs	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Shielding
Masonry walls: Interior	Missile Barrier
	Shelter, Protection
	Shielding

Component Type	Intended Function
Masonry walls: Interior	Structural Support
Metal components: All structural members	Shelter, Protection
	Structural Support
Metal decking	Structural Support
Offgas Stack and Flue	Gaseous Release Path
Spray Shields	Shelter, Protection
Steel Components	Shelter, Protection
	Structural Support
Steel Components (Atmospheric vent with screen)	Direct Flow
	Flood Barrier
	Structural Support
Steel components: Sump screen and trench cover	Shelter, Protection
	Structural Support
Steel elements: liner, liner anchors, integral attachments (accessible areas)	Structural Support
	Water retaining boundary
Steel elements: liner, liner anchors, integral attachments (inaccessible areas)	Structural Support
	Water retaining boundary

The aging management review results for these components are provided in:

Table 3.5.2-1	Auxiliary Building Summary of Aging Management Evaluation

2.4.2 Circulating Water Pump House (Byron)

Description

The Circulating Water Pump House is present at Byron Station, Units 1 and 2, only. The Circulating Water Pump House boundary includes the circulating water pump house, the chemical feed tank building adjoining the south side of the circulating water pump house, an emergency shower and eyewash structure adjoining the north side of the circulating water pump house, the sodium hypochlorite tank foundation and associated building located adjacent to the circulating water pump house on the south side and the two acid tank foundations and associated buildings, located south and north of the circulating water pump house. The Circulating Water Pump House boundary also includes the circulating water intake flume. The circulating water pump house will be discussed first and will include the chemical tank building directly adjoining the circulating water pump house and the buildings and foundations associated with the chemical storage tanks located on the north and south sides of the circulating water pump house. The circulating water intake flume will be discussed in a separate paragraph that follows.

Circulating Water Pump House:
The circulating water pump house is a multi-level structure and is located approximately 700 feet east of the main power block. In addition to the main floor level, there is an upper platform area that contains ventilation equipment, and a substructure that provides six forebay sections that provide a suction point for the pumps contained in the structure.

The circulating water pump house at the main floor level contains various pumps including electric driven fire pumps and non-essential service water pumps. In addition to the pumps, other related equipment including strainers, instrumentation panels, electrical motor control centers, crane hoists, and an overhead crane are also located in the circulating water pump house. The layout of the equipment is segregated such that the south side is for Unit 1 and north side for Unit 2, with the exception of the fire protection pumps that are common to both units. A separate room on the main level contains the diesel driven fire pump and diesel oil storage tank. A lower pit area accessible from the main level contains the circulating water pumps. Trash racks (bar grills) are located in the intake bays of the circulating water pump house to screen the water for debris.

The below grade portion of the circulating water pump house is constructed of reinforced concrete founded on bedrock and compacted fill. The floor at grade level is a structural reinforced concrete slab with a number of openings for various pumps and access ladders for personnel. The above grade exterior walls are comprised of insulated metal siding, supported by steel beams, girts, and columns. The roof consists of a built-up roofing system over precast concrete panels, and is supported by steel beams and columns.

The chemical feed tank building directly adjoins the circulating water pump house on the south side, and the construction is similar to the circulating water pump house except that the foundation consists of a concrete slab supported by concrete footings. The emergency shower and eyewash structure adjoining the north side of the circulating water pump house is a pre-engineered metal structure sitting on a concrete slab. The sodium hypochlorite building is a pre-engineered metal structure that is supported by steel beams on concrete footings. The two acid tanks and associated buildings are pre-engineered metal structures sitting on concrete slabs at grade level.

The systems, structures, and components associated with the circulating water pump house are all nonsafety-related. The main motor-driven and diesel-driven fire pumps for the plant are located in the circulating water pump house on the main level, along with the two motor driven jockey fire pumps. The diesel-driven fire pump is contained within a separate 3-hour fire rated room constructed of masonry walls within the circulating water pump house and the room is protected by an automatic wet-pipe sprinkler system.

The circulating water pump house provides physical support, shelter, and protection for the pumping equipment for the circulating water, fire protection, and non-essential service water systems that take suction from the circulating water intake flume. The circulating water pump house provides the suction point for cooling water for normal operations, as well as water for fire protection.

Circulating Water Intake Flume:
The circulating water intake flume is a reinforced concrete structure founded on bedrock and controlled backfill that is located directly east of the circulating water pump house. The structure acts as a canal and is constructed of reinforced concrete below grade and extends to grade level to provide 2 feet of freeboard with respect to normal water level in the flume. The purpose of the circulating water intake flume is to return water from the cooling tower basins to the circulating water pump house. The circulating water intake flume is nonsafety-related. The circulating water intake flume together with the cooling tower basins provides the water volume required to support the fire protection system.

Included in the boundary of the Circulating Water Pump House are components of the circulating water pump house and the circulating water intake flume in their entirety, as well as the chemical feed tank building directly adjoined to the circulating water pump house, the emergency shower and eyewash structure adjoining the north side of the circulating water pump house and the chemical storage tank buildings and foundations located outside on the north and south sides of the circulating water pump house. The circulating water pump house provides physical support, shelter, and protection for the fire protection equipment located within the structure.

Included in the boundary of the Circulating Water Pump House and determined to be within the scope of license renewal are the reinforced concrete slabs, walls, foundation, precast concrete panels, metal component structural members, trash rack bar steel components, hatches/plugs and masonry walls. Also included within the boundary is structural bolting associated with specific in scope components evaluated as part of the Circulating Water Pump House. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Circulating Water Pump House.

Included in the boundary of the Circulating Water Pump House and determined not to be within the scope of license renewal are the structural elements outside of the circulating water pump house that include the stop logs, stop log guides, exterior ladders, stairs, and metal decking. These components and structures are nonsafety-related and are provided to facilitate maintenance activities and provide access to equipment. These components do not perform a license renewal intended function and their failure will not prevent satisfactory accomplishment of a license renewal intended function. Also included in the boundary of the Circulating Water Pump House and determined not to be within the scope of license renewal are the emergency shower and eyewash structure adjoining the north side of the circulating water pump house, the chemical feed tank building directly adjoined to the circulating water pump house and the sodium hypochlorite and acid tank buildings and foundations located outside the north and south side of the circulating water pump house. These components and structures are nonsafety-related and do not perform a license renewal intended function and their failure will not prevent satisfactory accomplishment of a license renewal intended function.

Not included within the boundary of the Circulating Water Pump House are cranes and hoists, fire barriers, component supports, and structural commodities. Cranes and hoists are evaluated with the Cranes and Hoists System, and fire barriers are evaluated separately with the Fire Protection System. Component supports, including their respective bolting, are evaluated with the Component Supports Commodity Group. Structural commodities, including their respective bolting, are evaluated with the Structural Commodity Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track. Components and structures also evaluated separately from the Circulating Water Pump House are the cooling tower basins and the mechanical components for the circulating water, chemical feed and handling, miscellaneous drains, fire protection, instrument air, service air, treated water, pumphouse ventilation, and non-essential service water systems. These components and structures are evaluated with the following license renewal systems: Natural Draft Cooling Towers, Circulating Water System, Condensate and Feedwater Auxiliaries System, Non-Radioactive Drain System, Fire Protection System, Compressed Air System, Service Water System, Fresh Water System, and Circulating Water Ventilation System.

For more detailed information see UFSAR Sections 2.4.8 (Byron), 7.7.1.15, 9.2.1.1, 9.4.6 (Byron), and 10.4.5 (Byron).

Reason for Scope Determination

The Circulating Water Pump House (Byron) is not in scope under 10 CFR 54.4(a)(1) because no portions of the structure are safety-related or relied upon to remain functional during and following design basis events. The Circulating Water Pump House (Byron) is not in scope under 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the structure would not prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Circulating Water Pump House (Byron) meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The Circulating Water Pump House (Byron) is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Fire Protection (10 CFR 50.48). The circulating water pump house provides physical support, shelter, and protection for contained Fire Protection System components. 10 CFR 54.4(a)(3)

2. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Fire Protection (10 CFR 50.48). The circulating water intake flume together with the cooling tower basins provides the water volume required to support the fire protection system. 10 CFR 54.4(a)(3)

UFSAR References

2.4.8 (Byron)
7.7.1.15
9.2.1.1
9.4.6 (Byron)
10.4.5 (Byron)
Table 3.2-1

License Renewal Boundary Drawings

Byron Common:
LR-BYR-S-01A

Braidwood Common:
None.

Table 2.4-2 Circulating Water Pump House (Byron) Components Subject to Aging Management Review

Component Type	Intended Function
Bolting (Structural)	Structural Support
Concrete Anchors	Structural Support
Concrete Embedments	Structural Support
Concrete: Above-grade exterior (accessible areas)	Shelter, Protection
	Structural Support
Concrete: Below-grade exterior (inaccessible areas)	Direct Flow
	Shelter, Protection
	Structural Support
	Water retaining boundary
Concrete: Foundation, subfoundation (inaccessible areas)	Shelter, Protection
	Structural Support
Concrete: Interior	Shelter, Protection
	Structural Support
Hatches/Plugs	Shelter, Protection
Masonry walls: Interior	Shelter, Protection
	Structural Support
Metal decking	Structural Support
Precast Panel	Shelter, Protection
	Structural Support
Steel Components	Structural Support
Steel Components (Anti-vortex components)	Direct Flow
Steel Components (Trash Rack Bars)	Filter

The aging management review results for these components are provided in:

Table 3.5.2-2 Circulating Water Pump House (Byron)
Summary of Aging Management Evaluation

2.4.3 Component Supports Commodity Group

Description

The Components Support Commodity Group consists of structural elements and specialty components designed to transfer the load applied from a system, structure, or component (SSC) to the building structural element or directly to the building foundation. Supports include bolted connections, seismic anchors or restraints, support members, constant and variable spring hangers, rod hangers, guides, stops, straps, clamps, and clevis pins. Specialty components include snubbers, sliding support bearings and surfaces, vibration isolation elements, and high strength bolting.

The commodity group is comprised of the following supports:

- Supports for ASME Class 1, 2 and 3, and MC piping and components, including reactor pressure vessel support shoes, steam generator supports, pressurizer supports, and reactor coolant pump supports.

- Supports for cable trays, conduits, HVAC ducts, tube tracks, instrument tubing and non-ASME piping and components.

- Supports for emergency diesel generators (EDG), HVAC system components, and other miscellaneous mechanical equipment.

- Supports for platforms, pipe whip restraints, jet impingement shields, masonry walls, and other miscellaneous structures.

- Supports for racks, panels, cabinets, and enclosures for electrical equipment and instrumentation.

The purpose of a support is to transfer loads such as gravity, thermal, seismic, and other lateral and vertical loads imposed on or by the system, structure, or component to the supporting building structural element or foundation. Sliding surfaces, when incorporated into the support design, permit release of lateral forces but are relied upon to provide vertical support. Specialty supports such as snubbers only resist seismic forces. Vibration isolation elements are incorporated in the design of some vibrating equipment to minimize the impact of vibration, while still providing vertical support. Other support types such as guides and position stops allow displacement in a specified direction or preclude unacceptable movements and interactions.

The Component Supports Commodity Group includes supports for mechanical, electrical and instrumentation systems, components, and structures that are within the scope of license renewal. The group also includes supports for SSCs, which are not within the scope of license renewal, but their supports are required to restrain or prevent physical interaction with safety-related SSCs (e.g. seismic II/I). The supports include building concrete at location of expansion and grouted anchors and grout pads for support base plates; constant and variable load spring hangers, guides and stops; high-strength bolting for NSSS component supports; sliding surfaces and bearings; support members, welds, bolted connections and support anchorage to building structures; vibration isolators.

Snubbers are also included in the boundary of this commodity group, however, they are considered active components and are not subject to aging management review except for the end connections, which perform a passive function for structural support. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Component Supports Commodity Group.

Not included in the boundary of Component Supports Commodity Group are concrete equipment foundations, concrete anchors, and concrete embedments other than supports listed above. Concrete equipment foundations are evaluated separately as part of the concrete components evaluated with the license renewal structures that contain them. Concrete anchors and concrete embedments, other than supports listed above, are evaluated separately with the license renewal structures that contain them.

For more detailed information, see UFSAR Sections 3.2, 3.6, 3.9, 3.10, Appendix D, Attachment 3.7-A

Reason for Scope Determination

The Component Supports Commodity Group meets 10 CFR 54.4(a)(1) because it is a safety-related commodity group that is relied upon to remain functional during and following design basis events. The Component Supports Commodity Group meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the commodity group could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Component Supports Commodity Group also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Anticipated Transient Without Scram (10 CFR 50.62), and Station Blackout (10 CFR 50.63). The Component Supports Commodity Group is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61).

Intended Functions

1. Provides structural support or restraint to SSCs in the scope of license renewal. 10 CFR 54.4 (a)(1), (a)(2), (a)(3)

2. Provides structural support or restraint to SSCs not in the scope of license renewal to prevent interaction with safety-related SSCs. 10 CFR 54.4 (a)(2)

UFSAR References

3.2.1.1
3.2.1.2
3.6.2.3.2
3.9.3
3.10.1.2
3.10.3.2
Appendix D-D.11
Appendix D.8.7
Appendix D.8.17
Attachment 3.7-A

Table 3.2-1
Table 6.2-4A
Table B.9-1

<u>License Renewal Boundary Drawings</u>

Byron Common:
None.

Braidwood Common:
None.

Table 2.4-3 Component Supports Commodity Group Components Subject to Aging Management Review

Component Type	Intended Function
Supports for ASME Class 1 piping and components (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support
Supports for ASME Class 1 piping and components (Constant and variable load spring hangers; guides; stops)	Structural Support
Supports for ASME Class 1 piping and components (High-strength bolting for NSSS component supports)	Structural Support
Supports for ASME Class 1 piping and components (Sliding Surfaces – NSSS component supports)	Structural Support
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support
Supports for ASME Class 2 and 3 piping and components (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support
Supports for ASME Class 2 and 3 piping and components (Constant and variable load spring hangers; guides; stops)	Structural Support
Supports for ASME Class 2 and 3 piping and components (Sliding surfaces)	Structural Support
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support
Supports for ASME Class MC components (Sliding Surfaces)	Structural Support
Supports for ASME Class MC components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support

Component Type	Intended Function
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Sliding support bearings; sliding support surfaces)	Structural Support
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc. Mechanical Equipment (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc. Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc. Mechanical Equipment (Vibration isolation elements)	Vibration Isolation
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc. Structures (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc. Structures (Support members; welds; bolted connections; support anchorage to building structure)	Pipe Whip Restraint
	Structural Support
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support

Component Type	Intended Function
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support

The aging management review results for these components are provided in:

Table 3.5.2-3	Component Supports Commodity Group Summary of Aging Management Evaluation

2.4.4 Containment Structure

Description

The Containment Structure at Byron and Braidwood Stations, Units 1 and 2, includes the containment buildings, containment internal structures, and exterior structural features at each unit. The containment structure completely encloses the entire pressurized water reactor, steam generators, reactor coolant loops, and portions of the auxiliary and engineered safety features systems. The Containment Structure is classified as a safety related structure, designed to withstand the effects of design basis accident loads as applicable, which include the effects of tornado induced wind and missiles, flooding, earthquake, LOCA, and equipment generated missiles.

Containment Buildings:
The containment structure at each unit is a prestressed concrete shell structure made up of a cylinder with a shallow dome roof and flat foundation slab. The cylindrical portion is prestressed by a post-tensioning system consisting of horizontal and vertical tendons. There are three buttresses equally spaced around the containment and each horizontal tendon is anchored at buttresses 240 degrees apart, bypassing the intermediate buttress. The cylinder portion of the containment building has an inside diameter of 140 feet, a height of approximately 222 feet, and a wall thickness of 3 feet 6 inches. The containment wall has been thickened locally around main steam penetrations, personnel lock, and equipment hatch. The dome post-tensioning system is made up of three groups of tendons oriented 120 degrees to each other and anchored at the vertical face of the dome ring. The dome is 3 feet thick. The base foundation slab is conventionally reinforced concrete with high strength reinforcing steel that is 157 feet in diameter with a nominal thickness of 12 feet. A continuous access gallery, also called a tendon tunnel, is provided beneath the base slab for access to the vertical tendons. The base slab is supported on bedrock.

Continuous hoop and meridian conventional reinforcement is placed at the outside face of the cylindrical wall. Similar reinforcement has also been provided at the inside face where the cylindrical wall intersects with the base slab or dome ring and in the area where polar crane brackets are embedded in the containment wall. Transverse shear reinforcing is provided where required by design. The containment wall is prestressed using 201 hoop and 162 vertical unbonded tendons. Each hoop tendon is anchored at buttresses 240 degrees apart bypassing the intermediate buttress. Vertical tendons are anchored at the underside of the base slab and at the top of the dome ring. The anchorage zones for all the tendons have been provided with additional reinforcing to account for transverse tensile stresses resulting from anchorage forces reacting on the concrete. The dome has been conventionally reinforced in two directions. Radial ties have also been provided over the entire dome to account for radial tension due to prestressing tendons. Three groups of tendons oriented 120 degrees to each other have been provided in the dome. In each group there are 40 tendons spaced equally on a horizontal projection. Bearing plates for anchorage of the tendons are placed on wedge shaped pockets located on the vertical face of the dome ring.

The entire inside surface of the containment building is lined with a carbon steel liner to ensure a high degree of leak tightness in the event of a postulated accident. The 1/4-inch liner plate is anchored to the containment concrete by means of rolled steel sections embedded in the concrete and welded to the liner plate. The top of the base slab, within the containment, is lined with a steel liner plate, and then covered by the interior base mat. Thicker liner plate inserts have been provided to transfer concentrated loads.

Containment penetrations consist of a sleeve embedded in the containment concrete wall and welded to the containment liner to form part of the leak-tight pressure boundary. Containment penetrations include the personnel lock with equipment hatch, emergency personnel airlock, instrument and process pipe penetrations, electrical penetrations, and the fuel transfer tube and recirculation sump effluent pipe penetrations.

Personnel Lock with Equipment Hatch - An equipment access hatch and integral personnel airlock is provided for access to the interior of the containment. The equipment hatch is provided for access to the containment during shutdown. The transfer of equipment and components through the containment wall is accomplished through this opening. The equipment hatch is a round barrel frame, 18 feet 8 inches in diameter, with dished head access hatch; the cylindrical personnel lock is built integrally into the dished head. The integral personnel airlock is a round barrel 10 feet 2 inches in diameter and consists of two airtight doors in series which are mechanically interlocked so that one door cannot be opened unless the second door is sealed.

Emergency Personnel Airlock - The emergency personnel airlock consists of a round barrel 10 foot 2 inches in diameter, with a bulkhead and gasketed door at each end. The doors are mechanically interlocked such that one door cannot be opened unless the second door is sealed. The airlock can be pressure tested at any time without interfering with the normal operation of the plant. Provision is made to leak test the door seals on both doors.

Instrument and Process Pipe Penetrations - There are three types of instrument and process pipe penetrations. For all three penetration types, the penetration sleeve is anchored in the wall and extends just inside the containment wall liner, where the sleeve is welded to the containment liner plate. The head fitting, which seals the annulus between the sleeve and the instrument or process pipe, is on the outside of the containment. For Type I penetrations, the head fitting and a section of the process pipe is one forged piece. For Type II, the head fitting is forged and is welded to the process pipe by a full penetration weld. The head fitting for Type III penetrations is a flat plate attached to the process pipe by a full penetration weld. In addition to their function as primary containment barrier, the penetrations serve as anchors to the pipes and are designed to carry the loads associated with a postulated pipe break. Thermal growth and movement is absorbed in the piping system. The entire length of the penetration sleeve is designed as a containment component and is in the boundary of the Containment Structure. The portion of the containment penetration assembly that consists of the head fitting, which is directly exposed to process pipe pressure (Head Fitting Type I only), is considered to be a piping component having the same classification as the process pipe and, as such, it is evaluated with the applicable piping system. All other head fittings are classified as containment components and are in the boundary of the Containment Structure. Air gaps are provided around all pipes. Insulation and cooling coils are provided around hot pipes to reduce thermal stress in the containment during normal operations. Cooling water is provided by the Component Cooling System.

Electrical Penetrations - Electrical penetration assemblies are used to extend electrical conductors through the pressure boundary of the containment structure. Electrical penetrations are functionally grouped into low voltage power and low voltage control cable penetration assemblies, medium voltage power cable penetration assemblies, and shielded cable penetration assemblies. Hermetic seals between each conductor and header plates are obtained by the use of high strength, high temperature epoxy. An assembly is sized to be inserted in schedule 80 penetration nozzles. The electrical features of the electrical penetrations, including electrical continuity, electrical insulation, and containment isolation fuses/breakers are separately evaluated with electrical commodities and not in the boundary of the Containment Structure.

Fuel Transfer Tube and Recirculation Sump Effluent Pipe Penetrations - Only the following containment piping penetrations are fitted with expansion bellows: 1) fuel transfer tube penetration sleeve; and 2) recirculation sump effluent pipe, at the closure joint between the process pipe and guard pipe. There are three expansion bellows in the penetration sleeve of the fuel transfer tube and one bellow attached to the penetration sleeve of each recirculation sump effluent pipe. The bellows on the recirculation sump effluent pipes are flood seals and are not required to maintain containment integrity.

Guard pipe assemblies were utilized for the fuel transfer tube and the recirculation sump effluent pipe. The guard pipes on these moderate energy lines are used to ensure containment integrity, with a portion of the guard pipe serving as a containment sleeve. The fuel transfer tube penetrates the containment wall connecting the refueling cavity in the containment with the refueling canal in the fuel handling building. The penetration consists of a 20-inch pipe inside a 24-inch guard pipe. The fuel transfer tube is the inner pipe, which is fitted with a double-gasketed blind flange in the refueling canal. The guard pipe for the fuel transfer tube extends along the length of the fuel transfer tube from the inside of containment, through the containment wall, to the outside of containment. The outside of the guard pipe is welded to the steel liners in both the refueling cavity and the fuel transfer canal. The outside of the fuel transfer tube is sealed to the guard pipe with a seal ring inside of the refueling cavity and with expansion bellows inside of the fuel transfer canal. The portion of the guard pipe from the containment liner, across the bellows towards the inside of containment, including the end flange of the tube on the inside of containment, then back towards the containment liner, serves as the containment boundary. The fuel transfer tube is also sealed to the steel liners in both the refueling cavity and refueling canal. The fuel transfer tube is closed with a blind flange on the containment side. Expansion joint bellows provide for relative movement between the two structures. The fuel transfer tube and blind flange inside of the containment are evaluated with the Fuel Handling and Fuel Storage System.

The guard pipe for the recirculation sump piping extends from the recirculation sump, inside the containment, to the sump suction valve protection chamber, inside the Auxiliary Building. A seal ring exists between the guard pipe and the recirculation sump piping which serves as the containment boundary. The section of guard pipe and seal ring, which serve as the containment boundary, are evaluated as part of the Containment Structure. The sump suction valve protection chamber and the section of guard pipe that extends beyond the containment boundary are evaluated as part of the Auxiliary Building.

Containment Internal Structures:
Major containment internal structures consist of reinforced concrete or steel components. Internal structures of the containment support and shield major nuclear steam supply equipment, their associated piping, and auxiliary equipment. The containment internal structures also support various gallery floors, contain water for refueling, and support the polar crane. The internal structures include the following: reactor coolant loop supports, primary shield wall and reactor cavity, secondary shield wall, refueling cavity, interior base mat and sumps, polar crane supporting system, operating floor, intermediate floors and galleries, and steel components.

Reactor Coolant Loop Supports - The reactor vessel support, steam generator supports, reactor coolant pump supports, and pressurizer support are evaluated as part of the Component Supports Commodity Group.

Primary Shield Wall and Reactor Cavity - The primary shield wall is a circular, cylindrical, reinforced concrete structure. The primary shield wall forms the reactor cavity and also supports and shields the reactor vessel. The primary shield wall has an outside diameter of 34 feet and an inside diameter of 25 feet for the portion above the reactor vessel support, and 17 feet 1 inch for the portion below the reactor vessel support. The primary shield wall is supported by the interior base mat and anchored to the 12-foot thick containment base mat for uplift load. Internal surfaces of the reactor cavity sump are lined with 1/4 inch stainless steel plate.

Secondary Shield Wall - The secondary shield wall is a reinforced concrete structure that shields and provides lateral support for steam generators, reactor coolant pumps, and the pressurizer. Below the operating floor, the secondary shield wall is an irregular 12 sided polygonal structure, 4 feet 6 inches thick and approximately 49 feet high. Above the operating floor, the secondary shield wall separates into five enclosure compartments around the steam generators and the pressurizer, varying in thickness from 5 feet 0 inch to 2 feet 0 inch. The secondary shield wall is supported by the interior base mat and for the portion above the operating floor it is partially supported by the refueling cavity walls. The secondary shield wall is anchored to a 12 foot thick containment base mat. The secondary shield wall also provides missile protection for the containment liner plate.

Refueling Cavity – The refueling cavity is also called the reactor refueling pool. The refueling cavity contains treated borated water during refueling. The refueling cavity walls also support miscellaneous gallery floors, the operating floor, and the secondary shield wall above the operating floor. The bottom of the refueling cavity is divided into two levels. The upper level serves as the upper internals laydown area, while the lower level serves as the lower internals laydown area during refueling operations. The refueling cavity wall thickness varies from 3 feet 6 inches to 5 feet 0 inch. The interior face of the refueling cavity walls and floor is lined with 3/16 inch austenitic stainless steel plate. Drains were provided in the concrete behind the welds in the 3/16 stainless steel liner. The drains exhaust to sight glasses that can be used to monitor for refueling cavity leakage. During refueling, the refueling cavity is flooded with treated borated water. The refueling cavity is drained after refueling and maintained dry during plant operation. A rubber refueling cavity seal is installed around the reactor vessel flange to allow for flooding the refueling cavity.

Interior Base Mat and Sumps - The interior base mat is a 3-foot thick reinforced concrete slab 140 feet in diameter. The interior base mat serves as a foundation for all internal structures except the polar crane supports. The interior base mat was placed on the bottom containment liner and is not doweled into the containment base mat except along the bases of primary shield wall, secondary shield wall, and refueling cavity walls.

The interior base mat includes reinforced concrete for the reactor cavity and instrumentation tunnel, and the recirculation sumps and the containment sumps. The interior faces of the reactor recirculation sumps and the containment sumps are lined with 3/16 inch austenitic stainless steel plate. The interior base mat also contains shallow trenches designed to collect floor drainage and direct it to the containment building sumps. The shallow trenches are inside the containment cylindrical wall and inside the secondary shield wall. The containment building sumps and the trenches are lined with stainless steel plate and covered with stainless steel grating or perforated stainless steel plates to prevent the debris from entering the sumps.

Two redundant recirculation sump pits are physically separated from each other and are protected from high energy piping by the solid steel cover of the trash rack structure. The trash rack is a structure made of tube steel and angle steel supports, with side vertical stainless steel grating and a solid checkered plate cover. The top of the trash rack structure is approximately four feet above the containment floor elevation. The containment recirculation sumps are located below the containment floor elevation at the lowest floor elevation in containment, exclusive of the reactor vessel cavity. This maximizes the depth of the pool water above the sump screens. A trash rack structure, vertical grating on the perimeter and checkered plate on top, protects the openings for both sumps. The sump suction pipe is located inside the sump pits. Each sump pit has a concrete slab ceiling with three openings that allow water to enter the pit. The concrete slab provides further protection for the screens and sump suction pipe. A debris interceptor plate is installed at each grating sector to prevent larger debris from accessing the sump pits. The recirculation sump screens are installed inside sump pits. The sump screens and grating are made of stainless steel while the trash rack support elements are made of carbon steel. The sump effluent pipe and sump screen described above are evaluated with the Residual Heat Removal System. The other components described above, including the trash rack assembly, concrete slab ceiling, and sump liner are evaluated with the Containment Structure.

Polar Crane Supporting Systems - The polar crane rides on the crane rail which is anchored on top of 18 circular curved crane girders. The polar crane girders are supported by 36 crane brackets which are cantilevered from and embedded in the containment shell. Each crane girder is supported on three brackets. The polar crane girders and crane brackets are evaluated as part of the Cranes and Hoists system.

Operating Floor, Intermediate Floors, and Galleries - The operating floor surrounds the refueling cavity and the secondary shield wall. The operating floor is bounded by the containment cylindrical wall. The intermediate floors and galleries serve the dual function of providing access to electrical and mechanical components as well as structural support for these components. The floors and galleries consist of structural framing supported by the primary shield wall, secondary shield wall, and structural steel columns. Steel grating and reinforced concrete, on steel decking, span between framing beams. In addition, slotted connections are provided on various beams to allow for thermal movements of the beams.

Steel Components - Steel components inside the containment building include structural steel framing for the slabs described above, component support members, pipe whip restraints, miscellaneous steel for platforms, stairs, ladders, liners and covers for the sumps and drainage trenches, and embedded steel.

Exterior Structural Features:
In addition, the Containment Structure includes the following exterior structural features: a tendon access gallery, a buttress and walkway enclosure, and shielding outside of the personnel lock with equipment hatch.

Tendon Access Gallery - The annular reinforced concrete tendon access gallery is below the base slab of the containment buildings. The tendon gallery provides access to the bottom of the tendon anchorage and provides shelter and protection to the tendon anchorage.
Buttress and Walkway Enclosure - The exterior buttress and walkway enclosures contain the

ladders and access platforms that provide access to the tendon anchorages at the vertical buttresses and around the outside edge of the dome. The exterior buttress and walkway enclosures provide shelter and protection to the tendon anchorage. The ladders and access platforms inside of these enclosures, on the outside of the containment building wall, while providing access to the tendon anchorages for inspection, do not perform an intended function and their failure would not impact a safety-related function.

Shielding Outside of the Personnel Lock with Equipment Hatch - The personnel lock with equipment hatch is equipped with a concrete external shielding to allow access into the containment building for personnel and large equipment. The external shielding is evaluated as a containment building element and acts as a radiation and missile shield.

The purpose of the Containment Structure is to support and protect the enclosed vital mechanical and electrical equipment, including the reactor vessel, the reactor coolant system, the steam generators, pressurizer, and auxiliary and engineered safety features systems required for safe operation and shutdown of the reactor. The containment building also provides a reliable final barrier against the escape of fission products to ensure the leakage limits are not exceeded and fission product releases are within 10 CFR 20 during normal plant operation and 10 CFR 100 (10 CFR 50.67) during the postulated design basis accidents.

Included in the boundary of the Containment Structure are reinforced concrete components that make up the containment buildings, internal concrete structures, and the external structures. Steel elements, in the boundary of the Containment Structure, include concrete embedments that include supports for the liners, containment sleeves and containment bellows, transfer tube bellows, airlocks and equipment hatch, structural steel, miscellaneous stainless steel attached to the refueling cavity liners, containment penetrations, liners, the stainless steel honeycomb material at the pipe whip restraints, and sump trash racks. Also included within the boundary is structural bolting associated with specific in scope components evaluated as part of the Containment Structure. Other components, included in the boundary of the Containment Structure, are seals, gaskets, and moisture barriers that perform an intended function associated with the containment pressure boundary. The Containment Structure performs intended functions delineated in 10 CFR 54.4 and is within the scope of license renewal in its entirely; except for ladders and access platforms on the outside of the containment building wall. The ladders and access platforms on the outside of the containment building wall provide access to the tendon anchorages for inspection. The ladders and access platforms, on the outside of the containment building wall, do not perform an intended function and their failure would not impact a safety-related function. The rubber refueling cavity seals are short lived and are periodically replaced. Therefore, the rubber refueling cavity seals are not subject to an aging management review. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Containment Structure.

Not included in the boundary of the Containment Structure are the polar gantry crane, other cranes, and hoists inside the containment buildings, reactor coolant system and other mechanical systems and components, electrical systems, and commodities, fuel handling equipment and fuel transfer tube, component supports, and structural commodities. The polar gantry crane and other cranes and hoists inside the containment buildings are separately evaluated with the Cranes and Hoists. The reactor coolant system and other mechanical or electrical systems and components housed inside the Containment Structure are separately evaluated with their respective mechanical systems, electrical systems, or commodities. The fuel handling equipment and fuel transfer tube is separately evaluated with the Fuel Handling and Fuel Storage System. The recirculation sump effluent pipe and recirculation sump screen are evaluated with the Residual Heat Removal System. Not included in the boundary of the Containment Structure are pipe whip restraints except for the honeycomb material, component supports, and structural commodities. Component supports, including their respective bolting, are evaluated with the Component Supports Commodity Group. The component supports include the reactor vessel support, steam generator supports, reactor coolant pump supports, and pressurizer support, which are evaluated as part of the Component Supports Commodity Group. Pipe whip restraints, except for the honeycomb material, are evaluated with the Component Supports Commodity Group. Structural commodities, including their respective bolting, are evaluated with the Structural Commodity Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track.

For more detailed information, see UFSAR Sections 3.2, 3.6, 3.8, and 6.2.

Reason for Scope Determination

The Containment Structure meets 10 CFR 54.4(a)(1) because it is a safety-related structure that is relied upon to remain functional during and following design basis events. The Containment Structure meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the structure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Containment Structure also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Anticipated Transient Without Scram (10 CFR 50.62), and Station Blackout (10 CFR 50.63). The Containment Structure is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61).

Intended Functions

1. Provides physical support, shelter, and protection for safety-related systems, structures, and components. 10 CFR 54.4(a)(1)

2. Provide primary containment boundary. 10 CFR 54.4(a)(1)

3. Controls the potential release of fission products to the external environment so that offsite consequences of design basis events are within acceptable limits. 10 CFR 54.4(a)(1)

4. Provides sufficient air volume to absorb the energy released to the containment in the event of design basis events so that the pressure is within acceptable limits. 10 CFR 54.4(a)(1)

5. Provides a source of water for emergency core cooling systems. 10 CFR 54.4(a)(1)

6. Provides physical support, shelter, and protection for nonsafety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). 10 CFR 54.4(a)(2)

7. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulation for Fire Protection (10 CFR 50.48). 10 CFR 54.4(a)(3)

8. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulation for Environmental Qualification (10 CFR 50.49). 10 CFR 54.4(a)(3)

9. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulation for Anticipated Transients Without Scram (10 CFR 50.62). 10 CFR 54.4(a)(3)

10. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulation for Station Blackout (10 CFR 50.63). 10 CFR 54.4(a)(3)

UFSAR References

3.2
3.6
3.8
3.9
3.10
6.2
9.1
Appendix A, Regulatory Guide 1.82
Appendix B

License Renewal Boundary Drawings

Byron Common:
LR-BYR-S-01A

Braidwood Common:
LR-BRW-S-01A

Table 2.4-4 Containment Structure Components Subject to Aging Management Review

Component Type	Intended Function
Bolting (Containment Closure)	Pressure Boundary
Bolting (Structural)	Structural Support
Coatings (Service Level 1- Containment Boundary)	Maintain Adhesion
Coatings (Service Level 1- Containment Internal Structures)	Maintain Adhesion
Concrete Anchors	Structural Support
Concrete Curbs	Direct Flow
Concrete Embedments	Structural Support
Concrete: Above-grade exterior (accessible areas of exterior features)	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Shielding
	Structural Support
Concrete: Above-grade exterior (inaccessible areas of exterior features)	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Shielding
	Structural Support
Concrete: Below-grade exterior (inaccessible areas of exterior features)	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Shielding
	Structural Support
Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel (accessible areas)	Flood Barrier
	HELB Shielding
	Missile Barrier
	Pressure Boundary
	Shelter, Protection
	Shielding
	Structural Support
Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel (inaccessible areas)	Flood Barrier
	HELB Shielding
	Missile Barrier
	Pressure Boundary
	Shelter, Protection

Component Type	Intended Function
Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel (inaccessible areas)	Shielding
	Structural Support
Concrete: Foundation, subfoundation (inaccessible areas)	Flood Barrier
	Structural Support
Concrete: Interior	HELB Shielding
	Missile Barrier
	Pipe Whip Restraint
	Shelter, Protection
	Shielding
	Structural Support
Concrete: Interior (Exterior structural features)	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Shielding
	Structural Support
Concrete: Interior (Leak Chase System)	Direct Flow
Containment Liner (accessible)	Pressure Boundary
	Structural Support
Containment Liner (inaccessible)	Pressure Boundary
	Structural Support
Electrical and Instrumentation and Control Penetration Assemblies (Containment Boundary)	Flood Barrier
	HELB Shielding
	Pressure Boundary
	Shelter, Protection
	Structural Support
Hatches/Plugs	HELB Shielding
	Missile Barrier
	Shelter, Protection
	Shielding
	Water retaining boundary
Masonry walls: Interior (Removable)	Shielding
Mechanical Penetrations (Containment Boundary)	Flood Barrier
	HELB Shielding
	Pressure Boundary
	Shelter, Protection
	Structural Support
Metal components: All structural members	Structural Support

Component Type	Intended Function
Metal decking (Inside Containment Supporting Concrete Floors)	Structural Support
Metal decking (Outside Containment in Buttress and Walkway Enclosure)	Structural Support
Metal panels (Buttress and Walkway Enclosures)	Shelter, Protection
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support
Penetration Bellows (Containment Boundary)	Pressure Boundary
	Shelter, Protection
	Structural Support
Penetration sleeves (Guard pipe for fuel transfer tube)	Pressure Boundary
	Shelter, Protection
	Structural Support
	Water retaining boundary
Penetration sleeves (Guard pipe for recirculation sump effluent pipe)	Pressure Boundary
	Shelter, Protection
	Structural Support
	Water retaining boundary
Penetration sleeves (in refueling cavity for instruments)	Shelter, Protection
	Structural Support
	Water retaining boundary
Personnel airlock, equipment hatch	Pressure Boundary
	Shelter, Protection
Pipe Whip Restraints and Jet Impingement Shields (Energy Absorbing Material)	Pipe Whip Restraint
Prestressing system (Grease cap at tendon anchorage)	Shelter, Protection
Prestressing system (Tendons)	Structural Support
Prestressing system (Tendons, Anchorage Components)	Structural Support
Seals, gaskets, and moisture barriers (Gaskets and seals for refueling cavity and sumps)	Water retaining boundary
Seals, gaskets, and moisture barriers (Gaskets for grease caps at tendon anchorages)	Shelter, Protection
Seals, gaskets, and moisture barriers (Moisture barrier between bottom of containment liner and interior base mat)	Shelter, Protection

Component Type	Intended Function
Seals, gaskets, and moisture barriers (Seals at containment boundary)	Pressure Boundary
Sliding surfaces (support)	Structural Support
Steel Components	Shielding
	Structural Support
Steel components: Sump screen and trench cover	Filter
Steel elements: liner, liner anchors, integral attachments (Refueling cavity-accessible areas)	Structural Support
	Water retaining boundary
Steel elements: liner, liner anchors, integral attachments (Refueling cavity-inaccessible areas)	Direct Flow
	Structural Support
	Water retaining boundary
Steel elements: liner, liner anchors, integral attachments (Sumps- accessible areas)	Direct Flow
Steel elements: liner, liner anchors, integral attachments (Sumps-inaccessible areas)	Direct Flow
Tunnel (Tendon access gallery)	Shelter, Protection

The aging management review results for these components are provided in:

Table 3.5.2-4	Containment Structure Summary of Aging Management Evaluation

2.4.5 Deep Well Enclosures (Byron)

Description

The Deep Well Enclosures are present at Byron Station only. There are two Deep Well Enclosures present at Byron. The first one is located east of the condensate storage tanks and the second one is located at the southwest corner of the protected area inside the security fence.

The Deep Well Enclosures are safety-related structures constructed of reinforced concrete walls on spread footings with a removable concrete slab top. The purpose of the enclosures is to provide shelter and protection for well water system components. The deep wells and well water system at Byron are nonsafety-related and provide an emergency makeup source of water to the Essential Service Water Cooling Towers and essential service water system in the event that the safety-related makeup water source from the Rock River is not available.

Included within the boundary of the Deep Well Enclosures and determined to be within the scope of license renewal are the reinforced concrete walls, footings, and removable slab top. Also included within the boundary and determined to be within the scope of license renewal are the steel casing and grout inside the deep well which provide physical support for maintaining the well configuration, as well as structural bolting, miscellaneous steel vent, and concrete embedments associated with specific in scope components evaluated as part of the Deep Well Enclosures. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Deep Well Enclosures.

Not included within the boundary of the Deep Well Enclosures are the mechanical components, including piping, pumps, and valves, associated with the well water system. These components are evaluated separately with the Demineralized Water System for license renewal. Also not included within the boundary are structural commodities, including their respective bolting, which are evaluated with the Structural Commodity Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track.

For more detailed information, refer to UFSAR Sections 2.3.1.2.4 (Byron), 2.4.11.6 (Byron), 3.8.4.1.8, and 9.2.5.3.4.

Reason for Scope Determination

The Deep Well Enclosures (Byron) meet 10 CFR 54.4(a)(1) because they are safety-related structures that are relied upon to remain functional during and following design basis events. The Deep Well Enclosures (Byron) meet 10 CFR 54.4(a)(2) because failure of the structures could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Deep Well Enclosures (Byron) are not in scope under 10 CFR 54.4(a)(3) because they are not relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provides physical support, shelter, and protection for safety-related systems, structures, and components. The Deep Well Enclosures are classified as safety-related and provide shelter and protection for equipment during design basis events. 10 CFR 54.4(a)(1)

2. Provides physical support, shelter, and protection for nonsafety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4 (a)(1). 10 CFR 54.4(a)(2)

UFSAR References

2.3.1.2.4 (Byron)
2.4.11.6 (Byron)
3.8.4.1.8
9.2.5.3.4

License Renewal Boundary Drawings

Byron Common:
LR-BYR-S-01A

Braidwood Common:
None.

Table 2.4-5 **Deep Well Enclosures (Byron)** **Components Subject to Aging Management Review**

Component Type	Intended Function
Bolting (Structural)	Structural Support
Concrete Embedments	Structural Support
Concrete: Above-grade exterior (accessible areas)	Missile Barrier
	Shelter, Protection
	Structural Support
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection
	Structural Support
Concrete: Interior	Missile Barrier
	Shelter, Protection
	Structural Support
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection
Steel elements: liner, liner anchors, integral attachments (inaccessible areas)	Shelter, Protection
	Structural Support

The aging management review results for these components are provided in:

Table 3.5.2-5 Deep Well Enclosures (Byron)
Summary of Aging Management Evaluation

2.4.6 Essential Service Cooling Pond (Braidwood)

Description

The Essential Service Cooling Pond is present at Braidwood Station only and located south of the power block. The Essential Service Cooling Pond boundary includes the Braidwood cooling pond and dike system, the essential service cooling pond, pond makeup structure and fresh water holding pond, and the overflow spillway. Discussion of the individual structures is as follows:

Braidwood Cooling Pond:
The Braidwood cooling pond, also referred to as the Braidwood lake, is a water-filled former strip-mined area consisting of a soil base on underlying bedrock. The Braidwood cooling pond has an average depth of approximately five feet and total surface area of approximately 2,475 acres (3.87 square miles). Normal water level is about five feet below plant grade. The purpose of the Braidwood cooling pond is to provide a source of cooling water for the Circulating Water System and other nonsafety-related cooling systems. The cooling pond has an internal dike system intended to direct the warm water flow from the circulating water discharge around the perimeter of the pond and back to the lake screen house. The exterior of the pond is surrounded by a nonsafety-related water retaining dike system with soil and riprap embankments that rise to an elevation to prevent flooding of the Braidwood site. The essential service cooling pond area within the Braidwood cooling pond is safety-related, and the nonsafety-related exterior dike system provides flood protection for the site, however, the remaining portions of the Braidwood cooling pond are nonsafety-related and do not perform an intended function for license renewal.

Essential Service Cooling Pond:
The essential service cooling pond (ESCP) is a rectangular excavated area within the Braidwood cooling pond, adjacent to the lake screen house, covering an area of approximately 99 acres and at a depth approximately six feet lower than the rest of the overall cooling pond. The ESCP is the ultimate heat sink for Braidwood Station. It is designed to provide an adequate cooling water volume for a minimum of 30 days operation with no makeup in the event the nonsafety-related exterior retaining dikes of the Braidwood cooling pond fail. The bottom of the ESCP is compacted soil overlying bedrock with slopped embankments leading up to the bottom of the Braidwood cooling pond. Intake from the essential service water system is by piping located in the lake screen house with pumps located in the Auxiliary Building, while discharge is by two Category I essential service water pipes running to the south end of the ESCP. The pipes are supported by the essential service water discharge structure, an underwater concrete block structure, evaluated as part of the Lake Screen Structures. The essential service cooling pond is a Category I, safety-related structure required to maintain structural integrity and an adequate volume of cooling water for safety-related systems during design basis events.

Pond Makeup Structure:
The pond makeup structure and freshwater holding pond are located in the northeast region of the Braidwood cooling pond, along the northern edge. The pond makeup structure is a reinforced concrete wall that provides physical support for the circulating water makeup pipes that discharge into the freshwater holding pond. The freshwater holding pond is a reinforced concrete and earthen dike structure that allows for settlement of particulates in the makeup water, pumped from the Kankakee River, before entering the cooling pond. The essential

service cooling pond contains a sufficient volume of water without makeup to maintain adequate cooling for a minimum of 30 days, in accordance with Regulatory Guide 1.27. Therefore, makeup to the Braidwood cooling pond is not required for safe shutdown or relied upon in the mitigation of any design basis events, such that both the pond makeup structure and freshwater holding pond are nonsafety-related structures that do not perform an intended function for license renewal.

Overflow Spillway:
The overflow spillway is located on the western side of the Braidwood cooling pond. The purpose of the spillway is to passively drain the Braidwood cooling pond when the water level becomes sufficiently high to prevent overtopping of the exterior dikes that could potentially flood the power block. The spillway elevation is approximately nine inches above the normal Braidwood cooling pond surface elevation. The overflow spillway is a nonsafety-related structure, however, it is credited as providing drainage of the pond in the determination of the maximum water surface elevation and the controlling event for flooding at Braidwood.

Included within the boundary of the Essential Service Cooling Pond and determined to be within the scope of license renewal are the earthen structure and embankments of the essential service cooling pond. Also included within the boundary and determined to be within the scope of license renewal are the earthen and riprap elements of the overflow spillway and exterior dike system, as these structures provide flood protection measures for the site during probable maximum flood conditions. The Essential Service Cooling Pond is also the source of water volume for the Fire Protection System. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Essential Service Cooling Pond.

Included within the boundary of the Essential Service Cooling Pond and determined not to be within the scope of license renewal are the reinforced concrete, earthen, and riprap elements of the Braidwood cooling pond and interior dike system, pond makeup structure, and freshwater holding pond. These structures are nonsafety-related and do not perform an intended function for license renewal.

Not included within the boundary of the Essential Service Cooling Pond is the circulating water discharge structure, essential service water discharge structure, and lake screen house. These structures are evaluated separately with the Lake Screen Structures.

For more detailed information, refer to UFSAR Sections 2.4.2.2 (Braidwood), 9.2.1.2, and 9.2.5 (Braidwood).

Reason for Scope Determination

The Essential Service Cooling Pond (Braidwood) meets 10 CFR 54.4(a)(1) because it is a safety-related structure that is relied upon to remain functional during and following design basis events. The Essential Service Cooling Pond (Braidwood) meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the structure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Essential Service Cooling Pond (Braidwood) also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48) and Station Blackout (10 CFR 50.63). The Essential Service Cooling Pond (Braidwood) is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provides physical support, shelter, and protection for safety-related systems, structures, and components. 10 CFR 54.4 (a)(1)

2. Provides Ultimate Heat Sink (UHS) during design basis events. 10 CFR 54.4 (a)(1)

3. Provides a source of cooling water for plant safe shutdown. 10 CFR 54.4 (a)(1)

4. Provides physical support, shelter, and protection for nonsafety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4 (a)(1). 10 CFR 54.4 (a)(2)

5. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). 10 CFR 54.4 (a)(3)

6. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). 10 CFR 54.4 (a)(3)

UFSAR References

2.4.2.2 (Braidwood)
9.2.1.2
9.2.5 (Braidwood)

License Renewal Boundary Drawings

Byron Common:
None.

Braidwood Common:
LR-BRW-S-01A

Table 2.4-6 Essential Service Cooling Pond (Braidwood) Components Subject to Aging Management Review

Component Type	Intended Function
Earthen water-control structures (Essential Service Cooling Pond)	Heat Sink
	Water retaining boundary
Earthen water-control structures (Spillway and Dike System)	Direct Flow
	Flood Barrier

The aging management review results for these components are provided in:

Table 3.5.2-6 Essential Service Cooling Pond (Braidwood) Summary of Aging Management Evaluation

2.4.7 Essential Service Water Cooling Towers (Byron)

Description

The Essential Service Water Cooling Towers are present at Byron Station, Units 1 and 2, only. The two mechanical draft cooling tower units are located south and east of the Turbine Building Complex and consist of two four-cell concrete structures. The two cooling tower structures are erected over reinforced concrete water basins that are connected by an overflow design feature. The two units “0A” and “0B” are separately supported on 3 feet thick reinforced concrete mat foundations (45 feet by 174 feet) resting on grouted bedrock. The internal water distribution system and the clay tile fill are supported on a concrete beam and column system with bracing to resist lateral loads.

Each of the cooling towers consists of four cells. The cell enclosures are constructed of reinforced concrete, with openings provided in the walls at the bottom for air intake and an opening in the roof for air exhaust. Each cell is provided with safety-related service water distribution piping and nozzles, clay tile fill to break up the water into fine droplets, drift eliminators to remove water droplets entrained in the air, and an electrically driven fan to force air through the tower. The water basins, below the “A” cell of the 0A tower and the “E” cell of the 0B tower, contain sumps that include a trash rack to remove debris and an anti-vortexing box to prevent air entrainment into the suction lines that feed the safety-related service water pumps in the Auxiliary Building.

Several adjoining structures are integral to each of the two cooling tower units. Each of the two cooling tower units is provided with two valve chambers, which extend below grade. The valve chambers on the south west corner of each cooling tower unit contain hot water bypass valves, which are used for basin temperature control, and make-up valves that provide for make-up water to the basins. The valve chambers on the north east corner of each cooling tower unit contain a suction isolation valve for the suction line that feeds the essential service water pumps located in the Auxiliary Building. The valve chambers are constructed of reinforced concrete and are provided with doors or hatches for personnel access. The roofs of the valve chambers consist of either a concrete slab or a built-up roofing system over a concrete slab. In addition, each of the four cells in each of the cooling tower units contains a riser valve enclosure that houses the safety-related service water supply line and associated isolation valve to each cell. These enclosures are located on the west side for the 0A essential service water cooling tower unit and on the east side for the 0B essential service water cooling tower unit. The enclosures, including the roof, are constructed of reinforced concrete and are fitted with removable carbon steel plates located on the outside wall, to provide access to the enclosed equipment.

On the north and south ends of the cooling tower units there are adjoining electrical rooms that house four electrical substations (two per cooling tower unit). The electrical substations supply the required electrical power to the mechanical draft fan motors and other related equipment. The electrical rooms are constructed of reinforced concrete and are supported by a base slab at grade that rests on controlled compacted granular fill. The roofs of the electrical rooms consist of a built-up roofing system over a concrete slab. Located adjacent to the electrical room on the south end is a security structure that extends above the electrical room.

The reinforced concrete water basins are flanked by shallow concrete aprons below the air intake area for the cooling tower units. The short walls at the outer edge of the aprons prevent any water splash from escaping the water basins and also provide additional inventory for tornado events.

Adjacent to the west side of the 0B cooling tower unit is a sodium hypochlorite tank and an associated chemical tank building, an additional structure containing a sulfuric acid tank and pump is also located on the west side. The purpose of these structures is to house equipment for chemistry control of the safety-related service water system.

All of the structures and components described above are safety-related , with the exception of the security structure located on the south end, and the sodium hypochlorite tank and two chemical tank buildings located on the west side of the Essential Service Water Cooling Towers.

The Essential Service Water Cooling Towers provide physical support, shelter, and protection for the safety-related equipment located within the structures. The cooling tower basins also provide suction points for the safety-related Service Water System pumps that are located in the Auxiliary Building. The purpose of the Essential Service Water Cooling Towers is to provide for heat rejection from the safety-related Service Water system both on a normal and on an emergency basis. The Essential Service Water Cooling Towers provide the ultimate heat sink for the safety-related Service Water System. The ultimate heat sink is designed to withstand either the safe shutdown earthquake or the probable maximum flood of the Rock River occurring separately, consistent with the philosophy for ultimate heat sinks for nuclear power plants. The ultimate heat sink is also designed to withstand a design-basis tornado winds and tornado missiles, with noted exceptions as described in UFSAR section 9.2.5.3.2. The Essential Service Water Cooling Water Tower basins also provide a backup source of water to the Auxiliary Feedwater System during a seismic event when the condensate storage tank may not be available, and a backup source of fire water through a cross-connection between the safety-related Service Water System and the Fire Protection System.

Included in the boundary of the Essential Service Water Cooling Towers are all of the above described structures and related components.

Included in the boundary of the Essential Service Water Cooling Towers and determined to be within the scope of license renewal are the cooling tower units including concrete beams, columns, and bracing, the clay tile fill and drift eliminators, the water basins with sumps, trash racks, and anti-vortexing box, the valve chambers, the electric fans, and the electrical rooms. Also included within the boundary is structural bolting associated with the specific in scope components evaluated as part of the Essential Service Water Cooling Towers. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Essential Service Water Cooling Towers.

Included in the boundary of the Essential Service Water Cooling Towers and determined not to be within the scope of license renewal is the security structure on the south end of the Essential Service Water Cooling Towers and the sodium hypochlorite tank and two chemical tank buildings located on the west side of the Essential Service Water Cooling Towers. These components and structures are nonsafety-related and are provided to either facilitate security activities or maintain chemistry of the safety-related Service Water system, and do not perform a license renewal intended function. The failure of these structures or related components will not prevent satisfactory accomplishment of a safety-related function or a license renewal intended function.

Not included within the boundary of the Essential Service Water Cooling Towers are component supports, structural commodities, and fire barriers. Component supports, including their respective bolting, are evaluated with the Component Supports Commodity Group. Structural commodities, including their respective bolting, are evaluated with the Structural Commodity Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track. Fire barriers are evaluated separately with the Fire Protection System. Components also not included in the boundary of the Essential Service Water Cooling Towers are the mechanical components for the chemical feed and handling system, circulating water system, essential service water system, which includes the distribution piping and nozzles, instrument air system, non-essential service water system, switchgear heat removal system, and the well water system. These components and structures are evaluated separately with the following license renewal systems: Circulating Water System, Condensate and Feedwater Auxiliaries System, Compressed Air System, Service Water System, Auxiliary Building Ventilation System and Fresh Water System.

For more detailed information see UFSAR Sections 2.4.8 (Byron), 2.4.11 (Byron), 2.5.4 (Byron), 3.3.2, 3.4.1, 3.5, 3.8.4 (Byron), 8.3.1, 9.2.1.2, 9.2.5 (Byron), 10.4.9.3, Tables 3.2-1 and 9.2-16.

Reason for Scope Determination

The Essential Service Water Cooling Towers (Byron) meet 10 CFR 54.4(a)(1) because the Essential Service Water Cooling Towers (Byron) are safety-related structures that are relied upon to remain functional during and following design basis events. The Essential Service Water Cooling Towers (Byron) meet 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the structures could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Essential Service Water Cooling Towers (Byron) also meet 10 CFR 54.4(a)(3) because the structures are relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48) and Station Blackout (10 CFR 50.63). The Essential Service Water Cooling Towers (Byron) are not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provides physical support, shelter, and protection for safety-related systems, structures, and components. 10 CFR 54.4(a)(1)

2. Provides Ultimate Heat Sink (UHS) during design basis events. 10 CFR 54.4(a)(1)

3. Provides a source of cooling water for plant safe shutdown. 10 CFR 54.4(a)(1)

4. Provides physical support, shelter, and protection for nonsafety-related systems, structures, and components. 10 CFR 54.4(a)(2)

5. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). 10 CFR 54.4(a)(3)

6. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). 10 CFR 54.4(a)(3)

UFSAR References

2.4.8 (Byron)
2.4.11 (Byron)
3.3.2
3.4.1
3.5
8.3.1.4.4
9.2.1.2
9.2.5 (Byron)
10.4.9.3
Table 3.2-1

License Renewal Boundary Drawings

Byron Common:
LR-BYR-S-01A

Braidwood Common:
None.

Table 2.4-7 Essential Service Water Cooling Towers (Byron) Components Subject to Aging Management Review

Component Type	Intended Function
Bolting (Structural)	Structural Support
Concrete Anchors	Structural Support
Concrete Embedments	Structural Support
Concrete: Above-grade exterior (accessible areas)	Missile Barrier
	Shelter, Protection
	Structural Support
	Water retaining boundary
Concrete: Above-grade exterior (inaccessible areas)	Missile Barrier
	Shelter, Protection
	Structural Support
	Water retaining boundary
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Structural Support
	Water retaining boundary
Concrete: Foundation, subfoundation (inaccessible areas)	Flood Barrier
	Shelter, Protection
	Structural Support
Concrete: Interior	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Structural Support
Cooling Tower Fill	Heat Sink
Hatches/Plugs	Shelter, Protection
Louver (Drift Eliminators)	Direct Flow
Metal components: All structural members (Lintels)	Structural Support
Steel Components	Missile Barrier
	Shelter, Protection
Steel Components (Anti-vortex components)	Direct Flow
Steel Components (Trash Rack Assembly)	Filter
Support members; welds; bolted connections; support anchorage to building structure (Support Beams for Drift Eliminators)	Structural Support

The aging management review results for these components are provided in:

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron)
Summary of Aging Management Evaluation

2.4.8 Fuel Handling Building

Description

The Fuel Handling Building structure is shared by both Unit 1 and Unit 2 at Byron and Braidwood. The Fuel Handling Building is located adjacent to the Auxiliary Building between the Containment Structures. The Fuel Handling Building plan dimensions are approximately 90 feet by 120 feet. The Fuel Handling Building is classified as a safety-related structure designed to maintain its structural integrity during and following postulated design basis accidents and extreme environmental conditions. The boundary of the Fuel Handling Building also includes the adjacent fuel handling building train shed, which is used for access to the Fuel Handling Building. The fuel handling building train shed is a nonsafety-related structure.

The Fuel Handling Building is a reinforced concrete structure up to grade level, except in the spent fuel pool and new fuel storage vault area where reinforced concrete is continued up to the level at the top of the spent fuel pool. The walls below grade bear on a reinforced concrete mat foundation. At Byron, the reinforced concrete mat foundation is supported directly on bedrock. At Braidwood, the foundation is supported on lean concrete over glacial till and compacted sand. The portion of building above grade has a structural steel frame with reinforced concrete slabs on metal decking for the roof. The exterior walls are reinforced concrete for radiation shielding and missile protection. The interior walls are of either concrete or concrete block construction. The roof of the Fuel Handling Building consists of a built-up roofing system over a reinforced concrete slab on metal decking.

The fuel handling building train shed is a single story structure attached to the Fuel Handling Building, with a roll-up steel door that leads to the outside and another roll-up steel door that opens into the Fuel Handling Building. The fuel handling building train shed consists of structural steel columns and roof beams, on a reinforced concrete slab on grade, supported by compacted fill. Siding is used for the walls and the roof consists of a built-up roofing system over precast concrete slabs.

The Fuel Handling Building contains a single fuel transfer canal, spent fuel pool, spent fuel cask loading pit, cask decontamination area, and new fuel storage vaults, all of which are shared between Unit 1 and Unit 2. In addition, the Fuel Handling Building contains compartments that house spent fuel pool cooling equipment and supporting systems, as well as sumps. Exterior access for shipping and receiving fuel and other materials is through the train shed area. Fuel handling is accomplished by the fuel handling and storage system in the Fuel Handling Building with components that include the upending devices, transfer carts, transfer tube, spent fuel bridge crane, fuel handling building crane, new fuel elevator, new and spent fuel storage racks, and fuel rod storage baskets. During movement of irradiated fuel in the Fuel Handling Building, at least one of the two roll-up steel doors in the train shed is kept closed.

The Fuel Handling Building shares common walls with the Auxiliary Building, which are evaluated with the Auxiliary Building. There is access to the outside of the spent fuel pool and transfer canal walls on three sides of the spent fuel pool in Auxiliary Building rooms that extend below the bottom of the spent fuel pool. On the fourth side, there is only access to the top of the spent fuel pool wall on the outside. The Fuel Handling Building abuts the Containment Structures only at the fuel transfer canal, where the Fuel Handling Building and Containment Structures are separated by a seismic gap.

The fuel transfer canal, spent fuel pool, and spent fuel cask loading pit are constructed of structural reinforced concrete and lined with stainless steel. Stainless steel embedments are provided in the concrete for items such as scuppers. The stainless steel fuel transfer canal, spent fuel pool, and spent fuel cask loading pit liners were originally designed and constructed to safety-related requirements, but subsequently reclassified as nonsafety-related.

The fuel transfer canal is approximately 4 feet wide by 121 feet long by 36 feet deep. The fuel transfer canal extends between the Unit 1 and Unit 2 Containment Structures. The fuel transfer canal is an intermediate handling area adjacent to the spent fuel pool and is connected to the refueling cavity inside the Containment Structures by a fuel transfer tube. The fuel transfer tubes serve as passageways for fuel transfer operations between the Fuel Handling Building and the Containment Structures. The fuel transfer canal can be isolated from the spent fuel pool and drained by using a gate. The gate seal consists of inflatable seals supplied with air by the Compressed Air System.

The spent fuel pool is approximately 33 feet wide by 62 feet long by 41 feet deep. The spent fuel pool floor is 6-foot thick reinforced concrete. There is approximately 26 feet of borated water between the top of the active region of the spent fuel assemblies stored in the spent fuel racks and the spent fuel pool low level alarm. A separate, walled-off area is provided at the end of the spent fuel pool for the spent fuel cask loading pit. The spent fuel cask loading pit is provided with a gate to allow isolation from the spent fuel pool. The gate seal consists of inflatable seals supplied with air by the Compressed Air System.

The cask decontamination area is a separate concrete pit with a stainless steel liner and a sump in one corner, which provides for decontamination of spent fuel casks. The new fuel storage vault is a reinforced concrete pit, with covers, that provides dry storage for new fuel assemblies.

The fuel transfer tube penetrates the Containment Structure exterior wall and connects the refueling cavity in the containment with the fuel transfer canal in the Fuel Handling Building. The fuel transfer tube penetrations, where each of the Containment Structures connect to the Fuel Handling Building, consist of the 20 inch fuel transfer tube pipe inside a 24 inch guard pipe that serves as a sleeve around the fuel transfer tube. Expansion joint bellows provide for relative movement between the structures. The inner fuel transfer tube is fitted with a blind flange inside of the Containment Structure and a manually operated valve inside of the fuel transfer canal. The fuel transfer tube, blind flange, and manual operated valve are evaluated with the Fuel Handling and Fuel Storage System. There are three expansion joint bellows in the fuel transfer tube penetration sleeve. The fuel transfer tube is sealed to the stainless steel liner in the fuel transfer canal. The section of fuel transfer tube penetration sleeve, which serves as the containment boundary, is evaluated as part of the Containment Structure. The fuel transfer tube penetration sleeve that extends beyond the containment wall and is inside the Fuel Handling Building wall is evaluated as part of the Fuel Handling Building.

The fuel transfer canal, spent fuel pool, and cask decontamination area have a 3/16-inch stainless steel liner welded to carbon steel embedments in the walls and floors. Continuous embedded plates were placed in the concrete pool walls in an approximately 6 foot grid pattern. Embedded carbon steel, wide flange beams are anchored in a similar 6 foot grid pattern in the concrete pool floor. Smaller, individual carbon steel embedded plates were placed at 2 feet on center within these wall and floor grid systems. The liner plate was subsequently attached to the embedments in 6 foot panels with a continuous groove weld at the seams to the continuous grid embedments and with plug welds at 2 feet on center to the individual embedments. The design of the fuel transfer canal and the spent fuel pool includes a leak chase system that collects potential leakage through cracks in the seam welds of the stainless steel liners. Continuous drains are provided at liner weld seams for leak detection. The drains consist of channels formed in the concrete, embedded in the slabs and in the walls of the spent fuel pool and the fuel transfer canal, before the stainless steel liners were welded to the embedments. These drains are interconnected and any leakage is channeled to drain pipes under the stainless steel liner. The drain piping is embedded in the concrete structure up to the common wall with the Auxiliary Building, where the piping joins the Auxiliary Building floor drain system. At the point where the drain piping emerges from the concrete wall, valves and sight glasses are provided so that any leakage past the stainless steel liner is collected by the drain piping and becomes visible in the sight glasses, before any leakage would ultimately flow into the floor drainage system.

The purpose of the Fuel Handling Building is to provide physical support, shelter, and protection to systems, structures, and components housed within the Fuel Handling Building during normal plant operation, and during and following postulated design basis accidents and extreme environmental conditions. This function is provided to the Fuel Handling & Fuel Storage System, Spent Fuel Cooling System, Auxiliary Building Ventilation System, Compressed Air System, and their supporting systems. The building design features provide an essentially leak tight boundary to support the Auxiliary Building Ventilation System in maintaining the building at a slight negative pressure and prevent the undue release of radioactivity to the public.

The fuel transfer canal serves to facilitate the fuel transfer operation between the Fuel Handling Building and the Containment Structure. The spent fuel pool of the Fuel Handling Building provides for onsite storage of irradiated fuel assemblies in the spent fuel storage racks until they are removed for dry cask storage. The spent fuel pool and the fuel transfer canal, when in use, contain borated water inventory to maintain adequate cooling of the spent fuel assemblies. The water inventory, in combination with the building design features, provides radiological protection and keeps radiation doses below specified limits. The spent fuel cask loading pit is used to prepare the spent fuel cask for shipment. The cask decontamination area provides for decontamination of spent fuel shipping casks during dry cask storage campaigns. The new fuel storage vaults provide for dry storage of new fuel received onsite until it is transferred to the spent fuel pool in preparation for refueling. The roll-up steel doors of the train shed provide a structural pressure barrier during movement of irradiated fuel in the fuel handling building, and the train shed structure provides physical support, shelter, and protection.

Included within the boundary of the Fuel Handling Building and adjacent train shed are reinforced concrete elements of the building, concrete embedments that include scuppers and supports for the liners, the roll-up steel doors associated with movement of fuel and equipment, hatches, masonry walls, metal components such as a cable trench, metal decking under the concrete slabs, miscellaneous stainless steel attached to the stainless steel liners, stainless steel fuel transfer tube penetration sleeves and expansion joint bellows that are inside of the Fuel Handling Building and that extend into the fuel transfer canal, spent fuel pool gates and inflatable seals, structural steel components, and steel elements that include the liners and the integral attachments. The components included within the boundary are the miscellaneous stainless steel components inside of the spent fuel pool and fuel transfer canal, as well as miscellaneous steel associated with the leak chase system. Also included within the boundary is structural bolting associated with specific in scope components evaluated as part of the Fuel Handling Building. The license renewal evaluation of the Fuel Handling Building boundary concluded that the entire Fuel Handling Building and adjacent train shed was determined to be within the scope of license renewal. The inflatable gate seals are short lived and are periodically replaced. Therefore, the inflatable gate seals are not subject to an aging management review. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Fuel Handling Building.

Not included within the boundary of the Fuel Handling Building are component supports and structural commodities, as well as mechanical systems. Component supports, including their respective bolting, are evaluated with the Component Supports Commodity Group. Structural commodities, including their respective bolting, are evaluated with the Structural Commodity Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track. Piping and components associated with the spent fuel pool cooling system are evaluated with the Spent Fuel Cooling System. Drain piping and components, including valves and sight glasses, are evaluated with the Radioactive Drain System.

Also not included within the boundary of Fuel Handling Building license renewal structure are the upending devices, transfer carts, fuel transfer tube, spent fuel bridge crane, new fuel elevator, new and spent fuel storage racks, and fuel rod storage baskets, which are separately evaluated with the Fuel Handling & Fuel Storage System. The fuel handling building crane is separately evaluated with Cranes and Hoists. Also not included in the boundary of the Fuel Handling Building are the fuel transfer tube expansion joint bellows inside the Containment Structure and fire barriers. The expansion bellows inside the containment are separately evaluated with the Containment Structure. Fire barriers are evaluated with the Fire Protection System.

For more detailed information, see UFSAR Sections 2.5 (Byron), 2.5 (Braidwood), 3.3.2.3, 3.8.4.1.2, 9.1, and 15.7.4.2.1.

Reason for Scope Determination

The Fuel Handling Building meets 10 CFR 54.4(a)(1) because it is a safety-related structure that is relied upon to remain functional during and following design basis events. The Fuel Handling Building meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the structure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Fuel Handling Building also meets 10 CFR 54.4(a)(3) because the structure is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48) and Station Blackout (10 CFR 50.63). The Fuel Handling Building is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provides physical support, shelter, and protection for safety-related systems, structures, and components. 10 CFR 54.4(a)(1)

2. Controls the potential release of fission products to the external environment so that offsite consequences of design basis events are within acceptable limits. 10 CFR 54.4(a)(1)

3. Provides physical support, shelter, and protection for nonsafety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). 10 CFR 54.4(a)(2)

4. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). 10 CFR 54.4(a)(3)

5. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulation for Station Blackout (10 CFR 50.63). 10 CFR 54.4(a)(3)

UFSAR References

2.5 (Byron)
2.5 (Braidwood)
3.3.2.3
3.8.4.1.2
9.1
15.7.4.2.1

License Renewal Boundary Drawings

Byron Common:
LR-BYR-S-01A

Braidwood Common:
LR-BRW-S-01A

Table 2.4-8 Fuel Handling Building
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting (Structural)	Structural Support
Concrete Anchors	Structural Support
Concrete Curbs	Direct Flow
Concrete Embedments	Structural Support
Concrete Embedments (Scuppers)	Direct Flow
Concrete: Above-grade exterior (accessible areas)	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Shielding
	Structural Pressure Barrier
	Structural Support
Concrete: Above-grade exterior (inaccessible areas)	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Shielding
	Structural Pressure Barrier
	Structural Support
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier
	Shelter, Protection
	Structural Pressure Barrier
	Structural Support
Concrete: Foundation, subfoundation (inaccessible areas)	Flood Barrier
	Shelter, Protection
	Structural Support
Concrete: Interior	Flood Barrier
	Shelter, Protection
	Shielding
	Structural Pressure Barrier
	Structural Support
Concrete: Interior (Leak Chase System)	Direct Flow
Door Seal (Roll-up doors of train shed)	Structural Pressure Barrier
Doors (Roll-up doors of train shed)	Structural Pressure Barrier
Hatches/Plugs	Shelter, Protection
Masonry walls: Interior	Shelter, Protection
	Shielding
	Structural Support
Metal components: All structural members	Shelter, Protection
Metal decking	Structural Support

Component Type	Intended Function
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support
Penetration Bellows (Fuel Transfer Tube)	Expansion/Separation
	Shelter, Protection
	Water retaining boundary
Penetration sleeves (Fuel Transfer Tube)	Shelter, Protection
	Structural Support
	Water retaining boundary
Spent fuel pool gates	Water retaining boundary
Steel Components	Structural Support
Steel elements: liner, liner anchors, integral attachments (accessible areas)	Water retaining boundary
Steel elements: liner, liner anchors, integral attachments (inaccessible areas)	Structural Support
	Water retaining boundary

The aging management review results for these components are provided in:

Table 3.5.2-8 Fuel Handling Building
Summary of Aging Management Evaluation

2.4.9 Lake Screen Structures (Braidwood)

Description

The Lake Screen Structures are present at Braidwood Station, Units 1 and 2, only. The Lake Screen Structures are comprised of the lake screen house also known as the pond screen house, the chemical feed tank building directly adjoining the lake screen house, the foundations for the gas and chemical storage tanks located outside the lake screen house on the north and west sides of the lake screen house, the circulating water discharge structure, and the essential service water discharge structure. The lake screen house will be discussed first and will include the chemical feed tank building directly adjoining the lake screen house, the foundations for the gas and chemical storage tanks located outside on the north and west sides of the lake screen house, and the circulating water discharge structure located on the north west section of the Braidwood cooling pond. The essential service water discharge structure will be discussed in a separate section that follows.

Lake Screen House:
The lake screen house is a multi-level structure and is located approximately 1,300 feet south and west of the main power block. In addition to the main floor level, there is an upper platform area that contains ventilation equipment, and a substructure that provides six forebay sections for the pumps contained in the structure.

The lake screen house structure at the main floor level contains various pumps including electric driven fire pumps, nonessential service water pumps, and screen wash pumps. In addition to the pumps, other related equipment including strainers, traveling screens, instrumentation panels, electrical motor control centers, jib crane hoists, and an overhead crane are also located in the lake screen house. The layout of the equipment is segregated such that the east side is for Unit 1 and west side for Unit 2 with the exception of the fire protection pumps that are common to both units. A separate room on the main level contains the diesel driven fire pump and diesel oil storage tank. A lower pit area, accessible from the main level elevation, contains the Circulating Water pumps. The trash racks, trash rake, track for the trash rake, and trolley assembly, including a jib crane, are located on the outside of the lake screen house.

The lake screen house is supported on a 196 foot by 117 foot 6 inch mat foundation (varying from 4 to 5 feet thick) resting on the natural ground strata of glacial till, approximately 35 feet below grade level. The safety-related Service Water pipes are embedded in the mat foundation. The entire lake screen house below grade level is constructed of minimum 48-inch-thick structural reinforced concrete. The floor at grade level is a 42-inch-thick structural reinforced concrete slab with a number of openings for various pumps and access ladders for personnel. The substructure of the lake screen house, which houses the safety-related Service Water intakes and associated isolation valves, is designed as a safety-related structure. The exterior portions of the superstructure of the lake screen house building above grade are insulated metal siding, supported by steel beams, girts, and columns. The roof of the lake screen house building consists of a built-up roofing system over 3-1/2-inch-thick precast concrete panels, and is supported by steel beams and columns. The retaining walls adjoining the lake screen house are reinforced concrete wing walls founded on Wedron silty clay till. The walls extend as much as 100 feet east and west of the screen house.

The chemical feed tank building directly adjoins the lake screen house, and the construction is identical to the lake screen house except that the floor at grade is 46 inches thick. An adjacent plastic hut contains additional chemical injection equipment. The foundations for the chemical storage tanks and chemical injection feed equipment are located outside the lake screen house on the west side of the building and the foundation for the carbon dioxide gas tank is located north of the lake screen house. The chemical storage tank foundations consist of concrete slabs at grade level. The foundation for the carbon dioxide tank consists of concrete footings. The circulating water discharge structure is a reinforced concrete structure that is located at the northwest section of the Braidwood cooling pond. The structure provides a point of discharge for the two sixteen foot diameter circulating water pipes that are routed underground from the turbine building.

The systems, structures, and components associated with the lake screen house are all nonsafety-related, except for the substructure and the components associated with the safety-related portion of the Service Water system. Two intake lines are routed from the safety-related portion of the Essential Service Cooling Pond to the Auxiliary Building, where the safety-related Service Water pumps are located, which provide the safety-related Service Water suction supply. Each of these two separate intake lines is fed by three individual 30-inch diameter intake lines, for a total of six intake lines, three on the east side for Unit 1 and three on the west side for Unit 2. The intake lines are each provided with a 30-inch diameter manually operated gate valve contained within the lake screen house substructure. The safety-related Service Water piping that is located in the lake screen house is primarily contained within the base mat concrete foundation of the lake screen house structure, except for the portions of piping near the isolation valves. Each of these valves and associated section of piping is contained in a separate valve pit that has minimum 2-foot thick concrete walls and is covered by a steel plate. The substructure of the lake screen house, which houses the safety-related Service Water intakes and valve pits, is designed as a safety-related structure. The retaining walls adjoining the lake screen house are classified safety related. Failure of nonsafety-related portions of the lake screen house structure and equipment will not affect the safety-related Service Water piping and valves due to the spatial separation between the nonsafety-related structures and equipment and the safety-related Service Water piping and valves. In addition, the safety-related Service Water piping and valves are protected by the concrete enclosures protruding above the top of the mat.

The main motor-driven and diesel-driven fire pumps for the plant are located in the lake screen house on the main level, along with the two motor driven jockey fire pumps. The diesel-driven fire pump is contained within a separate 3-hour fire rated room, with masonry walls, within the lake screen house and the room is protected by an automatic wet-pipe sprinkler system.

The lake screen house provides physical support, shelter, and protection for the pumping equipment for the Circulating Water, nonsafety-related Service Water and Fire Protection systems that take suction from the cooling lake, and also provides the suction point for the safety-related Service Water System from the Essential Service Cooling Pond, which is the ultimate heat sink for Braidwood Station, Units 1 and 2. The lake screen house provides the suction point for water for normal operations, accident mitigation, as well as for fire protection. The purpose of the lake screen house is to provide physical support, shelter, and protection for the systems and equipment discussed above. In addition the lake screen house substructure provides protection to the safety-related Service Water components under postulated environmental and design basis accident loading conditions.

Essential Service Water Discharge Structure:
The essential service water discharge structure is a reinforced concrete structure that is approximately 2,800 feet south of the lake screen house and is located in the Essential Service Cooling Pond. The essential service water discharge structure is founded on approximately 23 feet of Wedron glacial till deposit overlying the Carbondale bedrock formation. The glacial till is stiff to hard and not susceptible to liquefaction. The essential service water discharge structure is backfilled with previously excavated sand compacted to minimum 85% relative density. This backfill is not susceptible to liquefaction. The essential service water discharge structure is safety-related. The purpose of the essential service water discharge structure is to provide the discharge point to the ultimate heat sink and anchorage for the discharge end of the essential service water pipes in the Essential Service Cooling Pond.

Included in the boundary of the Lake Screen Structures is the lake screen house and the essential service water discharge structure in their entirety as well as the chemical feed tank building directly adjoined to the lake screen house, the chemical storage tanks foundations located outside the lake screen house on the west side of the building, the foundation for the carbon dioxide gas tank located north of the lake screen house and the circulating water discharge structure located at the northwest section of the cooling pond. The substructures of the lake screen house (basemat, walls, and floor) and the essential service water discharge structure are safety-related structures that support and protect components of the essential service water system. These substructures provide the suction and discharge points to the Essential Service Cooling Pond, which is the ultimate heat sink. The lake screen house superstructure provides physical support, shelter, and protection for the fire protection equipment located within the structure.

Included in the boundary of the Lake Screen Structures and determined to be within the scope of license renewal are the reinforced concrete slabs, walls, foundation, adjoining concrete retaining walls, structural steel, hatches/plugs, metal decking inside the lake screen house, concrete anchors, concrete embedments, masonry walls, and the trash racks. Also included within the boundary is structural bolting associated with specific in scope components evaluated as part of the Lake Screen Structures. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Lake Screen Structures.

Included in the boundary of the Lake Screen Structures and determined not to be within the scope of license renewal are the structural elements outside of the lake screen house that include the stop logs, stop log guides, trash rake rail, exterior ladders, stairs, and metal decking. These components and structures are nonsafety-related and are provided to facilitate maintenance activities, provide access to the equipment and do not perform a license renewal intended function and their failure will not prevent satisfactory accomplishment of a safety-related function. Included in the boundary of the Lake Screen Structures and determined not to be within the scope of license renewal are the chemical feed tank building directly adjoined to the lake screen house and the chemical storage tanks foundations located outside the lake screen house on the west side of the building, the carbon dioxide gas tank foundation on the north side of the lake screen house building, and the circulating water discharge structure located on the north west corner of the Braidwood cooling pond. These components and structures are nonsafety-related and do not perform a license renewal intended function and their failure will not prevent satisfactory accomplishment of a safety-related function.

Not included in the boundary of the Lake Screen Structures are component supports, cranes and hoists, fire barriers, and structural commodities. Component supports, including their respective bolting, are evaluated separately with the Component Supports Commodity Group. Cranes and hoists are evaluated separately with the Cranes and Hoists system and fire barriers are evaluated separately with the Fire Protection System. Structural commodities, including their respective bolting, are evaluated with the Structural Commodity Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track.

Components and structures also not included in the boundary of the Lake Screen Structures are the mechanical components for the circulating water system (including trash rakes and travelling screens), chemical feed and handling system, essential service water system, miscellaneous drains system, fire protection and detection system, instrument air system, service air system, screen wash system, treated water system, pumphouse ventilation system, non-essential service water system and the essential service cooling pond. These components and structures are evaluated separately with the following license renewal systems: Circulating Water System, Condensate and Feedwater Auxiliaries System, Non-Radioactive Drain System, Fire Protection System, Compressed Air System, Service Water System, Fresh Water System, Circulating Water Ventilation System and Essential Service Cooling Pond.

For more detailed information see UFSAR Sections 3.4.1.3, 3.8.5.1.4 (Braidwood), 3.8.4.1.9 (Braidwood), 9.2.1.2, 9.2.1.2.2, 9.2.5 (Braidwood), 9.4.6.1 (Braidwood), and Table 3.2-1.

Reason for Scope Determination

The Lake Screen Structures (Braidwood) meet 10 CFR 54.4(a)(1) because portions of the Lake Screen Structures (Braidwood) are safety-related structures that are relied upon to remain functional during and following design basis events. The Lake Screen Structures (Braidwood) are not in scope under 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the structures would not prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Lake Screen Structures (Braidwood) also meet 10 CFR 54.4(a)(3) because the Lake Screen Structures (Braidwood) are relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48) and Station Blackout (10 CFR 50.63). The Lake Screen Structures (Braidwood) are not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provides physical support, shelter, and protection for safety-related systems, structures, and components. 10 CFR 54.4(a)(1)

2. Provides physical support, shelter, and protection for systems, structures, and components

relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). 10 CFR 54.4(a)(3)

3. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). 10 CFR 54.4(a)(3)

UFSAR References

2.4.1 (Braidwood)
2.4.11 (Braidwood)
2.5.4 (Braidwood)
3.4.1
3.8.4 (Braidwood)
3.8.5 (Braidwood)
9.2.1
9.2.5 (Braidwood)
9.4.6 (Braidwood)
Table 3.2-1

License Renewal Boundary Drawings

Byron Common:
None.

Braidwood Common:
LR-BRW-S-01A

Table 2.4-9 Lake Screen Structures (Braidwood)
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting (Structural)	Structural Support
Concrete Anchors	Structural Support
Concrete Embedments	Structural Support
Concrete: Above-grade exterior (accessible areas)	Shelter, Protection
	Structural Support
Concrete: Below-grade exterior (accessible areas)	Shelter, Protection
	Structural Support
Concrete: Below-grade exterior (inaccessible areas)	Direct Flow
	Shelter, Protection
	Structural Support
Concrete: Foundation, subfoundation (inaccessible areas)	Shelter, Protection
	Structural Support
Concrete: Interior	Shelter, Protection
	Structural Support
Hatches/Plugs	Missile Barrier
	Shelter, Protection
Masonry walls: Interior	Shelter, Protection
	Structural Support
Metal decking	Structural Support
Precast Panel	Shelter, Protection
	Structural Support
Steel Components	Structural Support
Steel Components (Trash Rack Bars)	Filter

The aging management review results for these components are provided in:

Table 3.5.2-9 Lake Screen Structures (Braidwood)
Summary of Aging Management Evaluation

2.4.10 Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms

Description

The Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms structure includes the main steam and auxiliary feedwater tunnels and the main steam isolation valve rooms.

The main steam and auxiliary feedwater tunnels are a bi-level reinforced concrete box section with the top of the tunnel approximately one foot below grade level. The main steam tunnel is the upper elevation compartment of the bi-level tunnel. Contained within the main steam tunnel are Main Steam and Main Condensate and Feedwater System piping and components which run to and from the Turbine Building Complex, underneath the Auxiliary Building, to both of the main steam isolation valve (MSIV) rooms on each unit. The auxiliary feedwater tunnel is the lower elevation compartment of the bi-level tunnel and contains Auxiliary Feedwater System piping and components that run from the Auxiliary Building to both of the MSIV rooms on each unit. The main steam and auxiliary feedwater tunnels also contain safety-related cables in conduit. The foundations of the tunnels at both stations are founded on excavated bedrock and are integral to the Auxiliary Building. Engineered backfill was placed between the tunnels and the Containment Structures and the Auxiliary Building.

The main steam and auxiliary feedwater tunnels are classified as safety-related structures. The main steam tunnels open directly into the turbine building and main steam isolation valve rooms to ensure the internal pressure of the tunnel is maintained within acceptable limits following the postulated rupture of the main steam or feed water systems piping. The MSIV room floor penetrations are sealed to ensure flood and HELB protection between the MSIV rooms and the auxiliary feedwater tunnels. The shared walls separating the main steam and auxiliary feedwater tunnels and the Auxiliary Building are sealed to ensure flood protection at piping and conduit penetrations.

There are two MSIV rooms adjoining each of the Unit 1 and Unit 2 Containment Structures. The MSIV rooms and Containment Structures are separated by a seismic gap to prevent their interaction during the postulated design basis seismic event. The MSIV rooms are multi-story structures, with portions that are below and above-grade, comprised of reinforced concrete slabs, walls, and foundation. The roof of the building is also reinforced concrete with removable concrete hatch plugs. The MSIV rooms are an integral part of the main steam and auxiliary feedwater tunnels. They house the Auxiliary Feedwater and Main Condensate and Feedwater system tie-ins, and the Main Steam System isolation and relief valves which exhaust to the atmosphere through piping penetrations in the MSIV room roof. The design of the MSIV rooms allow for doors and blowout panels to blow open to the environment in the event of a postulated rupture of the main steam or feedwater system piping.

The purpose of the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms is to provide support, shelter, and protection of Auxiliary Feedwater, Main Steam, and Main Condensate and Feedwater piping and components, as well as their supporting mechanical and electrical systems. The purpose of the tunnels is also to provide isolation from the Auxiliary Building to preclude adverse effects as a result of potential Main Steam, Auxiliary Feedwater, or Main Condensate and Feedwater System pipe breaks.

Included within the boundary of the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms and within the scope of license renewal are reinforced concrete components that make up the structures, as well as blowout panels, flood barriers, hatches and plugs, pipe whip restraints, and miscellaneous steel components. Also included within the boundary is structural bolting associated with the specific in scope components evaluated as part of the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms.

Not included within the boundary of the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms are component supports and structural commodities. Component supports, including their respective bolting, are evaluated with the Component Supports Commodity Group. Structural commodities, including their respective bolting, are evaluated with the Structural Commodity Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track. Also not included within the boundary of the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms are the nonsafety-related main steam isolation valve room ventilation components, which are evaluated with the Miscellaneous Ventilation Systems for license renewal.

For more detailed information related to the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms, see UFSAR Sections 3.6, 3.8.4.1.4, and Attachment C3.6.

Reason for Scope Determination

The Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms meet 10 CFR 54.4(a)(1) because the structures are safety-related structures that are relied upon to remain functional during and following design basis events. The Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms meet 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the structures could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms also meet 10 CFR 54.4(a)(3) because the structures are relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Anticipated Transient Without Scram (10 CFR 50.62), and Station Blackout (10 CFR 50.63). The Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms are not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61).

Intended Functions

1. Provides physical support, shelter, and protection for safety-related systems, structures, and components. 10 CFR 54.4(a)(1)

2. Provides physical support, shelter, and protection for nonsafety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4 (a)(1). 10 CFR 54.4(a)(2)

3. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). 10 CFR 54.4(a)(3)

4. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49). 10 CFR 54.4(a)(3)

5. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Anticipated Transients Without Scram (10 CFR 50.62). 10 CFR 54.4(a)(3)

6. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). 10 CFR 54.4(a)(3)

UFSAR References

3.6
3.8.4.1.4
Attachment C3.6

License Renewal Boundary Drawings

Byron Common:
LR-BYR-S-01A

Braidwood Common:
LR-BRW-S-01A

Table 2.4-10 Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms Components Subject to Aging Management Review

Component Type	Intended Function
Blowout Panels	Pressure Relief
	Shelter, Protection
Bolting (Structural)	Structural Support
Concrete: Above-grade exterior (accessible areas)	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Structural Support
Concrete: Above-grade exterior (inaccessible areas)	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Structural Support
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Structural Support
Concrete: Foundation, subfoundation (inaccessible areas)	Flood Barrier
	Shelter, Protection
	Structural Support
Concrete: Interior	Flood Barrier
	HELB Shielding
	Missile Barrier
	Shelter, Protection
	Structural Support
Flood Barriers	Flood Barrier
Hatches/Plugs	Flood Barrier
	HELB Shielding
	Missile Barrier
	Shelter, Protection
Pipe Whip Restraints and Jet Impingement Shields	Pipe Whip Restraint
Steel Components	Structural Support

The aging management review results for these components are provided in:

Table 3.5.2-10 Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms Summary of Aging Management Evaluation

2.4.11 Natural Draft Cooling Towers (Byron)

Description

The Natural Draft Cooling Towers are present at Byron Station, Units 1 and 2, only. The Natural Draft Cooling Towers boundary includes the two cooling towers (one per unit) and their associated cooling tower basins and riser valve buildings. The Natural Draft Cooling Towers are located on the east side of the site boundary, approximately 650 feet from the main power block, directly north and south of the Circulating Water Pump House.

The Natural Draft Cooling Towers are nonsafety-related structures designed and sized to provide cooling to the circulating water and non-essential service water systems. The cooling towers are 490 feet high and 450 feet in diameter at the widest point. The cooling towers are hyperbolic in shape, constructed of reinforced concrete, and founded on a reinforced concrete foundation supported on bedrock and controlled compacted fill. The cooling tower basins are approximately 605 feet in diameter with a 6-foot high basin curb wall. The cooling tower basins are constructed of reinforced concrete and are supported on bedrock and controlled compacted fill. The riser valve buildings are located at three equally spaced points along the outside perimeter of the cooling tower structures. The riser valve buildings consist of reinforced concrete slabs supported by a reinforced concrete foundation with insulated metal siding and roof supported by a steel frame.

The purpose of the Natural Draft Cooling Towers is to provide cooling for the circulating water and the non-essential service water systems. The cooling tower basins together with the circulating water intake flume also provide the required water for the Fire Protection System. The diesel and electric fire pumps required for 10 CFR 50.48 are located in the Circulating Water Pump House. The circulating water intake flume returns water from the natural draft cooling tower basins to the Circulating Water Pump House, which houses the circulating water, fire protection, and non-essential service water system pumps. The circulating water intake flume is evaluated for license renewal with the Circulating Water Pump House. The riser valve buildings house and support the circulating water piping, which returns heated water to the cooling towers for cooling, as well as valves and other equipment to support cooling tower operations. The riser valve buildings and associated equipment are not required to support the Fire Protection System.

The reinforced concrete cooling tower basins are the only portion of the Natural Draft Cooling Towers that are within the scope of license renewal because the basins provide the water required for the Fire Protection System. The remainder of the Natural Draft Cooling Tower and supporting structures has no safety-related or other license renewal intended function. The Natural Draft Cooling Tower structures are all nonsafety-related and separated from safety-related systems, structures, and components such that their failure would not impact a safety-related function.

Included in the boundary of the Natural Draft Cooling Towers and determined to be within the scope of license renewal are the reinforced concrete cooling tower basin slabs, foundations, basin walls and the seals and gaskets used to contain and provide the source of water for the Fire Protection system. Refer to the “Components Subject to Aging Management Review” table below for a complete list of components included in the boundary of the Natural Draft Cooling Towers.

Included in the boundary of the Natural Draft Cooling Towers and determined not to be within the scope of license renewal are the natural draft hyperbolic cooling towers, fill, louvers, support columns, the riser valve buildings and circulating water piping, basin screens, and other miscellaneous cooling tower components.

Not included in the boundary of the Natural Draft Cooling Towers are component supports and structural commodities. Component supports, including their respective bolting, are evaluated with the Component Supports Commodity Group. Structural commodities, including their respective bolting, are evaluated with the Structural Commodity Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track. Components also not included in the boundary of the Natural Draft Cooling Towers are the mechanical components associated with the circulating water system and fire protection systems which are evaluated with the Circulating Water and Fire Protection license renewal systems. The circulating water intake flume is evaluated separately for license renewal with the Circulating Water Pump House.

For more detailed information, see UFSAR Sections 2.3.2.2 (Byron), 9.2.1, 10.1, and 10.4.5 (Byron).

Reason for Scope Determination

The Natural Draft Cooling Towers (Byron) are not in scope under 10 CFR 54.4(a)(1) because no portions of the Natural Draft Cooling Towers are safety-related or relied upon to remain functional during and following design basis events. The Natural Draft Cooling Towers (Byron) are not in scope under 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the Natural Draft Cooling Towers would not prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Natural Draft Cooling Towers (Byron) meet 10 CFR 54.4(a)(3) because the basins of the Natural Draft Cooling Towers are relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The Natural Draft Cooling Towers (Byron) are not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Fire Protection (10 CFR 50.48). The circulating water intake flume together with the cooling tower basins provides the water required to support the fire protection system. 10 CFR 54.4(a)(3)

UFSAR References

2.3.2.2 (Byron)
9.2.1
10.1
10.4.5 (Byron)

License Renewal Boundary Drawings

Byron Common:
LR-BYR-S-01A

Braidwood Common:
None.

Table 2.4-11 Natural Draft Cooling Towers (Byron) Components Subject to Aging Management Review

Component Type	Intended Function
Concrete: Above-grade exterior (accessible areas)	Structural Support
	Water retaining boundary
Concrete: Above-grade exterior (inaccessible areas)	Structural Support
	Water retaining boundary
Concrete: Below-grade exterior (inaccessible areas)	Structural Support
	Water retaining boundary
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support
	Water retaining boundary

The aging management review results for these components are provided in:

Table 3.5.2-11	Natural Draft Cooling Towers (Byron) Summary of Aging Management Evaluation

2.4.12 RWST Foundation and Tunnel

Description

The refueling water storage tanks (RWST's) are located west of the Fuel Handling Building at Byron Station and east of the Fuel Handling Building at Braidwood Station. Each RWST is a reinforced concrete cylindrical tank structure with a stainless steel interior liner. The tanks are supported on a reinforced concrete mat that is continuous with the end of the Fuel Handling Building foundation. The RWST tunnels are routed around either side of the Fuel Handling Building and contain piping that runs from each Unit 1 and Unit 2 tank to the Auxiliary Building. The tunnels are a reinforced concrete box section, which are integrally connected at the Auxiliary Building and open to the safety injection pump rooms inside the Auxiliary Building. The tunnels at Byron are supported on bedrock between the Auxiliary Building and the RWST foundation. The tunnels at Braidwood are supported on compacted fill between the Auxiliary Building and the RWST foundation. The only access to the RWST tunnels is through the safety injection pump rooms inside the Auxiliary building or through a manhole on the top of each tunnel. The only access to each RWST is through an opening on the tank roof. The refueling water storage tanks, foundation, and tunnels are classified as safety-related structures.

The purpose of the refueling water storage tanks is to provide a source of borated water to the Chemical & Volume Control, Safety Injection, Residual Heat Removal, Containment Spray, and Spent Fuel Cooling systems. The reinforced concrete exterior of the tanks provide physical support and serve as a missile barrier. The RWST foundation provides physical support for the tanks and the RWST tunnels provide shelter and protection for safety-related Safety Injection System piping, conduits, and other components routed within.

Included within the boundary of the RWST Foundation and Tunnel and determined to be within the scope of license renewal is the reinforced concrete exterior of the refueling water storage tanks, the RWST foundation, and the tunnels. Other components included within the boundary and within the scope of license renewal are the access hatches to the tanks and tunnels, miscellaneous structural steel associated with tank bottom supports and the internal tank stainless steel ladders and platforms, as well as steel components associated with the tank leak chase. Also included within the boundary is structural bolting associated with specific in scope components evaluated as part of the RWST Foundation and Tunnel. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the RWST Foundation and Tunnel.

Included within the boundary of the RWST Foundation and Tunnel but determined not to be within the scope of license renewal are platforms and handrails supported on the outside of the structures. These platforms and handrails provide personnel access to the roofs of the refueling water storage tanks and do not perform an intended function for license renewal as their failure would not impact a safety-related function.

Not included within the boundary of the RWST Foundation and Tunnel are the internal stainless steel liners of the refueling water storage tanks, component supports, and structural commodities. The internal stainless steel liners of the refueling water storage tanks are evaluated with the Safety Injection System. Component supports, including their respective bolting, are evaluated with the Component Supports Commodity Group. Structural commodities, including their respective bolting, are evaluated with the Structural Commodity

Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track. Piping and components associated with the safety injection system, including the leak chase drain lines, are evaluated with the Safety Injection System.

For more detailed information, see UFSAR Sections 2.4.12 (Byron), 2.4.12 (Braidwood) and 3.8.4.1.3.

Reason for Scope Determination

The RWST Foundation and Tunnel meets 10 CFR 54.4(a)(1) because the structures are safety-related structures that are relied upon to remain functional during and following design basis events. The RWST Foundation and Tunnel meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the structure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The RWST Foundation and Tunnel also meets 10 CFR 54.4(a)(3) because they are relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), and Station Blackout (10 CFR 50.63). The RWST Foundation and Tunnel are not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61) or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provides physical support, shelter, and protection for safety-related systems, structures, and components. 10 CFR 54.4(a)(1)

2. Provides physical support, shelter, and protection for nonsafety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4 (a)(1). 10 CFR 54.4(a)(2)

3. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Fire Protection (10 CFR 50.48). 10 CFR 54.4(a)(3)

4. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Environmental Qualification (10 CFR 50.49). 10 CFR 54.4(a)(3)

5. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Station Blackout (10 CFR 50.63). 10 CFR 54.4(a)(3)

UFSAR References

2.4.12
3.8.4.1.3

License Renewal Boundary Drawings

Byron Common:
LR-BYR-S-01A

Braidwood Common:
LR-BRW-S-01A

Table 2.4-12 RWST Foundation and Tunnel Components Subject to Aging Management Review

Component Type	Intended Function
Bolting (Structural)	Structural Support
Concrete Curbs	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Structural Support
Concrete Embedments	Structural Support
Concrete: Above-grade exterior (accessible areas)	Missile Barrier
	Shelter, Protection
	Structural Support
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier
	Shelter, Protection
	Structural Support
Concrete: Foundation, subfoundation (accessible areas)	Structural Support
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support
Concrete: Interior	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Structural Support
Concrete: Interior (Leak Chase System)	Direct Flow
Hatches/Plugs	Missile Barrier
	Shelter, Protection
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support
Steel Components (Leak Chase System)	Direct Flow

The aging management review results for these components are provided in:

Table 3.5.2-12 RWST Foundation and Tunnel
Summary of Aging Management Evaluation

2.4.13 Radwaste and Service Building Complex

Description

The Radwaste and Service Building Complex is comprised of the radwaste building, the original service building, also called the old service building, the new service building, which is also known as the service building addition, and the radwaste tunnel. The radwaste building and original service building comprise a single building structure, located north of the Turbine Building Complex at Byron and south of the Turbine Building Complex at Braidwood. The new service building is located on the west side of the radwaste and service building structure at Byron and on the east side of the radwaste and service building structure at Braidwood. There are portions of the nonsafety-related radwaste building and nonsafety-related radwaste tunnel that perform a flood barrier, license renewal, intended function for the safety-related equipment located inside of the Auxiliary Building, which is evaluated separately for license renewal.

Radwaste Building and Original Service Building:
The radwaste and the original service buildings comprise the four story radwaste and service building joint structure. Portions of the first and second floors of the building structure are designated as the radwaste building, while the balance of the first two floors and the entire upper two floors are designated as the original service building. The building structure is a concrete and steel structure founded on a continuous mat foundation that also supports the Turbine Building Complex. The portions of the continuous mat foundation that support each structure are evaluated with that structure. Therefore, the Radwaste and Service Building Complex boundary does not include the portion of the continuous mat foundation that supports the Turbine Building Complex. The Turbine Building Complex foundation is evaluated separately under the Turbine Building Complex license renewal structure.

The purpose of the radwaste building is to provide physical support, shelter, and protection for radioactive solid radwaste treatment facilities, tanks, filters, radwaste cranes and hoists, and radwaste ventilation system. The radwaste building contains no safety-related systems, structures or components. However, a portion of the radwaste building is a flood barrier that prevents surface water from entering the Auxiliary Building. The nonsafety-related radwaste building and the nonsafety-related radwaste tunnel perform a flood barrier, license renewal, intended function for the safety-related equipment located inside of the Auxiliary Building. The radwaste building also provides physical support, shelter and protection to portions of the Fire Protection System which are relied upon in the safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Fire Protection.

The radwaste building is not credited for containment of liquid radwaste in the event of a postulated tank failure. As discussed in the UFSAR Section 15.7.2, the complete release of the worst case radionuclide inventory in the tanks containing the largest quantities of significant radionuclides is postulated for the spent resin storage tank and the boron recycle holdup tanks, which are housed in the Auxiliary Building. Evaluation of the accident consequences of a break in the spent resin storage tank and the boron recycle holdup tanks, as described in the UFSAR Section 15.7.3.4, concluded that the limits of 10 CFR 20 will not be exceeded at the nearest surface water intake. This evaluation bounds any potential releases from equipment within the radwaste building.

The purpose of the original service building is to provide office space and facilities for plant personnel, maintenance shops, equipment, and tools to support maintenance activities. The original service building contains no safety-related systems, structures or components. The original service building does provide physical support, shelter and protection to portions of the Fire Protection System which are relied upon in the safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Fire Protection.

New Service Building:
The new service building is a four story, commercial grade, steel building. The building foundation consists of a concrete mat on graded material with shallow piers and grade beams. The purpose of the new service building is to provide office space and facilities for plant personnel, maintenance shops, equipment, and tools to support maintenance activities. The new service building is nonsafety-related and contains no systems, structures, or components that perform a license renewal intended function. Failure of the new service building will not prevent the satisfactory accomplishment of a license renewal intended function. Therefore, the new service building is not within the scope of license renewal.

Radwaste Tunnel:
The radwaste tunnel is a below grade, reinforced concrete, box structure connecting the Auxiliary Building and the radwaste building. The roof of the radwaste tunnel opens up through the ground floor slab in the radwaste building, inside of a partial height wall which surrounds the opening in the floor. The boundary of the radwaste tunnel begins at the radwaste building and ends at the below grade entrance to the Auxiliary Building, at the exterior surface of the Auxiliary Building exterior wall. Areas inside the Auxiliary Building, which are considered an extension of the radwaste tunnel, are separately evaluated with the Auxiliary Building.

The purpose of the radwaste tunnel is to provide for transport of radioactive material and routing of nonsafety-related piping and cables between the radwaste building and the Auxiliary Building. The radwaste tunnel contains no safety-related systems, structures or components. However, the radwaste tunnel is a flood barrier that prevents surface water from entering the Auxiliary Building since the radwaste tunnel is below grade and opens to the Auxiliary Building. The nonsafety-related radwaste tunnel and the nonsafety-related radwaste building perform a flood barrier, license renewal, intended function for the safety-related equipment located inside of the Auxiliary Building.

The purpose of the Radwaste and Service Building Complex is to provide physical support, shelter, and protection for nonsafety-related systems, structures, and components. The Radwaste and Service Building Complex is classified as nonsafety-related and is separated from safety-related systems, structures, and components such that a structural failure would not impact a safety-related function. However, portions of the radwaste building and the radwaste tunnel function as a flood barrier for the safety-related equipment located inside of the Auxiliary Building. The flood barrier function is performed by components in the radwaste building that include the ground floor slab, the partial height wall that surrounds the opening in the slab, and the walls that support the ground floor slab. All of the reinforced concrete components and seals of the radwaste tunnel perform a flood barrier function. The radwaste building and original service building also provide physical support, shelter and protection to portions of the Fire Protection System.

Included in the boundary of the Radwaste and Service Building Complex and determined to be within the scope of license renewal are the reinforced concrete elements, concrete embedments, concrete anchors, precast concrete roof panels, metal decking, masonry walls, steel components, and windows of the radwaste building and original service building joint structure. Also included within the boundary is structural bolting associated with specific in scope components evaluated as part of the Radwaste and Service Building Complex. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Radwaste and Service Building Complex.

Included within the boundary of the Radwaste and Service Building Complex and determined not to be within scope of license renewal is the new service building. This structure is nonsafety-related and does not perform a license renewal intended function. Failure of the new service building will not prevent the satisfactory accomplishment of a license renewal intended function. Therefore, the new service building is not within the scope of license renewal.

Also included within the boundary of the Radwaste and Service Building Complex and determined not to be within scope of license renewal are other architectural elements in the miscellaneous operational and maintenance support areas that include furniture, drywall partitions and soffits, and suspended ceilings. These components and structures are nonsafety-related, and are provided to facilitate miscellaneous operational support. These components and structures are nonsafety-related and do not perform an intended function. Failure of the architectural elements in the miscellaneous operational support areas will not prevent the satisfactory accomplishment of a license renewal intended function.

Not included within the boundary of the Radwaste and Service Building Complex are the mechanical components, including the radioactive solid radwaste treatment facilities, tanks, and filters, which are separately evaluated with the Radwaste System, the radwaste cranes and hoists, which are separately evaluated with the Cranes and Hoists license renewal system, and the radwaste ventilation system, which is separately evaluated with the Auxiliary Building Ventilation System. These components are not within the scope of license renewal.

Not included within the boundary of the Radwaste and Service Building Complex are the fire barriers, component supports, and structural commodities. Fire barriers are evaluated separately with the Fire Protection System. Component supports, including their respective bolting, are evaluated with the Component Supports Commodity Group. Structural commodities, including their respective bolting, are evaluated with the Structural Commodity Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track.

For more detailed information, see UFSAR Sections 2.4.2.3 (Byron), 2.4.2.3 (Braidwood), 3.4, 3.7, 11.2, 11.4, and 15.7.

Reason for Scope Determination

The Radwaste and Service Building Complex is not in scope under 10 CFR 54.4(a)(1) because no portions of the buildings are safety related and the buildings do not contain any systems or component that are safety-related. The Radwaste and Service Building Complex meets 10 CFR 54.4(a)(2) because failure of the buildings or systems or components inside the buildings would prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Radwaste and Service Building Complex meets 10 CFR 54.4(a)(3) because the buildings or systems or components inside the buildings are relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). The Radwaste and Service Building Complex is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), Anticipated Transient Without Scram (10 CFR 50.62), or Station Blackout (10 CFR 50.63).

Intended Functions

1. Provides physical support, shelter, and protection for nonsafety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4 (a)(1). 10 CFR 54.4(a)(2)

2. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). 10 CFR 54.4(a)(3)

UFSAR References

2.4.2.3 (Byron)
2.4.2.3 (Braidwood)
3.4
3.7
11.2
11.4
15.7

License Renewal Boundary Drawings

Byron Common:
LR-BYR-S-01A

Braidwood Common:
LR-BRW-S-01A

Table 2.4-13 Radwaste and Service Building Complex Components Subject to Aging Management Review

Component Type	Intended Function
Bolting (Structural)	Structural Support
Concrete Anchors	Structural Support
Concrete Embedments	Structural Support
Concrete: Above-grade exterior (accessible areas)	Flood Barrier
	Shelter, Protection
	Structural Support
Concrete: Above-grade exterior (inaccessible areas)	Flood Barrier
	Shelter, Protection
	Structural Support
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier
	Shelter, Protection
	Structural Support
Concrete: Foundation, subfoundation (accessible areas)	Flood Barrier
	Shelter, Protection
	Structural Support
Concrete: Foundation, subfoundation (inaccessible areas)	Flood Barrier
	Shelter, Protection
	Structural Support
Concrete: Interior	Flood Barrier
	Shelter, Protection
	Structural Support
Masonry walls: Interior	Structural Support
Metal decking	Structural Support
Precast Panel	Shelter, Protection
	Structural Support
Steel Components	Structural Support
Windows	Shelter, Protection

The aging management review results for these components are provided in:

Table 3.5.2-13 Radwaste and Service Building Complex
Summary of Aging Management Evaluation

2.4.14 River Screen House (Byron)

Description

The River Screen House (Byron) boundary includes the river screen house and the circulating water blowdown structure due to the common location of the two structures. The river screen house will be discussed first, followed by the circulating water blowdown structure.

At Byron, the river screen house is located approximately 2 miles west of the main powerblock and is supported on a mat foundation established on compacted natural soils. The entire below grade portion of the river screen house is constructed of structural reinforced concrete. There are a number of openings in the main floor slab for the traveling screens, various pumps, and access ladders for personnel. The above grade exterior walls are insulated metal siding, supported by steel beams, girts and columns. Louvers are provided in three of the walls for ventilation purposes. A battery room is located in the corner of the building. The floor of this room is a structural reinforced concrete slab, the walls are of hollow concrete masonry units, and the ceiling is structural reinforced concrete on steel decking formwork supported by steel beams. An intermediate floor is provided in the river screen house and is constructed of structural reinforced concrete over steel decking and is supported by steel beams and columns. Located on the intermediate floor on both the north and south side are diesel oil storage tank rooms that are constructed of reinforced concrete with a door for access. Outside and adjacent to these rooms on both the north and south side are the essential service water makeup pump areas. These areas are enclosed by a minimum of 48-inch high reinforced concrete walls with access provided by a grating stair and platform over the top of the wall. The roof over the diesel oil storage tank rooms, which is also the roof of the river screen house, is constructed of structural reinforced concrete over steel decking and is supported by steel beams and columns. Included in the boundary of the river screen house is a sediment management system located in the Rock River upstream from the river screen house. The sediment management system is comprised of submerged upstream wing dams and precast concrete vanes that are designed to reduce accumulation of sediment at the intake to the structure and to assist in maintaining a permanent connection to the deep channel of the Rock River. Also included in the boundary are sheet pilings along the shoreline, a floating boom at the intake area to deflect ice sheets away from the structure intake, and a trash rack bar grill assembly also located at the intake of the structure. In addition to the main structure, there are also reinforced concrete slab foundations located off the east and south ends of the structure for electrical transformers and related equipment.

The purpose of the Byron river screen house is to provide physical support, shelter, and protection for both the safety-related and nonsafety-related equipment located in the structure. The nonsafety-related equipment includes the equipment associated with providing circulating water makeup from the Rock River to the circulating water intake flume. This equipment includes a trash rake rail and debris removal equipment located outside the structure for debris collection and removal. Inside the structure, nonsafety-related equipment includes traveling screens, screen wash pumps, circulating water makeup pumps, air compressors, ventilation equipment, overhead trolley hoists for equipment maintenance and other associated equipment to support the function of providing circulating water makeup. The safety-related equipment supported by the river screen house includes the diesel driven essential service water makeup pumps and their respective diesel oil storage tanks and associated equipment. The essential service water makeup pumps provide the safety-related makeup from the Rock

River to the Essential Service Water Cooling Tower basins. The river screen house at Byron is a Seismic Category I safety-related structure relied upon for postulated design basis events.

At Byron, the circulating water blowdown structure is located approximately 500 feet south and east of the river screen house. The structure includes a valve vault for the circulating water blowdown valves, a blowdown spray chamber, an outfall structure, and discharge flume to the Rock River. The structures are constructed of reinforced concrete. The valve vault structure above the reinforced concrete base is constructed of uninsulated corrugated metal supported by a steel frame. Also included as part of the boundary and located just north of the circulating water blowdown valve vault structure, is a reinforced concrete vault for circulating water blowdown instrumentation that also contains a valve and branch connection for a warm-up line.

The purpose of the circulating water blowdown structure at Byron is to transfer water from the circulating water blowdown line to the Rock River. The circulating water blowdown flow is used to maintain the natural draft cooling tower basin chemistry and also acts as dilution flow for liquid radwaste releases and sewage treatment plant discharges. The circulating water blowdown warm-up line provides warm water to the intake of the river screen house intake structure to control ice formation during the winter. All of the systems, structures, and components associated with the Byron circulating water blowdown structure are nonsafety-related and do not perform any intended functions for license renewal.

In summary, the River Screen House (Byron) boundary includes the river screen house and the circulating water blowdown structure. The river screen house is a Seismic Category I safety-related structure that is relied upon for postulated design basis events. The circulating water blowdown structure is nonsafety-related and does not perform any intended functions for license renewal.

Included in the boundary of the River Screen House (Byron) and determined to be within the scope of license renewal are the reinforced concrete slabs, walls, foundation, adjoining concrete retaining walls, structural steel, concrete anchors, concrete embedments, hatches/plugs, steel components, trash rack bar grill assembly, metal decking and earthen water-control structures. Also included within the boundary is structural bolting associated with specific in scope components evaluated as part of the River Screen House. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the River Screen House (Byron).

Included in the boundary of the River Screen House (Byron) and determined not to be within the scope of license renewal are the structural elements outside of the river screen house that include the sediment management components, trash rake rail and debris removal equipment, exterior ladders, stairs, metal decking, piles along the shoreline, transformer foundations, as well as stop logs and stop log guides located in the structure. These components and structures are nonsafety-related and are provided to facilitate or reduce maintenance activities, provide access to the equipment and do not perform a license renewal intended function and their failure will not prevent satisfactory accomplishment of a safety-related function. Included in the boundary of the River Screen House (Byron) and determined not within the scope of license renewal is the circulating water blowdown structure. These components and structures are nonsafety-related and do not perform a license renewal intended function and their failure will not prevent satisfactory accomplishment of a safety-related function.

Not included in the boundary of the River Screen House (Byron) are component supports, cranes and hoists, fire barriers, and structural commodities. Component supports, including their respective bolting, are evaluated separately with the Component Supports Commodity Group. Cranes and hoists are evaluated separately with the Cranes and Hoists System, and fire barriers are evaluated separately with the Fire Protection System. Structural commodities, including their respective bolting, are evaluated with the Structural Commodity Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track. In addition, mechanical and electrical systems and components housed in or located at the Byron river screen house are evaluated with their respective mechanical and electrical license renewal systems or commodities.

For more detailed information see UFSAR Sections 2.4.3.9 (Byron), 2.5.4.5 (Byron), 3.4, 3.5.2, 3.8.4 (Byron), 3.8.5.1.4 (Byron), and 11.2.

Reason for Scope Determination

The River Screen House meets 10 CFR 54.4(a)(1) because it is a safety-related structure that is relied upon to remain functional during and following design basis events. The River Screen House meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the structure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The River Screen House also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48) and Station Blackout (10 CFR 50.63). The River Screen House is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provides physical support, shelter, and protection for safety-related systems, structures, and components. 10 CFR 54.4(a)(1)

2. Provides physical support, shelter, and protection for nonsafety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4 (a)(1). 10 CFR 54.4(a)(2)

3. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Fire Protection (10 CFR 50.48). 10 CFR 54.4(a)(3)

4. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Station Blackout (10 CFR 50.63). 10 CFR 54.4(a)(3)

UFSAR References

2.4.3.9 (Byron)
2.5.4.5 (Byron)
3.4
3.5.2
3.8.4.1.7 (Byron)
3.8.5.1.4 (Byron)
8.3.1.4
9.2.5 (Byron)
10.4.5 (Byron)
11.2
Table 3.2-1
Figures 3.8-59 - 64
Figure Q130.9-13.

License Renewal Boundary Drawings

Byron Common:
LR-BYR-S-01A

Braidwood Common:
None.

Table 2.4-14 River Screen House (Byron) Components Subject to Aging Management Review

Component Type	Intended Function
Bolting (Structural)	Structural Support
Concrete Anchors	Structural Support
Concrete Embedments	Structural Support
Concrete: Above-grade exterior (accessible areas)	Shelter, Protection
	Structural Support
Concrete: Below-grade exterior (accessible areas)	Shelter, Protection
	Structural Support
Concrete: Below-grade exterior (inaccessible areas)	Direct Flow
	Shelter, Protection
	Structural Support
Concrete: Foundation, subfoundation (inaccessible areas)	Shelter, Protection
	Structural Support
Concrete: Interior	Flood Barrier
	Shelter, Protection
	Structural Support
Earthen water-control structures	Direct Flow
Hatches/Plugs	Shelter, Protection
Masonry walls: Interior	Structural Support
Metal decking	Structural Support
Steel Components	Structural Support
Steel Components (Trash Rack Bars)	Filter
Windows	Shelter, Protection

The aging management review results for these components are provided in:

Table 3.5.2-14 River Screen House (Byron)
Summary of Aging Management Evaluation

2.4.15 Structural Commodity Group

Description

The Structural Commodity Group shares material and environment properties allowing common programs across all in scope structures to manage their aging effects. Structural Commodities include bird screens; bolting (structural); cable trays; compressible joints and seals; conduit; doors; insulation and insulation jacketing; louvers; metal siding; miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.); panels, racks, cabinets, and other enclosures; penetration seals and sleeves; roofing, seals, gaskets, and moisture barriers; tube track. Structural commodities are located in the structures that are within the scope of license renewal.

Bird Screens:
Bird screens within the scope of license renewal include those bird screens attached to stationary louvers that are within the scope of license renewal and perform a license renewal intended function for filtering.

Bolting (Structural):
Bolting (Structural) within the scope of license renewal includes bolting which provides structural support for connections associated with structural steel assemblies which are within the scope of license renewal. Not included in the boundary for this commodity are containment structure pressure retaining bolting, structural bolts for cranes and hoists, structural bolting associated with component supports, structural bolting associated with specific in scope components evaluated as part of a specific room or structure, and structural bolts used for building main beams and columns. Containment structure pressure retaining bolting is identified and evaluated with the Containment Structure. Structural bolts for cranes and hoists are identified and evaluated with the Cranes and Hoists. Structural bolting associated with component supports is identified and evaluated with the Component Supports Commodity group. Structural bolts associated with specific in scope components which are part of a specific room or structure are identified and evaluated with the associated room or structure. Structural bolts associated with building main beams, columns, and components are identified and evaluated with the associated buildings, structures, and components.

Cable Trays:
Cable trays within the scope of license renewal include cable trays that provide license renewal intended functions of structural support and shelter/protection for various electrical and control system power, control, and instrumentation cables that are within the scope of license renewal.

Compressible Joints and Seals:
Compressible joints and seals within the scope of license renewal include those items that perform a license renewal intended function of shelter/protection for structures which are within the scope of license renewal. The purpose of compressible joints and seals is for attachment of one structure to another in a manner that allows for expansion and contraction due to changing ambient temperature conditions. This commodity group also includes flexible sections of iso-phase and non-segregated bus ductwork.

Conduit:
Conduit within the scope of license renewal include conduit that provide license renewal intended functions of structural support and shelter/protection for various electrical and control system power, control and instrumentation cables that are within the scope of license renewal.

Doors:
Doors within the scope of license renewal include those doors that perform various license renewal intended functions for shelter/protection, flood barrier, structural pressure barrier, radiation shielding, and HELB shielding for structures which are within the scope of license renewal. Not included in the boundary for this commodity are fire barrier doors that perform an intended function for fire protection and containment airlocks and equipment hatches. Fire barrier doors are identified and evaluated with the license renewal Fire Protection System. Containment airlocks and equipment hatches are identified and evaluated with the license renewal Containment Structure.

Insulation and Insulation Jacketing:
Insulation and insulation jacketing within the scope of license renewal includes the insulation and associated jacketing and straps for all insulated piping and components that are within the scope of license renewal. Insulation and insulation jacketing is comprised of pre-fabricated blankets, modules, or panels engineered as integrated assemblies to fit the surface to be insulated and to fit easily against the piping and components.

Metallic insulation consists of stainless steel mirror insulation. Nonmetallic insulation consists of light density, semi-rigid fibrous glass (pad) insulation, quilted between two layers of glass scrim and encapsulated in fiberglass cloth jackets forming a composite blanket; pre-molded fiberglass modules and panels encased in fiberglass cloth jackets; calcium silicate; ceramic fiber; foamed plastic; or mineral fiber.

Metallic insulation jacketing consist of aluminum, galvanized steel, stainless steel panels, or netting held in place by metallic straps, clips or bolts.

The purpose of the insulation is to improve thermal efficiency, minimize heat loads on the HVAC systems, provide for personnel protection, or prevent freezing of heat traced piping and sweating of cold piping and components. The insulation jacketing maintains the integrity of the underlying insulation. Insulation is also used to protect penetration concrete in close proximity to hot piping to maintain concrete temperatures within allowable limits. Piping and component insulation located inside of structures that are within the scope of license renewal can be required to resist seismic loading conditions and therefore, is within the scope of license renewal since failure of this insulation could impact a function defined for 10 CFR 54.4 (a)(1).

Nonsafety-related piping and component insulation located inside structures that are within the scope of license renewal can be required to protect nearby safety related components from overheating and therefore, is within the scope of license renewal since its failure could impact a function defined for 10 CFR 54.4 (a)(2). Nonsafety-related piping and component insulation which performs a function for freeze protection of heat traced piping and components is also within the scope of license renewal under 10 CFR 54.4 (a)(2).

Thermal piping and component insulation located inside structures that are not within the scope of license renewal is not within the scope of license renewal since failure of this insulation will not impact intended safety-related functions.

Louvers:
Louvers within scope of license renewal include those louvers that perform a license renewal intended function for shelter and protection and are located in structures that are within the scope of license renewal.

Metal Siding:
Metal siding, within the scope of license renewal, includes metal siding that performs a license renewal intended function of shelter/protection and is located on structures that are within the scope of license renewal.

Miscellaneous Steel (catwalks, stairs, handrails, ladders, and platforms, etc.):
Miscellaneous steel (catwalks, stairs, handrails ladders, and platforms, etc.) components that perform license renewal intended functions for structural support are located inside structures within the scope of license renewal are within the scope of license renewal since failure of a miscellaneous steel component during a seismic event could impact a function defined for 10 CFR 54.4 (a)(2). Included in this commodity group are the structural bolts associated with these steel structures described previously in this document. Not included in the boundary for this commodity is miscellaneous steel inside tanks, pools, and cavities. Miscellaneous steel components inside tanks, pools, and cavities are evaluated with those structures.

Panels, Racks, Cabinets, and Other Enclosures:
Panels, racks, cabinets, and other enclosures within the scope of license renewal include those items that perform license renewal intended functions for shelter/protection and structural support for equipment and components within the scope of license renewal.

Penetration Seals:
Penetration seals within the scope of license renewal include penetrations in walls, floors and ceilings that perform license renewal intended functions for shelter/protection, structural pressure boundary, structural support, flood barrier, radiation shielding, and HELB shielding for structures and components which are within the scope of license renewal. Not included in the boundary for this commodity are primary containment penetration seals and fire barrier penetration seals. Primary containment penetration seals are identified and evaluated with the Containment Structure. Fire barrier penetration seals are identified and evaluated with the license renewal Fire Protection System.

Penetration Sleeves:
Penetration sleeves within the scope of license renewal include those items that perform license renewal intended functions for structural support, flood barrier, shielding, HELB shielding, pipe whip restraint, structural pressure barrier, and shelter/protection for structures and components which are within the scope of license renewal. Not included in the boundary for this commodity are primary containment penetration sleeves and fire barrier penetration sleeves. Primary containment penetration sleeves are identified and evaluated with the Containment Structure. Fire barrier penetration sleeves are identified and evaluated with the Fire Protection System.

Roofing:
Roofing within the scope of license renewal include those roofs that perform license renewal intended functions for shelter/protection for structures which are within the scope of license renewal. The roofing material consists of the roofing outer membrane. Not included in the boundary for this commodity are the structural components that support the roofs. Structural components that support the roofs are identified and evaluated with the associated structures.

Seals, Gaskets, and Moisture Barriers (caulking, flashing, and other sealants):
Seals, gaskets, and moisture barriers (caulking, flashing, and other sealants) within the scope of license renewal include those items that perform license renewal intended functions for shelter/protection, flood barrier, structural pressure barrier, radiation shielding, and HELB shielding for structures and components which are within the scope of license renewal. Not included in the boundary for this commodity are seals, gaskets, and moisture barriers (caulking, flashing, and other sealants) used for primary containment pressure boundary integrity and seals, gaskets, and moisture barriers (caulking, flashing, and other sealants) used for fire protection. Seals, gaskets, and moisture barriers (caulking, flashing, and other sealants) used for primary containment pressure boundary integrity are identified and evaluated in the Containment Structure. Seals, gaskets, and moisture barriers (caulking, flashing, and other sealants) used for fire protection are identified and evaluated with the license renewal Fire Protection System.

Tube Track:
Tube track within the scope of license renewal includes tube track that performs license renewal intended functions for structural support and shelter/protection for various instrumentation tubing that is within the scope of license renewal.

Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Structural Commodity Group.

For more detailed information regarding structural commodities see UFSAR Sections 3.4.1.3, 5.2.3.2.3, 8.3.1.4, 9.1.2.3.10, 12.3.2.1.6.3, A1.36, B.8

Reason for Scope Determination

The Structural Commodity Group meets 10 CFR 54.4(a)(1) because it is a safety-related commodity group that is relied upon to remain functional during and following design basis events. The Structural Commodity Group meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the commodity group could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Structural Commodity Group also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Anticipated Transient Without Scram (10 CFR 50.62), and Station Blackout (10 CFR 50.63). The Structural Commodity Group is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Pressurized Thermal Shock (10 CFR 50.61).

Intended Functions

1. Provides physical support, shelter, and protection for safety-related systems, structures, and components. 10 CFR 54.4(a)(1)

2. Provides physical support, shelter, and protection for nonsafety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4 (a)(1). 10 CFR 54.4(a)(2)

3. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates

compliance with the Commission’s regulations for Fire Protection (10 CFR 50.48). 10 CFR 54.4(a)(3)

4. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Environmental Qualification (10 CFR 50.49). 10 CFR 54.4(a)(3)

5. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Anticipated Transients Without Scram (10 CFR 50.62). 10 CFR 54.4(a)(3)

6. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Station Blackout (10 CFR 50.63). 10 CFR 54.4(a)(3)

UFSAR References

3.4.1.3
5.2.3.2.3
8.3.1.4
9.1.2.3.10
12.3.2.1.6.3
A1.36
B.8

License Renewal Boundary Drawings

Byron Common:
None.

Braidwood Common:
None.

Table 2.4-15 Structural Commodity Group
Components Subject to Aging Management Review

Component Type	Intended Function
Bird Screen	Filter
Bolting (Structural)	Structural Support
Cable Trays	Shelter, Protection
	Structural Support
Compressible Joints and Seals	Shelter, Protection
Conduit	Shelter, Protection
	Structural Support
Doors	Flood Barrier
	HELB Shielding
	Shelter, Protection
	Shielding
	Structural Pressure Barrier
Insulation	Thermal Insulation
Insulation Jacketing	Thermal Insulation Jacket Integrity
Louver	Shelter, Protection
Metal siding	Shelter, Protection
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection
	Structural Support
Penetration Seals	Flood Barrier
	HELB Shielding
	Shelter, Protection
	Shielding
	Structural Pressure Barrier
	Structural Support
Penetration sleeves	Flood Barrier
	HELB Shielding
	Pipe Whip Restraint
	Shelter, Protection
	Shielding
	Structural Pressure Barrier
	Structural Support
Roofing	Shelter, Protection
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Flood Barrier
	HELB Shielding
	Shelter, Protection
	Shielding
	Structural Pressure Barrier
Tube Track	Shelter, Protection
	Structural Support

The aging management review results for these components are provided in:

Table 3.5.2-15	Structural Commodity Group Summary of Aging Management Evaluation

2.4.16 Switchyard Structures

Description

The Switchyard Structures boundary includes the 345-kV switchyard structures, the switchyard relay house, the switchyard maintenance building, the intermediate towers from the 345-kV switchyard to the main and system auxiliary transformers, and the towers at the transformers. The 345-kV switchyard at Byron is located west of the Containment Structures, while the 345-kV switchyard at Braidwood is located east of the Containment Structures. The switchyard relay house and the switchyard maintenance building are located inside the 345-kV switchyard. The Unit 1 and Unit 2 transformers are separated by the Auxiliary Building and located adjacent to the north and south of the ends of the Auxiliary Building.

The Switchyard Structures included within the scope of license renewal are the 345-kV switchyard structures, foundations, towers, and steel components that are associated with the in scope portions of the Offsite Power System, the switchyard relay house, the intermediate towers from the 345-kV switchyard to the system auxiliary transformers, and the transformer towers at the system auxiliary transformers. At Byron, the portions of the 345-kV switchyard structures associated with the in scope portions of the Offsite Power System are switchyard buses 6, 7, 13 and their associated circuit breakers. At Braidwood, the portions of the 345-kV switchyard structures associated with the in scope portions of the Offsite Power System are switchyard buses 4 and 14 and their associated circuit breakers.

The Switchyard Structures at Byron and Braidwood are nonsafety-related structures and are separated from safety-related systems, structures, and components such that their failure would not impact a safety related function. The 345-kV switchyard foundations, the intermediate tower foundations, and the transformer tower foundations consist of reinforced concrete below grade piers on footings bearing on compacted soil. The switchyard relay house is a single story masonry wall structure above grade, approximately 54' x 65' in plan dimensions, with reinforced concrete walls around a below grade level supported on a base slab on compacted soil. The roof is comprised of a precast concrete hollow slab covered with built-up roofing. The switchyard maintenance building is of similar construction and its foundation is reinforced concrete slab on grade with reinforced concrete footings around the perimeter. Siding was added around the switchyard relay house and switchyard maintenance building at Byron.

The purpose of the Switchyard Structures is to provide physical support, shelter, and protection for the Offsite Power System. The Offsite Power System receives offsite power from four (4) different independent sources at Byron and six (6) different independent sources at Braidwood. The power is fed to the plant through the Medium Auxiliary Power System via the system auxiliary transformers (SAT). The Offsite Power System also receives power generated by the station and transmits it over transmission lines to the Commonwealth Edison electric transmission network. The Offsite Power System is relied upon to provide offsite power during the restoration from a Station Blackout (SBO) event. The output of each main power transformer is connected to a 345-kV switchyard section consisting of circuit breakers, disconnect switches, buses, and associated equipment arranged in a double ring bus configuration. Overhead 345-kV transmission lines distribute power to the various points of the transmission system. The control power for the 345-kV switchyard breakers is supplied by two nonsafety-related 125-volt batteries located in the switchyard relay house.

Included in the boundary of the Switchyard Structures and determined to be within the scope of license renewal are reinforced concrete, metal decking, hatches, and masonry wall components of the relay house structure and concrete troughs for routing electrical cable throughout the switchyard. Also included in the boundary and determined to be within the scope of license renewal are the transmission towers, concrete anchors, concrete foundations, concrete embedments, steel components, and structural bolting associated with specific in scope components evaluated as part of the Switchyard Structures. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Switchyard Structures.

Included in the boundary of the Switchyard Structures and determined not to be within the scope of license renewal is the intermediate towers and transformer towers associated with the main transformers. The main transformers are not relied upon to provide offsite power during the restoration from a SBO event. The intermediate towers and transformer towers associated with the main transformers are nonsafety-related and do not perform an intended function, and their failure will not prevent the satisfactory accomplishment of a license renewal intended function. Therefore, the intermediate towers and transformer towers associated with the main transformers are not within the scope of license renewal.

Also included in the boundary of the Switchyard Structures and determined not to be within the scope of license renewal is the switchyard maintenance building. The switchyard maintenance building is nonsafety-related and does not perform an intended function, and its failure will not prevent the satisfactory accomplishment of a license renewal intended function, therefore it is not within the scope of license renewal.

Also determined not to be within the scope of license renewal are the other components and structures in the 345-kV switchyard that do not support the SBO intended function, including the wooden poles in the Braidwood switchyard. These components and structures in the 345-kV switchyard that do not support the SBO intended function are nonsafety-related and do not perform an intended function, and their failure will not prevent the satisfactory accomplishment of a license renewal intended function, therefore they are not within the scope of license renewal. The Byron switchyard does not contain any wooden poles.

Not included in the boundary of the Switchyard Structures are component supports, structural commodities, and the system auxiliary transformer foundations. Component supports, including their respective bolting are evaluated with the Component Supports Commodity Group. Structural commodities, including their respective bolting, are evaluated with the Structural Commodity Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track. The system auxiliary transformer foundations are evaluated with the Yard Structures.

Components also not included in the boundary of the Switchyard Structures are electrical components and commodities. These components and commodities are separately evaluated with the Offsite Power System.

For more detailed information, see UFSAR Sections 8.1 and 8.2.

Reason for Scope Determination

The Switchyard Structures are not in scope under 10 CFR 54.4(a)(1) because no portions of the Switchyard Structures are safety-related or relied upon to remain functional during and following design basis events. The Switchyard Structures are not in scope under 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the Switchyard Structures would not prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Switchyard Structures meet 10 CFR 54.4(a)(3) because the Switchyard Structures are relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). The Switchyard Structures are not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provides physical support, shelter, and protection for systems, structures and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). 10 CFR 54.4(a)(3).

UFSAR References

8.1
8.2
8.2.1
8.2.2

License Renewal Boundary Drawings

Byron Common:
LR-BYR-S-01A

Braidwood Common:
LR-BRW-S-01A

Table 2.4-16 Switchyard Structures
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting (Structural)	Structural Support
Concrete Anchors	Structural Support
Concrete Embedments	Structural Support
Concrete: Above-grade exterior (accessible areas)	Shelter, Protection
	Structural Support
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection
	Structural Support
Concrete: Foundation, subfoundation (inaccessible areas)	Shelter, Protection
	Structural Support
Concrete: Interior	Shelter, Protection
	Structural Support
Equipment supports and foundations	Structural Support
Hatches/Plugs	Shelter, Protection
Masonry walls: Above-grade exterior	Shelter, Protection
	Structural Support
Masonry walls: Interior	Shelter, Protection
	Structural Support
Metal decking	Structural Support
Steel Components	Structural Support
Transmission Towers	Structural Support

The aging management review results for these components are provided in:

Table 3.5.2-16 Switchyard Structures
Summary of Aging Management Evaluation

2.4.17 Turbine Building Complex

Description

The Turbine Building Complex is comprised of the turbine building and heater bay, the make-up demineralizer building, the condensate clean-up and technical support center building, and the auxiliary boiler stacks due to the common location of the four structures. The Turbine Building Complex at Byron Station is located east of the Auxiliary Building and south of the Radwaste and Service Building Complex; while the Turbine Building Complex at Braidwood Station is located west of the Auxiliary Building and north of the Radwaste and Service Building Complex.

The Turbine Building Complex houses various steam and power conversion equipment. For example, the Turbine Building Complex houses the main condenser, the condensate pumps, the heater drain pumps, the main turbines, the main generators and various auxiliary systems such as the auxiliary steam boilers and the station air compressors. The turbine building and heater bay will be discussed first followed by the make-up demineralizer building, the condensate clean-up and technical support center building, and the auxiliary boiler stacks.

Turbine Building and Heater Bay:
The boundary for the Turbine Building Complex includes the turbine building and heater bay. The turbine building and heater bay is a multi-story steel structure approximately 130 by 735 feet in plan area, founded on a reinforced concrete foundation mat. At Byron Station, the reinforced concrete foundation mat is supported on rock. At Braidwood Station, a portion of the reinforced concrete foundation mat is supported on rock and the remainder is supported on soil. There are portions of the turbine building that have reinforced concrete walls and base slabs that are below grade. The turbine building contains the turbine generator pedestal, which is a reinforced concrete structure on a reinforced concrete mat foundation. The floors are constructed on steel framing with either steel floor grating or concrete slabs on metal decking. The above grade exterior walls are constructed of steel framing and insulated metal siding. Metal siding which is designed to blow out to relieve tornado generated differential pressure has also been provided on the upper portion of the turbine building exterior walls. The turbine building roof is constructed of pre-cast concrete decking on structural steel framing. The auxiliary boiler stacks pass through the heater bay roof and are supported by the turbine building. There are also a number of ventilation openings on the turbine building roof. The turbine building also supports the turbine building overhead cranes.

There is a common wall between the turbine building and the Radwaste and Service Building Complex and it is evaluated with the Radwaste and Service Building Complex license renewal structure. There is a common wall between the turbine building and the Auxiliary Building and it is evaluated with the Auxiliary Building license renewal structure. The continuous mat foundation also supports the Auxiliary Building and the Radwaste and Service Building Complex. The Auxiliary Building foundation and the Radwaste and Service Building Complex foundation are evaluated separately under their respective license renewal structures.

The purpose of the turbine building and heater bay is to provide physical support, shelter, and protection for the systems and equipment discussed above. The turbine building also provides flood and missile protection to portions of the common wall between the turbine building and the Auxiliary Building. In addition the turbine building substructure provides physical support and protection to the safety-related Service Water components under postulated environmental and design basis accident loading conditions. The essential service water supply and discharge pipes are either below or embedded in the turbine building base mat. The pipes are not inside the open space of the turbine building and the pipes are adequately protected from any design bases event that may occur within the turbine building. The turbine building base mat is designed and constructed such that it will not suffer gross failure or collapse during either a safe shutdown earthquake (SSE) or a design-basis tornado. The essential service water supply and discharge pipes are evaluated separately with the Service Water System.

The turbine building is a nonsafety-related structure. However, the primary structural framing includes heavy steel bracing and is designed to prevent a turbine building collapse that could affect safety-related structures or components under design basis earthquake conditions and as a result of loads imposed by a design basis tornado. The design of the turbine building substructure and superstructure used the same seismic and tornado loading combinations and design allowables as were used in safety-related designs.

Make-up Demineralizer Building:
The boundary for the Turbine Building Complex includes the make-up demineralizer building. The make-up demineralizer building is located next to the south end of the turbine building and heater bay at Byron Station and next to the north end of the turbine building and heater bay at Braidwood Station. The make-up demineralizer building is a single story steel structure at Byron Station and is a two story steel structure at Braidwood Station. The make-up demineralizer building is founded on a reinforced concrete foundation. The exterior walls are constructed of steel framing and metal siding. The make-up demineralizer building roof consists of a built-up roof system over pre-cast concrete slabs on structural steel framing. The purpose of the make-up demineralizer building is to provide physical support, shelter, and protection for nonsafety-related portions of the Fire Protection, Main Condensate and Feedwater, and Demineralized Water Systems. The make-up demineralizer building provides physical support, shelter, and protection to portions of the Fire Protection System which are relied upon to demonstrate compliance with the Commission’s regulations for Fire Protection and portions of the Main Condensate and Feedwater System which are relied upon to demonstrates compliance with the Commission’s regulations for Station Blackout.

Condensate Clean-up and Technical Support Center Building:
The boundary for the Turbine Building Complex includes the condensate clean-up and technical support center building. The condensate clean-up and technical support center building is located next to the south end of the turbine building at Byron Station and next to the north end of the turbine building at Braidwood Station. The condensate clean-up and technical support center building is a multi-story steel structure founded on a reinforced concrete foundation mat. The exterior walls are constructed of steel framing and metal siding. The condensate clean-up and technical support center building roof consists of a built-up roof system over a concrete slab on steel decking supported by structural steel framing. The purpose of the condensate clean-up and technical support center building is to provide physical support, shelter, and protection for nonsafety-related portions of the Fire Protection System, Main Condensate and Feedwater System and house technical support center equipment and facilities that support the emergency preparedness program. The condensate clean-up and technical support center building first floor on the ground elevation provides physical support, shelter, and protection to nonsafety-related portions of the condensate clean-up system. The upper two levels house the technical support center equipment and facilities that support the emergency preparedness program. The technical support center equipment and facilities are not safety-related and do not perform a license renewal intended function.

The condensate clean-up and technical support center building provides physical support, shelter, and protection to portions of the Fire Protection System which are relied upon to demonstrate compliance with the Commission’s regulations for Fire Protection and portions of the Main Condensate and Feedwater System which are relied upon to demonstrate compliance with the Commission’s regulations for Station Blackout.

Auxiliary Boiler Stacks:
Included in the boundary of the Turbine Building Complex and determined not to be within scope of license renewal are the auxiliary boiler stacks. The auxiliary boiler stacks are located in the heater bay and pass through the heater bay roof. The auxiliary boiler stacks are associated with the Heating Water and Heating Steam System. The auxiliary boiler stacks are nonsafety-related and do not perform an intended function. Failure of the auxiliary boiler stacks will not prevent the satisfactory accomplishment of a license renewal intended function. Therefore, the auxiliary boiler stacks are not within the scope of license renewal.

The purpose of the Turbine Building Complex is to provide physical support, shelter, and protection for safety-related and nonsafety-related systems, structures, and components during normal plant operation and to provide flood protection and missile protection for components in the adjacent Auxiliary Building. The Turbine Building Complex contains auxiliary systems components, steam and power conversion systems components, and the support systems and components necessary to support Fire Protection, Station Blackout, and Anticipated Transients Without Scram. The Turbine Building Complex also contains certain nonsafety-related electrical and mechanical components that provide input signals and actuation devices for the reactor trip and engineered safety features actuation systems such as feedwater isolation. These components are evaluated with the Reactor Protection System and the Main Condensate and Feedwater System.

Included in the boundary of the Turbine Building Complex are components of the turbine building and heater bay, make-up demineralizer building, condensate clean-up and technical support center in its entirety as well as the auxiliary boiler stacks. The Turbine Building Complex provides physical support, shelter, and protection to equipment required for license renewal located in the structure. Portions of the turbine building also provide flood protection, missile barrier, and pressure relief for structures required for license renewal.

Included in the boundary of the Turbine Building Complex and determined to be within the scope of license renewal are reinforced concrete elements of the building, metal components, concrete embedments, concrete anchors, precast concrete roof panels, hatches, plugs, metal decking, masonry walls, blowout panels, windows, and steel components. Also included within the boundary is structural bolting associated with specific in-scope components evaluated as part of the Turbine Building Complex. Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Turbine Building Complex.

Included in the boundary of the Turbine Building Complex and determined not to be within scope of license renewal are the auxiliary boiler stacks. These components and structures are nonsafety-related and do not perform an intended function. Failure of the auxiliary boiler stacks will not prevent the satisfactory accomplishment of a license renewal intended function.

Included in the boundary of the Turbine Building Complex and determined not to be within scope of license renewal are the portions of the technical support center building that do not provide physical support, shelter and protection for nonsafety-related portions of the Fire

Protection and the Main Condensate and Feedwater Systems. These portions of the technical support center building contain architectural elements in the emergency preparedness support areas that include furniture, drywall partitions and soffits, and suspended ceilings. These components and structures are nonsafety-related, and are provided to facilitate emergency preparedness program support. These components and structures are nonsafety-related and do not perform an intended function. Failure of the architectural elements in the emergency preparedness support areas will not prevent the satisfactory accomplishment of a license renewal intended function.

Also included in the boundary of the Turbine Building Complex and determined not to be within scope of license renewal are other architectural elements in the miscellaneous operational support areas that include furniture, drywall partitions and soffits, and suspended ceilings. These components and structures are nonsafety-related, and are provided to facilitate miscellaneous operational support. These components and structures are nonsafety-related and do not perform an intended function. Failure of the architectural elements in the miscellaneous operational support areas will not prevent the satisfactory accomplishment of a license renewal intended function.

Not included within the boundary of the Turbine Building Complex are the fire barriers, component supports, and structural commodities. Fire barriers are evaluated separately with the Fire Protection System. Component supports, including their respective bolting, are evaluated with the Component Supports Commodity Group. Structural commodities, including their respective bolting, are evaluated with the Structural Commodity Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track.

Components also not included in the boundary of the Turbine Building Complex are the mechanical components for the auxiliary systems, electrical systems, and the steam and power conversion systems housed inside the Turbine Building Complex, as well as the cranes and hoists in the Turbine Building Complex. The mechanical or electrical systems are separately evaluated with their respective mechanical systems, electrical systems, or commodities. The turbine building overhead cranes and other cranes and hoists in the Turbine Building Complex are evaluated separately with the Cranes and Hoists System.

For more detailed information, see UFSAR Sections 3.3.2.2.2, 3.7.2.8, 3.8.5.1.2, and 9.2.1.2.3.

Reason for Scope Determination

The Turbine Building Complex is not in scope under 10 CFR 54.4(a)(1) because no portions of the structure are safety-related. The Turbine Building Complex meets 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the structure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Turbine Building Complex also meets 10 CFR 54.4(a)(3) because it is relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48), Anticipated Transient Without Scram (10 CFR 50.62), and Station Blackout (10 CFR 50.63). The Turbine Building Complex is not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49) or Pressurized Thermal Shock (10 CFR 50.61).

Intended Functions

1. Provides physical support, shelter, and protection for nonsafety-related systems, structures, and components (SSCs) whose failure could prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4 (a)(1). 10 CFR 54.4(a)(2)

2. Provides physical support, shelter, and protection for systems structures and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48). 10 CFR 54.4(a)(3)

3. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Anticipated Transient Without Scram (10 CFR 50.62). 10 CFR 54.4(a)(3)

4. Provides physical support, shelter, and protection for systems structures and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Station Blackout (10 CFR 50.63). 10 CFR 54.4(a)(3)

UFSAR References

1.2.11
Table 2.5-27 (Byron)
Table 2.5-29 (Braidwood)
Table 3.2-1
3.3.2.2.2
3.7.2.8
Table 3.7-15
3.8.5.1
3.8.5.1.2
Figure 3.8-44
Figure 3.8-45
9.2.1.2.3

License Renewal Boundary Drawings

Byron Common:
LR-BYR-S-01A

Braidwood Common:
LR-BRW-S-01A

Table 2.4-17 Turbine Building Complex Components Subject to Aging Management Review

Component Type	Intended Function
Blowout Panels	Pressure Relief
	Shelter, Protection
Bolting (Structural)	Structural Support
Concrete Anchors	Structural Support
Concrete Embedments	Structural Support
Concrete: Above-grade exterior (accessible areas)	Shelter, Protection
	Structural Support
Concrete: Above-grade exterior (inaccessible areas)	Shelter, Protection
	Structural Support
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection
	Structural Support
Concrete: Foundation, subfoundation (inaccessible areas)	Shelter, Protection
	Structural Support
Concrete: Interior	Flood Barrier
	Missile Barrier
	Shelter, Protection
	Structural Support
Hatches/Plugs	Shelter, Protection
	Structural Support
Masonry walls: Interior	Shelter, Protection
	Structural Support
Metal components: All structural members	Structural Support
Metal decking	Structural Support
Precast Panel	Shelter, Protection
	Structural Support
Steel Components	Structural Support
Windows	Shelter, Protection

The aging management review results for these components are provided in:

Table 3.5.2-17 Turbine Building Complex
Summary of Aging Management Evaluation

2.4.18 Yard Structures

Description

The Yard Structures include storage tank foundations, transformer foundations, duct banks, manholes and handholes, valve and instrument vaults, yard drainage catch basins and ditches, and other miscellaneous yard structures. The purpose of the Yard Structures is to provide physical support, missile barrier, shelter, and protection for safety-related and nonsafety-related components and commodities including components credited for Fire Protection, and Station Blackout.

Tank foundations:
The tank foundations, included within the boundary of Yard Structures, support the following tanks: condensate storage tanks, fuel oil storage tanks, filtered water storage tanks, primary water storage tanks, treated water storage tank (Byron only), blowdown monitor tank (Braidwood only), lime storage tanks, and the radwaste storage tank (Braidwood only).

The condensate storage tank foundations are reinforced concrete structures located southeast of the Turbine Building Complex at Byron and northwest of the Turbine Building Complex at Braidwood. The floors of the tanks rest on sand cushions and are surrounded by reinforced concrete ring wall foundations, which are under the tank walls. The foundation structures are founded on compacted backfill. Reinforced concrete valve vaults are located on the east side of the condensate storage tank foundations at Byron, and on the west side of the condensate storage tank foundations at Braidwood. The valve vaults are rectangular open top box structures with aluminum covers. The condensate storage tanks are within the scope of license renewal and are evaluated under the Main Condensate and Feedwater System. Therefore, the condensate storage tank foundations and valve vaults perform a license renewal intended function of physical support, shelter, and protection and are within the scope of license renewal.

Besides the condensate storage tanks and associated foundations, the tanks listed above do not perform a license renewal intended function, as addressed under the respective mechanical systems. These tanks and foundations are nonsafety-related and separated from safety-related systems, structures, and components such that their failure would not impact a safety-related function. Therefore, the following tank foundations and dikes do not perform any license renewal intended functions and are not within the scope of license renewal: filtered water storage tanks, primary water storage tanks, collection tanks, drain tanks, lime storage tanks, radwaste storage tank at Braidwood, acid tank, and fuel oil storage tanks.

Not included in the boundary for Yard Structures are the refueling water storage tanks (RWST) and associated foundations. The RWST foundations are evaluated with the RWST Foundation and Tunnel.

Transformer foundations:
The transformer foundations support oil filled transformers located in the yard. The transformer foundations are reinforced concrete slabs on grade and are located just north and south of the Auxiliary Building at Byron and Braidwood. The transformer foundations are nonsafety-related and separated from safety-related systems, structures, and components. The transformer foundations support the fire barrier walls between the transformers. The transformer foundations perform a license renewal intended function for structural support and

are also within the scope of license renewal. Not included within the boundary of the transformer foundations are the fire barrier walls that separate transformers. The fire barrier walls that separate transformers are evaluated with the Fire Protection System.

Duct banks, manholes, and handholes:
Manholes consist of reinforced concrete rectangular box structures buried underground with removable covers on top for personnel access. The manholes have an opening and cover to allow plant personnel access to electrical cables routed in underground duct banks. Manholes and handholes serve as intermediate connection points for duct banks routed in the yard area. The duct banks are used for the routing of cables between plant structures and between plant structures and the switchyard. Duct banks are comprised of the placement of multiple conduits in an excavated trench in the yard that are encased in concrete and then backfilled. Handholes consist of reinforced concrete or ductile cast iron rectangular box structures buried underground or placed above ground. The ductbanks, manholes, and handholes are supported on compacted fill.

Some of the duct banks, manholes, and handholes contain cables within the scope of license renewal. The cables within the scope of license renewal are required for safety-related systems and components at Byron only or are required for nonsafety-related systems and components required for fire protection and power restoration following a station blackout at both Byron and Braidwood. The duct banks, manholes, and handholes, which contain cables within the scope of license renewal, perform the license renewal intended functions of support, shelter, and protection and are within the scope of license renewal. At Byron the in scope duct banks, manholes, and handholes house power cables for the motor driven fire pump, the deep well pump, essential service water cooling tower valves, and essential service water cooling tower 480-volt substations power cables. At Braidwood, the in scope duct banks, manholes, and handholes house power cables for the motor driven fire pump.

Valve and line enclosures:
The valve and line enclosures, which are also referred to as pits or vaults, are reinforced concrete box structures located in the yard area and are buried below plant grade with a removable cover for personnel access. The valve and line enclosures are supported on compacted fill. The valve and line enclosures that are not within the scope of license renewal contain nonsafety-related piping, valves and instruments for systems and structures, which are not within the scope of license renewal, such as the valve enclosures for the Circulating Water System and the Primary Water Storage Tanks. The valve and line enclosures that are within the scope of license renewal contain piping, valves, and instruments for systems and structures that are within the scope of license renewal and perform license renewal intended functions. Valve and line enclosures, associated with systems and structures within the scope of license renewal, perform license renewal intended functions of support, missile protection, shelter, and protection. The in scope valve and line enclosures at Byron include the essential service water instrumentation pit located just west of the Essential Service Water Cooling Tower, the valve enclosures at the Condensate Storage Tanks, the essential service water makeup relief valve vaults along the right-of-way from the River Screen House to the Essential Service Water Cooling towers, and the essential service water blowdown line enclosures located just east of the Unit 1 Turbine Building Complex. The in scope valve and line enclosures at Braidwood include the essential service water return valve enclosure located just east of the receiving building, and the valve enclosures at the condensate storage tanks.

Yard drainage catch basins and ditches:
The yard drainage system includes both the storm drain system and normal waste drain system in both the Yard and Switchyard areas. The storm and normal waste drainage systems are comprised of buried reinforced concrete, polyethylene, cast iron, and corrugated metal pipe (CMP). It also contains at grade reinforced concrete catch basins, and oil separator pits and tanks. The catch basins allow inflow of storm water. The storm drainage system is provided to drain the Byron and Braidwood Yard and Switchyard areas. The yard drainage system is not credited in the safety analysis for flood protection. Therefore, the yard drainage system does not perform a license renewal intended function and is not within the scope of license renewal.

Miscellaneous yard structures:
The miscellaneous yard structures include site water wells, tritium detection wells, construction runoff pond at Byron, gas storage area, yard substations, microwave towers, trash compactor foundations, light poles, railroad tracks, roadways, sidewalks, bollards, reinforced concrete foundation slabs for buildings that have been removed from the site, concrete pads for commercial grade HVAC units for buildings that are not within the scope of license renewal, abandoned concrete equipment foundations, and miscellaneous yard sheds and foundations. These miscellaneous yard structures are structural features located in the yard area that are not tied to systems or components that are within the scope of license renewal. These miscellaneous yard structures are nonsafety-related and separated from safety-related systems, structures, and components such that their failure would not impact a safety-related function. These miscellaneous yard structures do not perform any license renewal intended functions and are not within the scope of license renewal.

Refer to the "Components Subject to Aging Management Review" table below for a complete list of components included in the boundary of the Yard Structures.

Not included within the boundary of the Yard Structures are the fire barriers, component supports, and structural commodities. Fire barriers are evaluated separately with the Fire Protection System. Component supports, including their respective bolting, are evaluated with the Component Supports Commodity Group. Structural commodities, including their respective bolting, are evaluated with the Structural Commodity Group. The Structural Commodity Group evaluates components such as bird screens; cable trays; compressible joints and seals; conduit; doors; piping and component insulation and insulation jacketing; louvers; metal siding; miscellaneous structural steel including platforms, stairs, ladders; panels, racks, cabinets, and other enclosures for electrical equipment and instrumentation; penetration seals; penetration sleeves including end caps; roofing; structural sealants, seismic gap seals, gaskets, flashing and other sealants and gap seals; and tube track.

Also not included within the boundary of the Yard Structures are the 345 kV switchyards. The 345 kV switchyards, including transmission towers located in the yard, are evaluated with the Switchyard Structures.

For more detailed information, see UFSAR Sections 2.1.1, 2.4, 8.3.1, 9.2.6, and Appendix B.1.

Reason for Scope Determination

The Yard Structures meet 10 CFR 54.4(a)(1) because the Yard Structures are safety-related structures that are relied upon to remain functional during and following design basis events. The Yard Structures are not in scope under 10 CFR 54.4(a)(2) because failure of nonsafety-related portions of the Yard Structures would not prevent satisfactory accomplishment of function(s) identified for 10 CFR 54.4(a)(1). The Yard Structures also meet 10 CFR 54.4(a)(3) because the Yard Structures are relied upon in the safety analyses and plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Fire Protection (10 CFR 50.48) and Station Blackout (10 CFR 50.63). The Yard Structures are not relied upon in any safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for Environmental Qualification (10 CFR 50.49), Pressurized Thermal Shock (10 CFR 50.61), or Anticipated Transient Without Scram (10 CFR 50.62).

Intended Functions

1. Provides physical support, shelter, and protection for safety-related systems, structures, and components (SSCs). 10 CFR 54.4(a)(1)

2. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Fire Protection (10 CFR 50.48). 10 CFR 54.4(a)(3)

3. Provides physical support, shelter, and protection for systems, structures, and components relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for Station Blackout (10 CFR 50.63). 10 CFR 54.4(a)(3)

UFSAR References

2.1.1
2.4
8.3.1
9.2.6
B.1

License Renewal Boundary Drawings

Byron Common:
LR-BYR-S-01A

Braidwood Common:
LR-BRW-S-01A

Table 2.4-18 Yard Structures
Components Subject to Aging Management Review

Component Type	Intended Function
Bolting (Structural)	Structural Support
Concrete: Above-grade exterior (accessible areas)	Missile Barrier
	Shelter, Protection
	Structural Support
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection
	Structural Support
Concrete: Foundation, subfoundation (accessible areas)	Structural Support
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support
Concrete: Interior	Shelter, Protection
	Structural Support
Equipment supports and foundations	Structural Support
Hatches/Plugs	Missile Barrier
	Shelter, Protection
Manholes, Handholes & Duct Banks	Shelter, Protection
	Structural Support

The aging management review results for these components are provided in:

Table 3.5.2-18 Yard Structures
Summary of Aging Management Evaluation

2.5 SCOPING AND SCREENING RESULTS: ELECTRICAL

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

The determination of electrical systems that fall within the scope of license renewal is made through the application of the process described in Section 2.1. The results of the electrical systems scoping review are contained in Section 2.2.

Subsection 2.1.6.1 provides the screening methodology for determining which electrical components and commodity groups within the scope of 10 CFR 54.4 meet the requirements contained in 10 CFR 54.21(a)(1). The electrical commodity groups that meet those screening requirements are identified in this section. These identified electrical commodity groups consequently require an aging management review.

As described in Subsection 2.1.6.1, the screening was performed on a commodity group basis for the in scope electrical and I&C systems as well as the electrical and I&C component types associated with in scope mechanical systems listed in Table 2.2-1.

Components which support or interface with electrical and I&C components, for example, cable trays, conduits, instrument racks, panels and enclosures, are assessed as part of the Component Supports Commodity Group in Section 2.4.3.

2.5.1 ELECTRICAL SYSTEMS

The results of the electrical system scoping review are contained in Section 2.2. Additional system details are included in the UFSAR Sections 7 and 8. In addition to the electrical and I&C systems and components, certain switchyard components are credited to restore offsite power following a station blackout (SBO). The boundary for offsite power restoration following a SBO is shown in simplified diagrams in Figures 2.1-2 and 2.1-3 for Byron and Braidwood Stations, respectively.

2.5.2 ELECTRICAL COMMODITIES

2.5.2.1 Identification of Electrical Commodities

The first step of the screening process for electrical commodities is to use plant documentation to identify the electrical components and commodities within the electrical, I&C, and mechanical systems based on plant design documentation, drawings, and the plant equipment database (PassPort), as well as by interfacing with the parallel mechanical and civil screening efforts. The electrical components and commodities identified at BBS are listed below. This list includes electrical components and commodities identified in NEI 95-10 Appendix B in addition to components and commodities added per NUREG-1800 Table 2.1-5.

Electrical Components and Commodities for In Scope Systems:

- Alarm Units
- Analyzers

- Annunciators
- Batteries
- Cable Connections (Metallic Parts)
- Cable Tie-Wraps
- Chargers
- Circuit Breakers
- Communication Equipment
- Connection Contacts
- Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage
- Converters
- Electric Heaters
- Electrical Controls and Panel Internal Assemblies
- Electrical Penetrations
- Elements, RTDs, Sensors, Thermocouples, Transducers
- Fuse Holders
- Fuses
- Generators, Motors
- Heat Trace
- High Voltage Insulators
- Indicators
- Insulation Material for Electrical Cables and Connections
- Inverters
- Isolators
- Light Bulbs
- Loop Controllers
- Metal Enclosed Bus
- Meters
- Motor Generator Sets
- Power Supplies
- Radiation Monitors
- Recorders
- Regulators
- Relays (and Bistables)
- Signal Conditioners
- Solenoid Operators
- Solid State Devices
- Splices
- Surge Arresters
- Switches
- Switchgear, Load Centers, Motor Control Centers, Distribution Panels
- Switchyard Bus and Connections

- Terminal Blocks
- Transformers
- Transmission Conductors
- Transmission Connectors
- Transmitters
- Uninsulated Ground Conductors

2.5.2.2 Application of Screening Criterion 10 CFR 54.21 (a)(1)(i) to the Electrical Components and Commodities

Following the identification of the electrical components and commodity groups, the criterion of 10 CFR 54.21(a)(1)(i) is applied to identify electrical commodity groups that perform their functions without moving parts or without a change in configuration or properties. The following electrical commodity groups meet the screening criteria of 10 CFR 54.21 (a)(1)(i):

- Cable Connections (Metallic Parts)
- Cable Tie-Wraps
- Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage
- Electrical Penetrations
- Fuse Holders (Not Part of Active Equipment)
- High Voltage Insulators
- Insulation Material for Electrical Cables and Connections
- Metal Enclosed Bus
- Splices
- Switchyard Bus and Connections
- Terminal Blocks
- Transmission Conductors
- Transmission Connectors
- Uninsulated Ground Conductors

2.5.2.3 Elimination of Electrical Commodity Groups with No License Renewal Intended Functions

The following electrical commodity groups do not have a license renewal intended function:

Cable Tie-Wraps

Tie-wraps are used in cable installations as cable ties. Cable ties hold groups of cables together for restraint and ease of maintenance. Cable ties are used to bundle wires and cables together to keep the wire and cable runs neat and orderly. Cable ties are used to restrain wires and cables within raceways to facilitate cable installation. There are no current license basis requirements for Byron or Braidwood that tie-wraps remain functional during and following design basis events. Cable ties are not credited for maintaining cable ampacity, ensuring maintenance of cable minimum bending radius, or maintaining cables within vertical raceways at Byron or Braidwood. The seismic qualification of cable trays does not credit the use of cable ties. Tie-wraps are not credited in the Byron or Braidwood design basis in terms of any 10 CFR 54.4 intended function. Therefore, cable tie-wraps are not within the scope of license renewal and are not subject to aging management review.

Uninsulated Ground Conductors

The Uninsulated Ground Conductors commodity group is comprised of grounding cable and associated connectors. Ground conductors are provided for equipment and personnel protection. They do not perform an intended function for license renewal. Therefore, Uninsulated Ground Conductors are not within the scope of license renewal and are not subject to aging management review.

2.5.2.4 Application of Screening Criteria 10 CFR 54.21 (a)(1)(ii) to Electrical Commodities

The 10 CFR 54.21 (a)(1)(ii) screening criterion was applied to the specific commodities that remained following application of the 10 CFR 54.21 (a)(1)(i) criterion. 10 CFR 54.21 (a)(1)(ii) allows the exclusion of those commodities that are subject to replacement based on a qualified life or specified time period. The only electrical commodities identified for exclusion by the criteria of 10 CFR 54.21 (a)(1)(ii) are electrical and I&C components and commodities included in the Environmental Qualification (EQ) Program. This is because electrical and I&C components and commodities included in the EQ Program have defined qualified lives and are replaced prior to the expiration of their qualified lives. No electrical and I&C components and commodities within the EQ Program are subject to aging management review in accordance with the screening criteria of 10 CFR 54.21 (a)(1)(ii).

Electrical Penetrations

Electrical penetrations at BBS are environmentally qualified. They are evaluated as a time-limited aging analysis and ultimately managed by the Environmental Qualification (EQ) of Electric Components (B.3.1.3) program. The electrical continuity of electrical penetration pigtails that could potentially be exposed to an adverse localized environment is included in the evaluation for Insulation Material for Electrical Cables and Connections, Section 2.5.2.5.5. The shelter, protection and pressure boundary intended functions of electrical penetrations are included in the evaluation for Containment Structure, Section 2.4.4.

2.5.2.5 Electrical Commodities Subject to Aging Management Review

The electrical commodities subject to aging management review are identified in Table 2.5.2-1, along with the associated intended functions. These electrical commodities are further described below.

2.5.2.5.1 Cable Connections (Metallic Parts)

The Cable Connectors (Metallic Parts) commodity group includes metallic portions of cable connections that are not included in the EQ Program. The metallic connections evaluated include splices, threaded connectors, compression type termination lugs, and terminal blocks.

Therefore, Cable Connections (Metallic Parts) meet the screening criterion of 10 CFR 54.21(a)(1)(ii) and are subject to aging management review.

2.5.2.5.2 Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage

The Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage commodity group includes connector contacts for electrical connections that are not included in the EQ Program and are located in the Auxiliary Building, the Containment Structure, the Fuel Handling Building, or the Radwaste and Service Building Complex. These electrical connections meet the screening criterion of 10 CFR 54.21(a)(1)(ii) and are subject to aging management review.

2.5.2.5.3 Fuse Holders (Not Part of Active Equipment)

The Fuse Holders (Not Part of Active Equipment) commodity group is separated for aging management review into subcategories based on their treatment in NUREG-1801:

Fuse Holders (Not Part of Active Equipment): Insulation Material

The Fuse Holder (Not Part of Active Equipment): Insulation Material commodity group includes fuse holders that are not part of active equipment and are not included in the EQ Program. The non-metallic portions of fuse holders that are not part of active equipment and are not included in the EQ Program meet the screening criterion of 10 CFR 54.21(a)(1)(ii) and are subject to aging management review. Insulating portions of fuse holders are evaluated with insulation material for electrical cables and connections in Section 2.5.2.5.5.

Fuse Holders (Not Part of Active Equipment): Metallic Clamps

The Fuse Holder (Not Part of Active Equipment): Metallic Clamps commodity group includes fuse holders that are not part of active equipment and are not included in the EQ Program. The metallic portions of fuse holders that are not part of active equipment and are not included in the EQ Program meet the screening criterion of 10 CFR 54.21(a)(1)(ii) and are subject to aging management review.

2.5.2.5.4 High Voltage Insulators

The High Voltage Insulators commodity group supports a portion of the circuits that supply power from the electric utility transmission system and switchyard to the system auxiliary transformers. The High Voltage Insulators commodity group supports in scope license renewal components used for recovery from a station blackout event. High Voltage Insulators are not included in the EQ program. Therefore, High Voltage Insulators meet the screening criterion of 10 CFR 54.21(a)(1)(ii) and are subject to an aging management review.

2.5.2.5.5 Insulation Material for Electrical Cables and Connections

The insulated cables and connections commodity group is separated for aging management review into subcategories based on their treatment in NUREG-1801:

- Insulation material for electrical cables and connections
- Insulation material for electrical cables and connections used in instrumentation circuits
- Conductor insulation for inaccessible power cables greater than or equal to 400 volts

Insulation material for electrical cables and connections also include:

- Electrical penetration insulated cables/pigtails
- Splices
- Terminal blocks
- Fuse holders (not part of active equipment): insulation material

Insulation material for electrical cables and connections that are included in the EQ Program are not subject to an aging management review in accordance with the screening criteria of 10 CFR 54.21 (a)(1)(ii). Insulation material for electrical cables and connections not included in the EQ Program meet the criterion of 10 CFR 54.21(a)(1)(ii) and are subject to an aging management review.

Insulation material for electrical cables and connections that are part of active equipment (e.g., motor leads and connections, cables and connections internal to relays, chargers, switchgear, transformers, power supplies) are maintained along with the other subcomponents in the active equipment and are not subject to an aging management review.

2.5.2.5.6 Metal Enclosed Bus

The Metal Enclosed Bus commodity group distributes 4.16 kV power from the System Auxiliary Transformers 142-1, 142-2, 242-1, and 242-2 to the 4.16 kV Class 1E switchgear utilizing non-segregated bus work. These portions of the power distribution system are in the scope of license renewal and supply electrical power from the switchyard to plant buses to power in scope license renewal components for recovery from a station blackout event. The Metal Enclosed Bus commodity group is not included in the EQ Program. Therefore, metal enclosed bus meets the screening criterion of 10 CFR 54.21(a)(1)(ii) and is subject to aging management review.

2.5.2.5.7 Switchyard Bus and Connections, Transmission Conductors, and Transmission Connectors

The Switchyard Bus and Connections commodity group forms a portion of the circuits that supply power from the electrical utility grid to plant buses to power in scope license renewal components used for recovery from a station blackout. The Switchyard Bus and Connections are not included in the EQ program. Therefore, Switchyard Bus and Connections between the offsite transmission network and the plant electrical distribution system meets the screening criterion of 10 CFR 54.21(a)(1)(ii) and are subject to an aging management review.

The Transmission Conductors commodity group forms a portion of the circuits that supply power from the electric utility grid to plant buses to power in scope license renewal components used for recovery from a station blackout. The Transmission Conductors are not included in the EQ program. Therefore, Transmission Conductors between the offsite transmission network and the plant electrical distribution system meets the screening criterion of 10 CFR 54.21(a)(1)(ii) and are subject to an aging management review.

The Transmission Connectors commodity group forms a portion of the circuits that supply power from the electric utility grid to plant buses to power in scope license renewal components used for recovery from a station blackout. The Transmission Connectors are not included in the EQ program. Therefore, Transmission Connectors between the offsite transmission network and the plant electrical distribution system meets the screening criterion of 10 CFR 54.21(a)(1)(ii) and are subject to an aging management review.

2.5.2.5.8 Splices and Terminal Blocks

Splices and Terminal Blocks are evaluated with the Insulation Material for Electrical Cables and Connections in Section 2.5.2.5.5.

Table 2.5.2-1 Electrical Commodities Subject to Aging Management Review

Component Type or Commodity	Intended Function
Cable Connections (Metallic Parts)	Electrical Continuity
Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage	Electrical Continuity
Fuse Holders (Not Part of Active Equipment): Metallic Clamps	Electrical Continuity
High Voltage Insulators	Insulate (Electrical)
Insulation Material for Electrical Cables and Connections	Insulate (Electrical)
Metal Enclosed Bus	Electrical Continuity
	Shelter, Protection
	Insulate (Electrical)
Switchyard Bus and Connections, Transmission Conductors, and Transmission Connectors	Electrical Continuity

The aging management review results for these commodities are provided in Table 3.6.2-1 Electrical Commodities – Summary of Aging Management Evaluation.

3.0 AGING MANAGEMENT REVIEW RESULTS

This section provides the results of the aging management review for those structures and components identified in Section 2.0 as being subject to aging management review.

Descriptions of the service environments that were used in the aging management review to determine aging effects requiring management are included in Table 3.0-1, Byron and Braidwood Service Environments. The environments used in the aging management reviews are listed in the Environment column. The third column identifies one or more of the NUREG-1801 environments that were used when comparing the Byron and Braidwood Aging Management Review results to the NUREG-1801 results.

Most of the Aging Management Review (AMR) results information in Section 3 is presented in the following two tables:

- **Table 3.x.1** - where '3' indicates the LRA section number, 'x' indicates the subsection number from NUREG-1801, and '1' indicates that this is the first table type in Section 3. For example, in the Reactor Vessel, Internals, and Reactor Coolant System subsection, this table would be number 3.1.1, in the Engineered Safety Features subsection, this table would be 3.2.1, and so on. For ease of discussion, this table will, hereafter, be referred to in this Section as "Table 1."

- **Table 3.x.2-y** - where '3' indicates the LRA section number, 'x' indicates the subsection number from NUREG-1801, and '2' indicates that this is the second table type in Section 3; and 'y' indicates the table number for a specific system. For example, for the Reactor Vessel, within the Reactor Vessel, Internals, and Reactor Coolant System subsection, this table would be 3.1.2-2 and for the Reactor Vessel Internals, it would be Table 3.1.2-3. For the Combustible Gas Control System, within the Engineered Safety Features (ESF) subsection, this table would be 3.2.2-1. For the next system within the ESF subsection, it would be Table 3.2.2-2. For ease of discussion, this table will, hereafter, be referred to in this section as "Table 2."

TABLE DESCRIPTION

NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," contains the generic evaluation of existing plant programs. It documents the technical basis for determining where existing programs are adequate without modification, and where existing programs should be augmented for the extended period of operation. The evaluation results documented in NUREG-1801 indicate that many of the existing programs are adequate to manage the aging effects for particular structures or components, within the scope of license renewal, without change. NUREG-1801 also contains recommendations on specific areas for which existing programs should be augmented for license renewal. In order to take full advantage of NUREG-1801, a comparison between the BBS AMR results and the tables of NUREG-1801 has been performed. The results of that comparison are provided in the two tables.

Table 1

The purpose of Table 1 is to provide a summary comparison of how the facility aligns with the corresponding tables of NUREG-1800. The table is essentially the same as Tables 3.1.1 through 3.6.1 provided in NUREG-1800, except that the “ID” and “Type” columns have been replaced by an “Item Number” column, and the “Rev2 Item” and “Rev1 Item” columns have been replaced by a “Discussion” column.

The “Item Number” column provides the reviewer with a means to cross-reference from Table 2 to Table 1.

The “Discussion” column is used to provide clarifying or amplifying information. The following are examples of information that might be contained within this column:

- “Further Evaluation Recommended” information or reference to where that information is located
- The name of a plant specific aging management program being used, if applicable
- Exceptions to the NUREG-1800 assumptions, if applicable
- A discussion of how the line is consistent with the corresponding line item in NUREG-1800, when that may not be intuitively obvious
- A discussion of how the item is different than the corresponding line item in NUREG-1800 when it may appear to be consistent (e.g., when there is exception taken to an aging management program that is listed in NUREG-1800), if applicable

The format of Table 1 provides the reviewer with a means of aligning a specific Table 1 row with the corresponding NUREG-1800 table row, thereby, allowing for the ease of checking consistency.

Table 2

Table 2 provides the detailed results of the aging management reviews for those components identified in LRA Section 2 as being subject to aging management review. There will be a Table 2 for each of the systems within a Chapter 3 Section grouping. For example, for Byron and Braidwood, the Engineered Safety Features System Group contains tables specific to the Combustible Gas Control System, Containment Spray System, Residual Heat Removal System, and Safety Injection System.

Table 2 consists of the following nine columns:

- Component Type
- Intended Function
- Material
- Environment
- Aging Effect Requiring Management
- Aging Management Programs

- NUREG-1801 Item
- Table 1 Item
- Notes

Component Type – The first column identifies all of the component types from Section 2 of the LRA that are subject to aging management review. They are listed in alphabetical order.

Intended Function – The second column contains the license renewal intended functions for the listed component types. Definitions of intended functions are contained in Table 2.1-1.

Material – The third column lists the particular materials of construction for the component type.

Environment – The fourth column lists the environments to which the component types are exposed. Service environments are indicated and a list of these environments is provided in Table 3.0-1.

Aging Effect Requiring Management – As part of the aging management review process, the aging effects that are required to be managed in order to maintain the intended function of the component type are identified for the material and environment combination. These aging effects requiring management are listed in the fifth column.

Aging Management Programs – The aging management programs used to manage the aging effects requiring management are listed in the sixth column of Table 2. Aging management programs are described in Appendix B.

NUREG-1801 Item – Each combination of component type, material, environment, aging effect requiring management, and aging management program that is listed in Table 2, is compared to NUREG-1801, with consideration given to the standard notes, to identify consistency. Consistency is documented by noting the appropriate NUREG-1801 item number in the seventh column of Table 2. If there is no corresponding item number in NUREG-1801, this field in column seven is left blank. Thus, a reviewer can readily identify the correlation between the plant-specific tables and the NUREG-1801 tables.

Table 1 Item – Each combination of component, material, environment, aging effect requiring management, and aging management program that has an identified NUREG-1801 item number must also have a Table 3.x.1 line item reference number. The corresponding line item from Table 1 is listed in the eighth column of Table 2. If there is no corresponding item in NUREG-1801, this field in column eight is left blank. The Table 1 Item allows correlation of the information from the two tables.

Notes – The notes provided in each Table 2 describe how the information in the table aligns with the information in NUREG-1801. Each Table 2 contains standard lettered notes and, if applicable, plant-specific numbered notes.

The standard lettered notes (e.g., A, B, C) provide standard information regarding comparison of the Byron and Braidwood aging management review results with the NUREG-1801 Aging Management Table line item identified in the seventh column. In addition to the standard lettered notes, numbered plant-specific notes provide additional clarifying information when appropriate.

TABLE USAGE

Table 1

The reviewer evaluates each row in Table 1 by moving from left to right across the table. Since the Component, Aging Effect, Aging Management Programs and Further Evaluation Recommended information is taken directly from NUREG-1800, no further analysis of those columns is required. The information intended to help the reviewer the most in this table is contained within the Discussion column. Here the reviewer will be given plant-specific information necessary to determine, in summary, how the Byron and Braidwood evaluations and programs align with NUREG-1800. This may be in the form of descriptive information within the Discussion column or the reviewer may be referred to other locations within the LRA for further information.

Table 2

Table 2 contains all of the Aging Management Review information for the plant, whether or not it aligns with NUREG-1801. For a given row within the table, the reviewer is able to see the intended function, material, environment, aging effect requiring management and aging management program combination for a particular component type within a system. In addition, if there is a correlation between the combination in Table 2 and a combination in NUREG-1801, this will be identified by a referenced item number in column seven, NUREG-1801 Item. The reviewer can refer to the item number in NUREG-1801, if desired, to verify the correlation. If the column is blank, no corresponding combination in NUREG-1801 was found. As the reviewer continues across the table from left to right, within a given row, the next column is labeled Table 1 Item. If there is a reference number in this column, the reviewer is able to use that reference number to locate the corresponding row in Table 1 and see how the aging management program for this particular combination aligns with NUREG-1801.

Table 2 provides the reviewer with a means to navigate from the components subject to Aging Management Review (AMR) in LRA Section 2 all the way through the evaluation of the programs that will be used to manage the effects of aging of those components.

A listing of the acronyms used in this section is provided in Section 1.6.

Cumulative Fatigue Damage and TLAAs in Table 2

A fatigue analysis is considered to be a time-limited aging analysis (TLAA) as defined in 10 CFR 54.3 when it is within the current licensing basis and is based upon transient cycle assumptions associated with 40 years of plant operation. This includes explicit ASME Section III, Class 1 analyses for piping and components and implicit ASME Section III, Class 2 and 3 and ANSI B31.1 analyses for piping. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1).

Table 1 and Table 2 include an entry in the Aging Management Program column indicating "TLAA" for each line item that has a component for which a fatigue TLAA (explicit or implicit) has been identified. See LRA Section 4.3 for details regarding the

Byron and Braidwood fatigue design bases, fatigue TLAAs identified, and TLAA evaluations for the period of extended operation.

Table 3.0-1 – Byron and Braidwood Service Environments

Byron and Braidwood AMR Environment	Description	NUREG-1801 Environments Used For AMR Comparison
Adverse Localized Environment	This environment represents conditions with excessive heat, radiation, moisture, or voltage, sometimes in the presence of oxygen. Aging effects can be concentrated or applicable to a general plant area. This environment is only used for electrical commodities.	Adverse localized environment caused by heat, radiation, or moisture Adverse localized environment caused by heat, radiation, oxygen, moisture, or voltage Adverse localized environment caused by significant moisture
Air/Gas-Dry	This environment includes air with a very limited concentration of moisture. This includes air that has been treated to reduce the dew point well below the system operating temperature. This also includes commercial grade gases (such as nitrogen, freon, etc.) that are provided as a high quality product with little if any external contaminants (bottled gas).	Air – dry Gas
Air – Indoor, Uncontrolled	This environment is for indoor locations that are sheltered/protected from weather. Surfaces of components in this environment may be wetted, but only rarely; equipment surfaces are normally dry.	Air – indoor, controlled or uncontrolled Air – indoor, controlled or uncontrolled or Air – outdoor Air - indoor, uncontrolled Air – indoor, uncontrolled or Air – outdoor Air – indoor, uncontrolled or Air – outdoor or Ground water/soil Any environment Various

Byron and Braidwood AMR Environment	Description	NUREG-1801 Environments Used For AMR Comparison
Air – Outdoor	This environment includes atmospheric air with a temperature range of -22°F to 102°F and a relative humidity up to 100%. This environment is subject to periodic wetting and wind. This environment includes the external environment of components located in underground vaults or pits.	Air – indoor, controlled or uncontrolled or Air – outdoor Air – indoor, uncontrolled or Air – outdoor Air – indoor, uncontrolled or Air – outdoor or Ground water/soil Air – indoor, uncontrolled or Air – outdoor or Water – flowing or standing Air – outdoor Air – outdoor or Ground water/soil Air-indoor uncontrolled or condensation Any environment Various
Air with Borated Water Leakage	This environment is similar to the Air – Indoor Uncontrolled environment, but is used for components located within buildings that have systems containing treated borated water as they may be susceptible to borated water leakage and subsequent boric acid corrosion. This includes the external environment for components located within the Auxiliary Building, Containment Structure, and Fuel Handling Building.	Air - indoor, uncontrolled Air – indoor, uncontrolled or Air – outdoor Air – indoor, uncontrolled or Air – outdoor or Ground water/soil Air with borated water leakage Air with leaking secondary-side water and/or steam Air with metal temperature up to 288°C (550°F) Air with reactor coolant leakage Any environment System temperature up to 340°C (644°F)[1] Various
Closed Cycle Cooling Water	This environment includes treated water subject to the Closed Treated Water Systems Program. The Closed Treated Water Systems Program relies on maintenance of system corrosion inhibitor concentrations within specified limits of Electric Power Research Institute 1007820 to minimize corrosion.	Closed-cycle cooling water Steam or Treated water Treated water

Byron and Braidwood AMR Environment	Description	NUREG-1801 Environments Used For AMR Comparison
Closed Cycle Cooling Water >140°F	This environment is the same as the Closed Cycle Cooling Water environment, except the Closed Cycle Cooling Water >140°F environment is used for components with an operating temperature >140°F that are constructed of stainless steel. For materials other than stainless steel, the Closed Cycle Cooling Water environment is used.	Closed-cycle cooling water Closed-cycle cooling water >60°C (>140°F)
Concrete	This environment is one where components are embedded in concrete. The concrete environment is not considered aggressive with respect to embedded metallic components.	Concrete Soil or concrete
Condensation	This environment is an internal air environment containing warm or moist air where condensation may occur and periodically wet the component surface. This environment includes air with enough moisture to facilitate loss of material caused by pitting and crevice corrosion for most common materials. Although condensation may occur, it is not expected to be significant enough to result in ponding and pooling that can pose a spatial interaction concern. Ponding and pooling to this degree, as would expected to be found in HVAC drip pans and drains lines, is considered Waste Water.	Air – indoor, uncontrolled (External)[2] Air – indoor, uncontrolled or Air – outdoor Any environment Condensation Moist air or condensation (Internal)
Diesel Exhaust	This environment represents the exhaust from diesel engines. It is considered to have the potential to concentrate contaminants and be subject to wetting through condensation.	Diesel exhaust
Fuel Oil	Fuel oil used for diesel engines. Water contamination of fuel oil is assumed.	Fuel oil

Byron and Braidwood AMR Environment	Description	NUREG-1801 Environments Used For AMR Comparison
Groundwater/ Soil	This is the external environment for structural components buried in the soil.	Air – indoor, uncontrolled or Air – outdoor or Ground water/soil Any environment Ground water/soil Soil Various
Lubricating Oil	Lubricating oils are low to medium viscosity hydrocarbons used for bearing, gear, and engine lubrication. This environment also functionally encompasses hydraulic oil (non water based) and heat conduction oil. Water contamination of lubricating oil is assumed.	Lubricating oil
Raw Water	Raw water is water that has not been demineralized or treated to any significant extent. Raw water in plant systems may have been rough filtered to remove large particles and may contain a biocide additive for control of micro- and macro-organisms. The Rock River (Byron), and Kankakee River and cooling pond (Braidwood), as well as ground water from wells, provide the sources of raw water utilized at Byron and Braidwood Stations. Raw water is also rain or ground water. Potable water, water that is used for drinking or other personal use, is considered raw water.	Air – indoor, uncontrolled or Air – outdoor or Water – flowing or standing Any environment Raw water Raw water (potable)

Byron and Braidwood AMR Environment	Description	NUREG-1801 Environments Used For AMR Comparison
Reactor Coolant	The Reactor Coolant environment is treated borated water used within the reactor coolant system to transfer heat from the fuel inside the reactor vessel core to the steam generators. The Reactor Coolant environment also includes steam inside the pressurizer. The temperature of the Reactor Coolant environment is assumed to be >482°F. The Reactor Coolant environment has been selected for the following systems for consistency with NUREG-1801 terminology: Reactor Vessel, Reactor Vessel Internals, Reactor Coolant System, and Steam Generators. The components in other systems may use the Treated Borated Water environment, which is functionally equivalent to the Reactor Coolant environment.	Air with reactor coolant leakage (Internal); or reactor coolant Reactor coolant Reactor coolant >250°C (>482°F) Reactor coolant and neutron flux Reactor coolant and secondary feedwater/steam[1] Reactor coolant or steam System temperature up to 340°C (644°F)[1] Treated borated water >60°C (>140°F)
Reactor Coolant and Neutron Flux	The Reactor Coolant and Neutron Flux environment is used for components within the Reactor Vessel and Reactor Vessel Internals systems that are in contact with reactor coolant and are exposed to neutron fluence projected to exceed 1.0 x 10^{17} n/cm^2 (E >0.1 MeV) within 60 years. The temperature of the Reactor Coolant and Neutron Flux environment is assumed to be >482°F.	Reactor coolant Reactor Coolant and Neutron Flux
Soil	This is the external environment for mechanical components buried in the soil.	Soil Soil or concrete
Steam	The Steam environment is the internal environment associated with dry steam, such as main steam. Wet steam is included within the Treated Water environment, and is not described as Steam.	Reactor coolant and secondary feedwater/steam[1] Secondary feedwater or steam Steam Steam or Treated water System temperature up to 340°C (644°F)[1] Treated water Treated water >60°C (>140°F)

Byron and Braidwood AMR Environment	Description	NUREG-1801 Environments Used For AMR Comparison
Treated Borated Water	Treated borated water is treated water with boric acid in non-reactor coolant pressure boundary systems.	Any environment Treated borated water Treated water[3] Treated water (borated) Treated water or Treated borated water Various
Treated Borated Water >140°F	This environment is the same as the Treated Borated Water environment, except the Treated Borated Water >140°F environment is used for components with an operating temperature >140°F that are constructed of stainless steel. For materials other than stainless steel, the Treated Borated Water environment is used.	Reactor coolant[1] System temperature up to 340°C (644°F)[1] Treated borated water Treated borated water (primary) Treated borated water (primary) >60°C (>140°F) Treated borated water >60°C (>140°F) Treated water (borated) Treated water (borated) >60°C (>140°F)
Treated Water	Treated water is demineralized water or chemically purified water and is the base water for all clean systems. Treated water may be deaerated and include corrosion inhibitors, biocides, or some combination of these treatments. This environment includes wet steam. Dry steam, such as main steam, is addressed as its own environment.	Reactor coolant[1] Reactor coolant and secondary feedwater/steam[1] Secondary feedwater or steam Steam Steam or Treated water Treated borated water[1] Treated water

Byron and Braidwood AMR Environment	Description	NUREG-1801 Environments Used For AMR Comparison
Treated Water >140°F	This environment is the same as the Treated Water environment, except the Treated Water >140°F environment is used for components with an operating temperature >140°F that are constructed of stainless steel. For materials other than stainless steel, the Treated Water environment is used. This environment includes wet steam. Dry steam, such as main steam, is addressed as its own environment.	Reactor coolant[1] Secondary feedwater or steam System temperature up to 340°C (644°F)[1] Treated borated water[1] Treated water Treated water >60°C (>140°F)
Treated Water >482°F	This environment is the same as the Treated Water environment, except the Treated Water >482°F environment is used for components with an operating temperature >482°F that are constructed of Cast Austenitic Stainless Steel (CASS). This environment includes wet steam. Dry steam, such as main steam, is addressed as its own environment.	Secondary feedwater or steam
Waste Water	This environment includes radioactive, potentially radioactive, or non-radioactive waters that are collected from equipment and floor drains, vent system drains, and waters processed by the radwaste system. Waste waters may contain contaminants, including oil and boric acid, depending on location, as well as originally treated water that is no longer monitored by a chemistry program.	Waste Water
Waste Water >140°F	This environment is the same as the Waste Water environment, except the Waster Water >140°F environment is used for systems operating at temperatures >140°F that contain stainless steel components.	Waste Water
Water – flowing	Water that is refreshed, thus having larger impact on leaching; this can be raw water, groundwater, groundwater intrusion through concrete walls, or flowing water under a foundation.	Water – flowing Water – flowing or standing

1. This environmental alignment is only utilized for TLAA related line items. Differences between the NUREG-1801 environment and the BBS AMR environment do not affect aging management of the cumulative fatigue damage aging effect for the applicable components.
2. This environmental alignment is only utilized for the AMR comparison of the loss of preload aging effect. Differences between the NUREG-1801 environment and the BBS AMR environment do not affect aging management of the loss of preload aging effect for the applicable components.
3. This environmental alignment is only utilized for certain structural items exposed to treated borated water. Differences between the NUREG-1801 environment and the BBS AMR environment do not affect aging management of the loss of material aging effect for the applicable components.

3.1 AGING MANAGEMENT OF REACTOR VESSEL, INTERNALS, AND REACTOR COOLANT SYSTEM

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

3.1.1 INTRODUCTION

This section provides the results of the aging management review for those components identified in Section 2.3.1, Reactor Vessel, Internals, and Reactor Coolant System, as being subject to aging management review. The systems, or portions of systems, which are addressed in this section are described in the indicated sections.

- Reactor Coolant System (2.3.1.1)
- Reactor Vessel (2.3.1.2)
- Reactor Vessel Internals (2.3.1.3)
- Steam Generators (2.3.1.4)

3.1.2 RESULTS

The following tables summarize the results of the aging management review for Reactor Vessel, Internals, and Reactor Coolant System.

Table 3.1.2-1 Reactor Coolant System - Summary of Aging Management Evaluation

Table 3.1.2-2 Reactor Vessel - Summary of Aging Management Evaluation

Table 3.1.2-3 Reactor Vessel Internals - Summary of Aging Management Evaluation

Table 3.1.2-4 Steam Generators - Summary of Aging Management Evaluation

3.1.2.1 Materials, Environments, Aging Effects Requiring Management And Aging Management Programs

3.1.2.1.1 Reactor Coolant System

Materials

The materials of construction for the Reactor Coolant System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Carbon or Low Alloy Steel with Stainless Steel Cladding
- Cast Austenitic Stainless Steel (CASS)
- Copper Alloy with less than 15% Zinc
- Glass

- Gray Cast Iron
- Low Alloy Steel
- Nickel Alloy
- Stainless Steel
- Stainless Steel Bolting

Environments

The Reactor Coolant System components are exposed to the following environments:

- Air with Borated Water Leakage
- Air/Gas - Dry
- Closed Cycle Cooling Water
- Condensation
- Lubricating Oil
- Reactor Coolant
- Reactor Coolant and Neutron Flux
- Treated Borated Water
- Treated Borated Water > 140°F
- Treated Water

Aging Effect Requiring Management

The following aging effects associated with the Reactor Coolant System components require management:

- Cracking
- Cumulative Fatigue Damage
- Loss of Fracture Toughness
- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Reactor Coolant System components:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)
- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Closed Treated Water Systems (B.2.1.12)

- Compressed Air Monitoring (B.2.1.14)
- Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Flux Thimble Tube Inspection (B.2.1.24)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- Lubricating Oil Analysis (B.2.1.26)
- One-Time Inspection (B.2.1.20)
- One-Time Inspection of ASME Code Class 1 Small Bore-Piping (B.2.1.22)
- PWR Vessel Internals (B.2.1.7)
- TLAA
- Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (B.2.1.6)
- Water Chemistry (B.2.1.2)

3.1.2.1.2 Reactor Vessel

Materials

The materials of construction for the Reactor Vessel components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Carbon or Low Alloy Steel with Nickel Alloy Cladding
- Carbon or Low Alloy Steel with Stainless Steel Cladding
- Cast Austenitic Stainless Steel (CASS)
- High Strength Low Alloy Steel Bolting with Yield Strength of 150 ksi or Greater
- Nickel Alloy
- Stainless Steel
- Stainless Steel Bolting

Environments

The Reactor Vessel components are exposed to the following environments:

- Air with Borated Water Leakage
- Reactor Coolant
- Reactor Coolant and Neutron Flux

- Treated Borated Water
- Treated Borated Water > 140°F

Aging Effect Requiring Management

The following aging effects associated with the Reactor Vessel components require management:

- Cracking
- Cumulative Fatigue Damage
- Loss of Fracture Toughness
- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Reactor Vessel components:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)
- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- One-Time Inspection (B.2.1.20)
- One-Time Inspection of ASME Code Class 1 Small Bore-Piping (B.2.1.22)
- Reactor Head Closure Stud Bolting (B.2.1.3)
- Reactor Vessel Surveillance (B.2.1.19)
- TLAA
- Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (B.2.1.6)
- Water Chemistry (B.2.1.2)

3.1.2.1.3 Reactor Vessel Internals

Materials

The materials of construction for the Reactor Vessel Internals components are:

- Nickel Alloy
- Stainless Steel
- Stainless Steel Bolting

Environments

The Reactor Vessel Internals components are exposed to the following environments:

- Reactor Coolant
- Reactor Coolant and Neutron Flux

Aging Effect Requiring Management

The following aging effects associated with the Reactor Vessel Internals components require management:

- Change in Dimension
- Cracking
- Cumulative Fatigue Damage
- Loss of Fracture Toughness
- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Reactor Vessel Internals components:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)
- PWR Vessel Internals (B.2.1.7)
- TLAA
- Water Chemistry (B.2.1.2)

3.1.2.1.4 Steam Generators

Materials

The materials of construction for the Steam Generators components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Carbon or Low Alloy Steel with Nickel Alloy Cladding
- Carbon or Low Alloy Steel with Stainless Steel Cladding
- Cast Austenitic Stainless Steel (CASS) – (Byron Unit 1 and Braidwood Unit 1 only)
- Low Alloy Steel
- Nickel Alloy
- Stainless Steel
- Stainless Steel Bolting

Environments

The Steam Generators components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air with Borated Water Leakage
- Air/Gas - Dry
- Reactor Coolant
- Steam
- Treated Borated Water > 140°F
- Treated Water
- Treated Water > 140°F
- Treated Water > 482°F – (Byron Unit 1 and Braidwood Unit 1 only)
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Steam Generators components require management:

- Cracking
- Cumulative Fatigue Damage
- Loss of Fracture Toughness
- Loss of Material
- Loss of Preload
- Reduction of Heat Transfer
- Wall Thinning

Aging Management Programs

The following aging management programs manage the aging effects for the Steam Generators components:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)
- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Flow-Accelerated Corrosion (B.2.1.8)

- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- One-Time Inspection (B.2.1.20)
- Steam Generators (B.2.1.10)
- TLAA
- Water Chemistry (B.2.1.2)

3.1.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

NUREG-1801 provides the basis for identifying those programs that warrant further evaluation by the reviewer in the license renewal application. For the Reactor Vessel, Internals, and Reactor Coolant System, those programs are addressed in the following subsections.

3.1.2.2.1 Cumulative Fatigue Damage

Fatigue is a time-limited aging analysis (TLAA) as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). This TLAA is addressed separately in Section 4.3, “Metal Fatigue Analysis,” of this SRP-LR.

Cumulative fatigue damage is an aging effect assessed by a fatigue time-limited aging analysis (TLAA). The fatigue TLAA is required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of fatigue as a TLAA for the Chemical and Volume Control System, Main Steam System, and Reactor Vessel Internals is discussed in Section 4.3, “Metal Fatigue.” The evaluation of fatigue as a TLAA for the Reactor Coolant System, Reactor Vessel, and Steam Generators is discussed in Section 4.3, “Metal Fatigue” and Section 4.7, “Other Plant-Specific Time-Limited Aging Analysis.”

Item Number 3.1.1-4 is not applicable to BBS. BBS Westinghouse designed pressure vessels do not utilize support skirts.

Item Numbers 3.1.1-6, 3.1.1-7, and 3.1.1-11 are applicable to BWRs only and are not used for BBS.

3.1.2.2.2 Loss of Material due to General, Pitting, and Crevice Corrosion

1. *Loss of material due to general, pitting, and crevice corrosion could occur in the steel PWR steam generator upper and lower shell and transition cone exposed to secondary feedwater and steam. The existing program relies on control of water chemistry to mitigate corrosion and Inservice Inspection (ISI) to detect loss of material. The extent and schedule of the existing steam generator inspections are designed to ensure that flaws cannot attain a depth sufficient to threaten the integrity of the welds. However, according to NRC Information Notice (IN) 90-04, the program may not be sufficient to detect pitting and crevice corrosion, if general and pitting corrosion of the shell is known to exist. The GALL Report recommends augmented inspection to manage this aging effect. Furthermore, the GALL Report clarifies that*

this issue is limited to Westinghouse Model 44 and 51 Steam Generators, where a high-stress region exists at the shell to transition cone weld. Acceptance criteria are described in Branch Technical Position RLSB-1.

BBS will implement the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program and the Water Chemistry (B.2.1.2) program to manage loss of material for steel steam generator components: shell, head, nozzles, safe ends, and welds exposed to steam and treated water in the Steam Generators.

Augmented inspection recommended for Westinghouse Model 44 and 51 steam generators is not applicable to Byron and Braidwood Stations. Byron and Braidwood Stations do not have Westinghouse Model 44 or 51 type steam generators. The Byron and Braidwood Station, Unit 1 steam generators were replaced in their entirety with Babcock and Wilcox re-circulating feedring replacement steam generators. The Byron and Braidwood Station, Unit 2 steam generators are the original equipment Westinghouse Model D-5 re-circulating pre-heater type steam generators.

The ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD (B.2.1.1) program and the Water Chemistry (B.2.1.2) program are described in Appendix B.

2. *Loss of material due to general, pitting, and crevice corrosion could occur in the steel PWR steam generator shell assembly exposed to secondary feedwater and steam. The existing program relies on control of secondary water chemistry to mitigate corrosion. However, some applicants have replaced only the bottom part of their recirculating steam generators, generating a cut in the middle of the transition cone, and, consequently, a new transition cone closure weld. The GALL Report recommends volumetric examinations performed in accordance with the requirements of ASME Code Section XI for upper shell-to and lower shell-to transition cones with gross structural discontinuities for managing loss of material due to general, pitting, and crevice corrosion in the welds for Westinghouse Model 44 and 51 Steam Generators, where a high-stress region exists at the shell to transition cone weld.*

   The new continuous circumferential weld, resulting from cutting the transition cone as discussed above, is a different situation from the SG transition cone welds containing geometric discontinuities. Control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant flow conditions. The new transition area weld is a field-weld as opposed to having been made in a controlled manufacturing facility, and the surface conditions of the transition weld may result in flow conditions more conducive to initiation of general, pitting, and crevice corrosion than those of the upper and lower transition cone welds. Crediting of the ISI program for the new SG transition cone weld may not be an effective basis for managing loss of material in this weld, as the ISI criteria would only perform a VT-2 visual leakage examination of the weld as part of the system leakage test performed pursuant to ASME Section XI requirements. In addition, ASME Section XI does not require licensees to remove insulation when performing visual examination on non-borated treated water systems. Therefore, the effectiveness of the chemistry control program should be verified to ensure that loss of material due to general, pitting and crevice corrosion is not occurring.

For the new continuous circumferential weld, the GALL Report recommends further evaluation to verify the effectiveness of the chemistry control program. A one-time inspection at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly, such that the component's intended function will be maintained during the period of extended operation. Furthermore, the GALL Report clarifies that this issue is limited to replacement recirculating steam generators with a new transition cone closure weld.

Further evaluation of the effectiveness of the Water Chemistry (B.2.1.2) program is required for applicants that have replaced only the bottom part of the steam generator, creating a new transition cone weld. The Byron and Braidwood Station, Unit 1 steam generators were replaced in their entirety with Babcock and Wilcox re-circulating feedring replacement steam generators. The Byron and Braidwood Station, Unit 2 steam generators are the original equipment Westinghouse Model D-5 re-circulating pre-heater type steam generators. Therefore, further evaluation of the effectiveness of the Water Chemistry (B.2.1.2) program due to new transition cone closure welds is not applicable to the Byron and Braidwood Stations.

3.1.2.2.3 Loss of Fracture Toughness due to Neutron Irradiation Embrittlement

1. *Neutron irradiation embrittlement is a TLAA to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 10^{17} n/cm2 (E >1 MeV) at the end of the license renewal term. Certain aspects of neutron irradiation embrittlement are TLAAs as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). This TLAA is addressed separately in Section 4.2, "Reactor Vessel Neutron Embrittlement Analysis," of this SRP-LR.*

   Loss of fracture toughness due to neutron irradiation embrittlement of the reactor vessel beltline material is an aging effect and mechanism assessed by a time-limited aging analysis (TLAA). TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The evaluation of neutron irradiation embrittlement as a TLAA for the Reactor Vessel is discussed in Section 4.2, "Reactor Vessel Neutron Embrittlement Analysis."

2. *Loss of fracture toughness due to neutron irradiation embrittlement could occur in BWR and PWR reactor vessel beltline shell, nozzle, and welds exposed to reactor coolant and neutron flux. A reactor vessel materials surveillance program monitors neutron irradiation embrittlement of the reactor vessel. The reactor vessel surveillance program is plant-specific, depending on matters such as the composition of limiting materials, availability of surveillance capsules, and projected fluence levels. In accordance with 10 CFR Part 50, Appendix H, an applicant is required to submit its proposed withdrawal schedule for approval prior to implementation. Untested capsules placed in storage must be maintained for future insertion. Thus, further staff evaluation is required for license renewal. Specific recommendations for an acceptable AMP are provided in Chapter XI, Section M31 of the GALL Report.*

   BBS will implement the Reactor Vessel Surveillance (B.2.1.19) program to manage loss of fracture toughness of the steel reactor vessel beltline shell, nozzles, and welds exposed to reactor coolant and neutron flux in the Reactor Vessel. The

Reactor Vessel Surveillance program provides sufficient material data and dosimetry to monitor irradiation embrittlement at the end of the period of extended operation and to determine the need for operating restrictions on the cold leg operating temperature, neutron spectrum, and neutron fluence. The Reactor Vessel Surveillance (B.2.1.19) program is described in Appendix B.

3. *Ductility – Reduction in Fracture Toughness is a plant-specific TLAA for Babcock and Wilcox (B&W) reactor internals to be evaluated for the period of extended operation in accordance with the staff's safety evaluation concerning "Demonstration of the Management of Aging Effects for the Reactor Vessel Internals," Babcock and Wilcox Owners Group report number BAW-2248, which is included in BAW-2248A, March 2000. Plant-specific TLAAs are addressed in Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses," of this SRP-LR.*

   Item Number 3.1.1-15 is not applicable to BBS. This Item Number is for Babcock and Wilcox PWRs only and is not used for Byron and Braidwood Stations which are Westinghouse PWRs.

3.1.2.2.4 Cracking due to Stress Corrosion Cracking and Intergranular Stress Corrosion Cracking

1. *Cracking due to stress corrosion cracking (SCC) and intergranular stress corrosion cracking (IGSCC) could occur in the stainless steel and nickel alloy BWR top head enclosure vessel flange leak detection lines. The GALL Report recommends that a plant-specific AMP be evaluated because existing programs may not be capable of mitigating or detecting cracking due to SCC and IGSCC. Acceptance criteria are described in Branch Technical Position RLSB-1.*

   Item Number 3.1.1-16 is applicable to BWRs only and is not used for Byron and Braidwood Stations which are Westinghouse PWRs.

2. *Cracking due to SCC and IGSCC could occur in stainless steel BWR isolation condenser components exposed to reactor coolant. The existing program relies on control of reactor water chemistry to mitigate SCC and on ASME Section XI ISI to detect cracking. However, the existing program should be augmented to detect cracking due to SCC and IGSCC. The GALL Report recommends an augmented program to include temperature and radioactivity monitoring of the shell-side water and eddy current testing of tubes to ensure that the component's intended function will be maintained during the period of extended operation. Acceptance criteria are described in Branch Technical Position RLSB-1.*

   Item Number 3.1.1-17 is applicable to BWRs only and is not used for Byron and Braidwood Stations which are Westinghouse PWRs.

3.1.2.2.5 Crack Growth due to Cyclic Loading

Crack growth due to cyclic loading could occur in reactor vessel shell forgings clad with stainless steel using a high-heat-input welding process. Growth of intergranular separations (underclad cracks) in the heat-affected zone under austenitic stainless steel cladding is a TLAA to be evaluated for the period of extended operation for all the SA-

508-Cl-2 forgings where the cladding was deposited with a high heat input welding process. The methodology for evaluating the underclad flaw should be consistent with the flaw evaluation procedure and criterion in the ASME Section XI Code, 2004 edition[1]. See the SRP-LR, Section 4.7, "Other Plant-Specific Time-Limited Aging Analysis," for generic guidance for meeting the requirements of 10 CFR 54.21(c).

Item Number 3.1.1-18 is not applicable for Byron and Braidwood Stations. The reactor vessel shells are not fabricated of SA-508 Class 2 forgings clad with stainless steel using a high heat input welding process.

3.1.2.2.6 Cracking due to Stress Corrosion Cracking

1. *Cracking due to SCC could occur in the PWR stainless steel reactor vessel flange leak detection lines and bottom-mounted instrument guide tubes exposed to reactor coolant. The GALL Report recommends further evaluation to ensure that these aging effects are adequately managed. The GALL Report recommends that a plant-specific AMP be evaluated to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.*

   BBS will implement the ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD (B.2.1.1) program to manage cracking in stainless steel reactor vessel flange leak detection lines exposed to reactor coolant in the Reactor Vessel. The ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD (B.2.1.1) program relies on VT-2 examinations to identify and evaluate the degradation of stainless steel reactor vessel flange leak detection lines to ensure that there is no loss of intended function. The ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD (B.2.1.1) program is described in Appendix B.

   BBS will implement the Water Chemistry (B.2.1.2) program and the ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD (B.2.1.1) program to manage cracking in stainless steel bottom-mounted instrument guide tube (external to bottom head) exposed to reactor coolant in the Reactor Coolant System. The Water Chemistry (B.2.1.2) program minimizes contaminants which promote stress corrosion cracking. The ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD (B.2.1.1) program relies on VT-2 examinations to identify and evaluate the degradation of stainless steel bottom-mounted instrument guide tube (external to bottom head) to ensure that there is no loss of intended function. The Water Chemistry (B.2.1.2) program and the ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD (B.2.1.1) program are described in Appendix B.

2. *Cracking due to SCC could occur in Class 1 PWR cast austenitic stainless steel (CASS) reactor coolant system piping, piping components, and piping elements exposed to reactor coolant. The existing program relies on control of water chemistry to mitigate SCC; however, SCC could occur for CASS components that do not meet the NUREG-0313 guidelines with regard to ferrite and carbon content. The GALL Report recommends further evaluation of a plant-specific program for these components to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.*

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[1] Refer to the GALL Report, Chapter I, for applicability of other editions of the ASME Code, Section XI.

BBS will implement the Water Chemistry (B.2.1.2) program and the ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD (B.2.1.1) program to manage cracking in Class 1 cast austenitic stainless steel (CASS) reactor coolant pressure boundary piping, piping components, and piping elements exposed to reactor coolant in the Reactor Coolant System. The Water Chemistry (B.2.1.2) program minimizes contaminants which promote stress corrosion cracking. The ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD (B.2.1.1) program includes condition monitoring activities of reactor coolant pressure boundary CASS components susceptible to cracking due to stress corrosion cracking to ensure that there is no loss of intended function. The Water Chemistry (B.2.1.2) program and the ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD (B.2.1.1) program are described in Appendix B.

3.1.2.2.7 Cracking due to Cyclic Loading

Cracking due to cyclic loading could occur in steel and stainless steel BWR isolation condenser components exposed to reactor coolant. The existing program relies on ASME Section XI ISI. However, the existing program should be augmented to detect cracking due to cyclic loading. The GALL Report recommends an augmented program to include temperature and radioactivity monitoring of the shell-side water and eddy current testing of tubes to ensure that the component's intended function will be maintained during the period of extended operation. Acceptance criteria are described in Branch Technical Position RLSB-1.

Item Number 3.1.1-21 is applicable to BWRs only and is not used for Byron and Braidwood Stations which are Westinghouse PWRs.

3.1.2.2.8 Loss of Material due to Erosion

Loss of material due to erosion could occur in steel steam generator feedwater impingement plates and supports exposed to secondary feedwater. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

Item Number 3.1.1-22 is not applicable to BBS. Steel steam generator feedwater impingement plates and supports are not used at the Byron and Braidwood Stations. The Byron and Braidwood Stations, Unit 1 replacement steam generators are Babcock and Wilcox re-circulating feedring design and do not have feedwater impingement plates. The Byron and Braidwood Station, Unit 2 steam generators are the original equipment Westinghouse Model D-5 re-circulating pre-heater type steam generators with nickel-alloy feedwater impingement plates.

3.1.2.2.9 Cracking due to Stress Corrosion Cracking and Irradiation-Assisted Stress Corrosion Cracking

Cracking due to SCC and irradiation-assisted stress corrosion cracking (IASCC) could occur in inaccessible locations for stainless steel and nickel-alloy Primary and Expansion PWR reactor vessel internal components. If aging effects are identified in accessible locations, the GALL Report recommends further evaluation of the aging effects in inaccessible locations on a plant-specific basis to ensure that this aging effect is *adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.*

BBS will implement the PWR Vessel Internals (B.2.1.7) program to manage cracking of stainless steel and nickel-alloy reactor vessel internal components exposed to reactor coolant with neutron flux in the Reactor Vessel Internals. The PWR Vessel Internals (B.2.1.7) program examines 100 percent of the volume or area of each accessible stainless steel and nickel-alloy reactor vessel internals primary and expansion inspection category component that is susceptible to cracking. The minimum examination coverage for primary and expansion inspection category is 75 percent of the component's total (accessible and inaccessible) inspection volume or area. When addressing a set of like components (e.g., bolting), the inspection shall examine a minimum sample size of 75 percent of the total population of like components.

If defects are discovered in the 75 percent sample size, the information will be entered into the corrective action program to evaluate the results of the examination, including the potential for additional defects to be present in the inaccessible portion of the population, to ensure the intended functions are maintained until the next scheduled examination. The PWR Vessel Internals (B.2.1.7) program is described in Appendix B.

3.1.2.2.10 Loss of Fracture Toughness due to Neutron Irradiation Embrittlement, Change in Dimension due to Void Swelling, Loss of Preload due to Stress Relaxation, or Loss of Material due to Wear

Loss of fracture toughness due to neutron irradiation embrittlement, change in dimension due to void swelling, loss of preload due to stress relaxation, or loss of material due to wear could occur in inaccessible locations for stainless steel and nickel-alloy Primary and Expansion PWR reactor vessel internal components. If aging effects are identified in accessible locations, the GALL Report recommends further evaluation of the aging effects in inaccessible locations on a plant-specific basis to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

BBS will implement the PWR Vessel Internals (B.2.1.7) program to manage loss of fracture toughness, change in dimension, loss of preload, and loss of material of stainless steel and nickel-alloy reactor vessel internal components exposed to reactor coolant with neutron flux in the Reactor Vessel Internals. The PWR Vessel Internals (B.2.1.7) program examines 100 percent of the volume or area of each accessible stainless steel and nickel-alloy reactor vessel internals primary and expansion inspection category component that is susceptible to loss of fracture toughness, change in dimension, loss of preload, or loss of material. The minimum examination coverage for primary and expansion inspection category is 75 percent of the component's total (accessible and inaccessible) inspection volume or area. When addressing a set of like components (e.g., bolting), the inspection shall examine a minimum sample size of 75 percent of the total population of like components.

If defects are discovered in the 75 percent sample size, the information will be entered into the corrective action program to evaluate the results of the examination, including the potential for additional defects to be present in the inaccessible portion of the population, to ensure the intended functions are maintained until the next scheduled examination. The PWR Vessel Internals (B.2.1.7) program is described in Appendix B.

3.1.2.2.11 Cracking due to Primary Water Stress Corrosion Cracking

1. *Foreign operating experience in steam generators with a similar design to that of Westinghouse Model 51 has identified extensive cracking due to primary water stress corrosion cracking (PWSCC) in steam generator (SG) divider plate assemblies fabricated of Alloy 600 and/or the associated Alloy 600 weld materials, even with proper primary water chemistry (EPRI TR-1014982). Cracks have been detected in the stub runner, adjacent to the tubesheet/stub runner weld and with depths of almost a third of the divider plate thickness. Therefore, the water chemistry program may not be effective in managing the aging effect of cracking due to PWSCC in SG divider plate assemblies. This is of particular concern for steam generators where the tube-tubesheet welds are considered structural welds and/or where the divider plate assembly contributes to the mechanical integrity of the tubesheet.*

   Although these SG divider plate cracks may not have a significant safety impact in and of themselves, these cracks could impact adjacent items, such as the tubesheet and the channel head, if they propagate to the boundary with these items. For the tubesheet, PWSCC cracks in the divider plate could propagate to the tubesheet cladding with possible consequences to the integrity of the tube/tubesheet welds. For the channel head, the PWSCC cracks in the divider plate could propagate to the SG triple point and potentially affect the pressure boundary of the SG channel head.

   The existing program relies on control of reactor water chemistry to mitigate cracking due to PWSCC. The GALL Report recommends that a plant-specific AMP be evaluated, along with the primary water chemistry program, because the existing primary water chemistry program may not be capable of mitigating cracking due to PWSCC. Acceptance criteria are described in Branch Technical Position RLSB-1.

   BBS will manage cracking of the nickel alloy steam generator divider plates exposed to reactor coolant in the Steam Generators as follows:

   The Byron and Braidwood Stations, Unit 1 replacement Babcock and Wilcox re-circulating feedring steam generators utilize a divider plate fabricated of Alloy 690 material. The tubesheet cladding is Alloy 600. The stub runner is a weld build up bar (Alloy 600, 82) and not a rolled bar. The primary head is fabricated from low carbon steel with stainless steel cladding. The divider plate is seal welded to the tubesheet and primary head with Alloy 690 weld material.

   The Byron and Braidwood Stations, Unit 2 original equipment Westinghouse Model D-5 pre-heater type steam generators utilize a divider plate fabricated of Alloy 600 material and installed with Alloy 600 weld material. The tubesheet cladding and divider plate stub runner are Alloy 600 material. The primary head is fabricated from low carbon steel with stainless steel cladding.

There is a concern regarding the effectiveness of the water chemistry control and potential cracking at the divider plate welds to the primary head and tubesheet cladding. BBS commits to perform one (1) of the following three (3) resolution options for Unit 1 and 2:

Option 1: Inspection
Perform a one-time inspection, under the Steam Generators (B.2.1.10) program, of each steam generator to assess the condition of the divider plate welds and the effectiveness of the Water Chemistry (B.2.1.2) program. For the Byron and Braidwood, Unit 1 steam generators which were replaced in 1998, the inspection will be performed between 2018 and the start of the period of extended operation to allow the steam generators to acquire at least twenty years of service. For the Unit 2 steam generators which currently have at least twenty years of service, the inspection will be performed prior to entering the period of extended operation. The examination technique(s) will be capable of detecting primary water stress corrosion cracking (PWSCC) in the divider plate assemblies and associated welds.

or

Option 2: Analysis
Perform an analytical evaluation of the steam generator divider plate welds in order to establish a technical basis which concludes that the steam generator reactor coolant pressure boundary is adequately maintained with the presence of steam generator divider plate weld cracking. The analytical evaluation will be submitted to the NRC for review and approval prior to entering associated period of extended operation.

or

Option 3: Industry/NRC Studies
If results of industry and NRC studies and operating experience document that potential failure of the steam generator reactor coolant pressure boundary due to PWSCC of the steam generator divider plate welds is not a credible concern, this commitment will be revised to reflect that conclusion.

2. *Cracking due to PWSCC could occur in steam generator nickel alloy tube-to-tubesheet welds exposed to reactor coolant. Unless the NRC has approved a redefinition of the pressure boundary in which the tube-to-tubesheet weld is no longer included, the effectiveness of the primary water chemistry program should be verified to ensure cracking is not occurring:*

   - *For plants with Alloy 600 steam generator tubes that have not been thermally treated and for which an alternate repair criteria such as C*, F* or W* has been permanently approved, the weld is no longer part of the pressure boundary and no plant specific aging management program is required;*
   - *For plants with Alloy 600 steam generator tubes that have not been thermally treated and for which there is no permanently approved alternate repair criteria such as C*, F* or W*, a plant-specific AMP is required;*

- *For plants with Alloy 600TT steam generator tubes and for which an alternate repair criteria such as H* has been permanently approved, the weld is no longer part of the pressure boundary and no plant specific aging management program is required;*
- *For plants with Alloy 600TT steam generator tubes and for which there is no alternate repair criteria such as H* permanently approved, a plant-specific AMP is required;*
- *For plants with Alloy 690TT steam generator tubes with Alloy 690 tubesheet cladding, the water chemistry is sufficient, and no further action or plant-specific aging management program is required;*
- *For plants with Alloy 690TT steam generator tubes and with Alloy 600 tubesheet cladding, either a plant-specific program or a rationale for why such a program is not needed is required.*

The existing program relies on control of reactor water chemistry to mitigate cracking due to PWSCC. The GALL Report recommends that a plant-specific AMP be evaluated, along with the primary water chemistry program, because the existing primary water chemistry program may not be capable of mitigating cracking due to PWSCC. Acceptance criteria are described in Branch Technical Position RLSB-1.

BBS will manage cracking of the nickel alloy tube-to-tubesheet welds exposed to reactor coolant in the Steam Generators as follows:

The Byron and Braidwood Stations, Unit 1 replacement Babcock and Wilcox re-circulating feedring steam generators utilize Alloy 690TT steam generator tubes with Alloy 600 tubesheet cladding. There is a concern regarding the effectiveness of the water chemistry control and the potential failure of the primary-to-secondary pressure boundary due to primary water stress corrosion cracking (PWSCC) of the tube-to-tubesheet welds. Byron and Braidwood Stations commit to perform one (1) of the following three (3) resolution options for Unit 1:

Option 1: Inspection
Perform a one-time inspection, under the Steam Generator (B.2.1.10) program, of a representative number of tube-to-tubesheet welds in each steam generator to determine if PWSCC cracking is present. For the Byron and Braidwood, Unit 1 steam generators which were replaced in 1998, the inspection will be performed between 2018 and the start of the period of extended operation to allow the steam generators to acquire at least twenty years of service. The examination technique(s) will be capable of detecting primary water stress corrosion cracking (PWSCC) in the tube-to-tubesheet welds. If cracking is identified, the condition will be resolved through repair or engineering evaluation to justify continued service, as appropriate, and a periodic monitoring program will be established to perform routine tube-to-tubesheet weld inspections for the remaining life of the steam generators.

or

Option 2: Analysis - Susceptibility
Perform an analytical evaluation of the steam generator tube-to-tubesheet welds to determine that the welds are not susceptible to primary water stress corrosion cracking. The evaluation for determining that the tube-to-tubesheet welds are not susceptible to primary water stress corrosion cracking will be submitted to the NRC for review and approval prior to entering the associated period of extended operation.

or

Option 3: Analysis – Pressure Boundary
Perform an analytical evaluation of the steam generator tube-to-tubesheet welds redefining the reactor coolant pressure boundary of the tubes, where the steam generator tube-to-tubesheet welds are not required to perform a reactor coolant pressure boundary function. The redefinition of the reactor coolant pressure boundary will be submitted to the NRC for review and approval prior to entering the associated period of extended operation.

The Byron and Braidwood Stations, Unit 2 original equipment Westinghouse Model D-5 pre-heater type steam generators utilize Alloy 600TT steam generator tubes with Alloy 600 tubesheet cladding. A license amendment (Adams Accession Number: ML12262A360), approved by the NRC, redefined the pressure boundary in which the tube-to-tubesheet weld is no longer included; therefore a plant specific program to verify the effectiveness of the Water Chemistry (B.2.1.2) program is not required. The Steam Generators (B.2.1.10) program is described in Appendix B.

3.1.2.2.12 Cracking due to Fatigue

EPRI 1016596, Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-Rev. 0) identifies cracking due to fatigue as an aging effect that can occur for the lower flange weld in the core support barrel assembly, fuel alignment plate in the upper internals assembly, and core support plate lower support structure in PWR internals designed by Combustion Engineering. The GALL Report recommends that inspection for cracking in this component be performed if acceptable fatigue life cannot be demonstrated by TLAA through the period of extended operation as defined in 10 CFR 54.3.

Item Number 3.1.1-26 is applicable to Combustion Engineering PWRs only and is not used for BBS which are Westinghouse PWRs.

3.1.2.2.13 Cracking due to Stress Corrosion Cracking and Fatigue

Cracking due to stress corrosion cracking and fatigue could occur in nickel alloy control rod guide tube assemblies, guide tube support pins exposed to reactor coolant, and neutron flux. The GALL Report, AMR Item IV.B2.RP-355, recommends further evaluation of a plant-specific AMP to ensure this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

Item Number 3.1.1-27 is not applicable to BBS. The control rod guide tube assemblies and guide tube support pins (split pins) at BBS are made of stainless steel.

3.1.2.2.14 Loss of Material due to Wear

Loss of material due to wear could occur in nickel alloy control rod guide tube assemblies, guide tube support pins and in Zircaloy-4 incore instrumentation lower thimble tubes exposed to reactor coolant, and neutron flux. The GALL Report, AMR Items IV.B2.RP-356 and IV.B3.RP-357, recommends further evaluation of a plant-specific AMP to ensure this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

Item Number 3.1.1-28 is not applicable to BBS. The control rod guide tube assemblies and guide tube support pins (split pins) at BBS are made of stainless steel. The BBS Westinghouse reactor vessel internals do not use Zircaloy-4 incore instrumentation lower thimble tubes.

3.1.2.2.15 Quality Assurance for Aging Management of Nonsafety-Related Components

QA provisions applicable to License Renewal are discussed in Section B.1.3.

3.1.2.3 Time-Limited Aging Analysis

The time-limited aging analyses identified below are associated with the Reactor Vessel, Internals, and Reactor Coolant System components:

- Section 4.2, Reactor Vessel Neutron Embrittlement Analysis
- Section 4.3, Metal Fatigue
- Section 4.7, Other Plant-Specific Time-Limited Aging Analyses

3.1.3 CONCLUSION

The Reactor Vessel, Internals, and Reactor Coolant System piping, fittings, and components that are subject to aging management review have been identified in accordance with the requirements of 10 CFR 54.4. The aging management programs selected to manage aging effects for the Reactor Vessel, Internals, and Reactor Coolant System components are identified in the summaries in Section 3.1.2.1 above.

A description of these aging management programs is provided in Appendix B, along with the demonstration that the identified aging effects will e managed for the period of extended operation.

Therefore, based on the conclusions provided in Appendix B, the effects of aging associated with the Reactor Vessel, Internals, and Reactor Coolant System components will be adequately managed so that there is reasonable assurance that the intended functions are maintained consistent with the current licensing basis during the period of extended operation.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-1	High strength, low-alloy steel top head closure stud assembly exposed to air with potential for reactor coolant leakage	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation (See SRP, Sec 4.3 "Metal Fatigue," for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA	Cumulative fatigue damage is an aging effect assessed by a fatigue TLAA. Further evaluation is documented in subsection 3.1.2.2.1.
3.1.1-2	Nickel alloy tubes and sleeves exposed to reactor coolant and secondary feedwater/steam	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation (See SRP, Sec 4.3 "Metal Fatigue," for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA	Cumulative fatigue damage is an aging effect assessed by a fatigue TLAA. Further evaluation is documented in subsection 3.1.2.2.1.
3.1.1-3	Stainless steel or nickel alloy reactor vessel internal components exposed to reactor coolant and neutron flux	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation (See SRP, Sec 4.3 "Metal Fatigue," for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA	Cumulative fatigue damage is an aging effect assessed by a fatigue TLAA. Further evaluation is documented in subsection 3.1.2.2.1.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-4	Steel pressure vessel support skirt and attachment welds	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation (See SRP, Sec 4.3 “Metal Fatigue,” for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA	Not Applicable. See subsection 3.1.2.2.1.
3.1.1-5	Steel, stainless steel, or steel (with stainless steel or nickel alloy cladding) steam generator components, pressurizer relief tank components or piping components or bolting	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation (See SRP, Sec 4.3 “Metal Fatigue,” for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA	Cumulative fatigue damage is an aging effect assessed by a fatigue TLAA. Further evaluation is documented in subsection 3.1.2.2.1.
3.1.1-6	BWR Only				
3.1.1-7	BWR Only				

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-8	Steel (with or without nickel-alloy or stainless steel cladding), or stainless steel; or nickel alloy steam generator components exposed to reactor coolant	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation, and for Class 1 components environmental effects on fatigue are to be addressed. (See SRP, Sec 4.3 "Metal Fatigue," for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA	Cumulative fatigue damage is an aging effect assessed by a fatigue TLAA. Further evaluation is documented in subsection 3.1.2.2.1.
3.1.1-9	Steel (with or without nickel-alloy or stainless steel cladding), stainless steel; nickel alloy RCPB piping; flanges; nozzles & safe ends; pressurizer shell heads & welds; heater sheaths & sleeves; penetrations; thermal sleeves exposed to reactor coolant	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation, and for Class 1 components environmental effects on fatigue are to be addressed. (See SRP, Sec 4.3 "Metal Fatigue," for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA	Cumulative fatigue damage is an aging effect assessed by a fatigue TLAA. Further evaluation is documented in subsection 3.1.2.2.1.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-10	Steel (with or without nickel-alloy or stainless steel cladding), stainless steel; nickel alloy reactor vessel flanges; nozzles; penetrations; pressure housings; safe ends; thermal sleeves; vessel shells, heads and welds exposed to reactor coolant	Cumulative fatigue damage due to fatigue	Fatigue is a TLAA evaluated for the period of extended operation, and for Class 1 components environmental effects on fatigue are to be addressed. (See SRP, Sec 4.3 “Metal Fatigue,” for acceptable methods to comply with 10 CFR 54.21(c)(1))	Yes, TLAA	Cumulative fatigue damage is an aging effect assessed by a fatigue TLAA. Further evaluation is documented in subsection 3.1.2.2.1.
3.1.1-11	BWR Only				
3.1.1-12	Steel steam generator components: upper and lower shells, transition cone; new transition cone closure weld exposed to secondary feedwater or steam	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” and Chapter XI.M2, “Water Chemistry," and, for Westinghouse Model 44 and 51 S/G, if corrosion of the shell is found, additional inspection procedures are developed	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program and Water Chemistry (B.2.1.2) program will be used to manage loss of material of steel steam generator components: shell, head, nozzles, safe ends, and welds exposed to steam and treated water. See subsection 3.1.2.2.2.1 and 3.1.2.2.2.2.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-13	Steel (with or without stainless steel cladding) reactor vessel beltline shell, nozzles, and welds exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA is to be evaluated in accordance with Appendix G of 10 CFR Part 50 and RG 1.99. The applicant may choose to demonstrate that the materials of the nozzles are not controlling for the TLAA evaluations	Yes, TLAA	Loss of fracture toughness of steel reactor vessel beltline shell, nozzles, and welds is a TLAA; further evaluation is documented in subsection 3.1.2.2.3.1.
3.1.1-14	Steel (with or without cladding) reactor vessel beltline shell, nozzles, and welds; safety injection nozzles	Loss of fracture toughness due to neutron irradiation embrittlement	Chapter XI.M31, “Reactor Vessel Surveillance”	Yes, plant specific or integrated surveillance program	Consistent with NUREG-1801. The Reactor Vessel Surveillance (B.2.1.19) program will be used to manage loss of fracture toughness of steel reactor vessel beltline shell, nozzles, and welds exposed to reactor coolant and neutron flux. See subsection 3.1.2.2.3.2.
3.1.1-15	Stainless steel and nickel alloy reactor vessel internal components exposed to reactor coolant and neutron flux	Reduction in ductility and fracture toughness due to neutron irradiation	Ductility - Reduction in Fracture Toughness is a TLAA to be evaluated for the period of extended operation. See the SRP, Section 4.7, "Other Plant-Specific TLAAs," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA	Not Applicable. See subsection 3.1.2.2.3.3.

Table 3.1.1	**Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System**				
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.1.1-16	BWR Only				
3.1.1-17	BWR Only				
3.1.1-18	Reactor vessel shell fabricated of SA508-Cl 2 forgings clad with stainless steel using a high-heat-input welding process exposed to reactor coolant	Crack growth due to cyclic loading	Growth of intergranular separations is a TLAA evaluated for the period of extended operation. The Standard Review Plan, Section 4.7, “Other Plant-Specific Time-Limited Aging Analysis,” provides guidance for meeting the requirements of 10 CFR 54.21(c).	Yes, TLAA	Not Applicable. See subsection 3.1.2.2.5.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-19	Stainless steel reactor vessel closure head flange leak detection line and bottom-mounted instrument guide tubes (external to reactor vessel)	Cracking due to stress corrosion cracking	A plant-specific aging management program is to be evaluated	Yes, plant-specific	The ASME XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program will be used to manage cracking in the stainless steel reactor vessel closure head flange leak detection lines exposed to reactor coolant. The ASME XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program and Water Chemistry (B.2.1.2) program will be used to manage cracking in the stainless steel bottom-mounted instrument guide tubes (external to bottom head) exposed to reactor coolant. See subsection 3.1.2.2.6.1.
3.1.1-20	Cast austenitic stainless steel Class 1 piping, piping components, and piping elements exposed to reactor coolant	Cracking due to stress corrosion cracking	Chapter XI.M2, "Water Chemistry" and, for CASS components that do not meet the NUREG-0313 guidelines, a plant specific aging management program	Yes, plant-specific	The ASME XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program and Water Chemistry (B.2.1.2) program will be used to manage cracking in the Class 1 reactor coolant pressure boundary cast austenitic stainless steel piping, piping components, and piping elements exposed to reactor coolant. See subsection 3.1.2.2.6.2.
3.1.1-21	BWR Only				

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.1.1-22	Steel steam generator feedwater impingement plate and support exposed to secondary feedwater	Loss of material due to erosion	A plant-specific aging management program is to be evaluated	Yes, plant-specific	Not Applicable. See subsection 3.1.2.2.8.
3.1.1-23	Stainless steel or nickel alloy PWR reactor vessel internal components (inaccessible locations) exposed to reactor coolant and neutron flux	Cracking due to stress corrosion cracking, and irradiation-assisted stress corrosion cracking	Chapter XI.M16A, “PWR Vessel Internals," and Chapter XI.M2, “Water Chemistry”	Yes, if accessible Primary, Expansion or Existing program components indicate aging effects that need management	Consistent with NUREG-1801 with exceptions. The PWR Vessel Internals (B.2.1.7) program and the Water Chemistry (B.2.1.2) program will be used to manage cracking in inaccessible stainless steel PWR reactor vessel internal components exposed to reactor coolant and neutron flux. Exceptions apply to the NUREG-1801 recommendations for PWR Vessel Internals (B.2.1.7) program implementation. See subsection 3.1.2.2.9.
3.1.1-24	Stainless steel or nickel alloy PWR reactor vessel internal components (inaccessible locations) exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; or changes in dimension due to void swelling; or loss of preload due to thermal and irradiation enhanced stress relaxation; or loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals”	Yes, if accessible Primary, Expansion or Existing program components indicate aging effects that need management	Consistent with NUREG-1801 with exceptions. The PWR Vessel Internals (B.2.1.7) program will be used to manage loss of fracture toughness, changes in dimension, loss of preload, and loss of material in inaccessible stainless steel PWR reactor vessel internal components exposed to reactor coolant and neutron flux. Exceptions apply to the NUREG-1801 recommendations for PWR Vessel Internals (B.2.1.7) program implementation. See subsection 3.1.2.2.10.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-25	Steel (with nickel-alloy cladding) or nickel alloy steam generator primary side components: divider plate and tube-to-tube sheet welds exposed to reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M2, “Water Chemistry”	Yes, plant-specific	Consistent with NUREG-1801. The Water Chemistry (B.2.1.2) program and Steam Generators (B.2.1.10) program will be used to manage cracking of nickel alloy steam generator divider plates and tube-to-tubesheet welds exposed to reactor coolant. See subsections 3.1.2.2.11.1 and 3.1.2.2.11.2.
3.1.1-26	Stainless steel Combustion Engineering core support barrel assembly: lower flange weld exposed to reactor coolant and neutron flux; Upper internals assembly: fuel alignment plate (applicable to plants with core shrouds assembled with full height shroud plates) exposed to reactor coolant and neutron flux; Lower support structure: core support plate (applicable to plants with a core support plate) exposed to reactor coolant and neutron flux	Cracking due to fatigue	Chapter XI.M16A, “PWR Vessel Internals," and Chapter XI.M2, “Water Chemistry,” if fatigue life cannot be confirmed by TLAA	Yes, evaluate to determine the potential locations and extent of fatigue cracking	Not Applicable. See subsection 3.1.2.2.12.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-27	Nickel alloy Westinghouse control rod guide tube assemblies, guide tube support pins exposed to reactor coolant and neutron flux	Cracking due to stress corrosion cracking and fatigue	A plant-specific aging management program is to be evaluated	Yes, plant-specific	Not Applicable. See subsection 3.1.2.2.13.
3.1.1-28	Nickel alloy Westinghouse control rod guide tube assemblies, guide tube support pins, and Zircaloy-4 Combustion Engineering incore instrumentation thimble tubes exposed to reactor coolant and neutron flux	Loss of material due to wear	A plant-specific aging management program is to be evaluated	Yes, plant-specific	Not Applicable. See subsection 3.1.2.2.14.
3.1.1-29	BWR Only				
3.1.1-30	BWR Only				
3.1.1-31	BWR Only				

Table 3.1.1	**Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System**				
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.1.1-32	Stainless steel, nickel alloy, or CASS reactor vessel internals, core support structure, exposed to reactor coolant and neutron flux	Cracking, or loss of material due to wear	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program will be used to manage cracking and loss of material of nickel alloy and stainless steel reactor vessel, nozzles, thermal sleeves, and reactor vessel internals core support structure components exposed to reactor coolant and reactor coolant and neutron flux in the Reactor Vessel and Reactor Vessel Internals.
3.1.1-33	Stainless steel, steel with stainless steel cladding Class 1 reactor coolant pressure boundary components exposed to reactor coolant	Cracking due to stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for ASME components, and Chapter XI.M2, "Water Chemistry"	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of steel with stainless steel cladding, cast austenitic stainless steel, and stainless steel Class 1 reactor coolant pressure boundary components exposed to reactor coolant in the Reactor Coolant System, Reactor Vessel, and Steam Generators.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-34	Stainless steel, steel with stainless steel cladding pressurizer relief tank (tank shell and heads, flanges, nozzles) exposed to treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for ASME components, and Chapter XI.M2, "Water Chemistry"	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of stainless steel piping, piping components, and piping elements exposed to treated borated water >140°F in the Reactor Vessel.
3.1.1-35	Stainless steel, steel with stainless steel cladding reactor coolant system cold leg, hot leg, surge line, and spray line piping and fittings exposed to reactor coolant	Cracking due to cyclic loading	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program will be used to manage cracking of Class 1 cast austenitic stainless steel and stainless steel hot leg, intermediate leg, and cold leg piping exposed to reactor coolant in the Reactor Coolant System.
3.1.1-36	Steel, stainless steel pressurizer integral support exposed to air with metal temperature up to 288°C (550°F)	Cracking due to cyclic loading	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program will be used to manage cracking of steel pressurizer integral support exposed to air with borated water leakage in the Reactor Coolant System.
3.1.1-37	Steel reactor vessel flange	Loss of material due to wear	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program will be used to manage loss of material of steel reactor vessel head flange in the Reactor Vessel.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-38	Cast austenitic stainless steel Class 1 pump casings, and valve bodies and bonnets exposed to reactor coolant >250 deg-C (>482 deg-F)	Loss of fracture toughness due to thermal aging embrittlement	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components. For pump casings and valve bodies, screening for susceptibility to thermal aging is not necessary.	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program will be used to manage loss of fracture toughness of cast austenitic stainless steel Class 1 pump casings and valve bodies exposed to reactor coolant in the Reactor Coolant System and Steam Generators.
3.1.1-39	Steel, stainless steel, or steel with stainless steel cladding Class 1 piping, fittings and branch connections < NPS 4 exposed to reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking (for stainless steel only), and thermal, mechanical, and vibratory loading	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, Chapter XI.M2, "Water Chemistry," and XI.M35, "One-Time Inspection of ASME Code Class 1 Small-bore Piping"	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1), One-Time Inspection of ASME Code Class 1 Small Bore-Piping (B.2.1.22), and Water Chemistry (B.2.1.2) program will be used to manage cracking of stainless steel Class 1 piping, fittings and branch connections < NPS 4" exposed to reactor coolant in the Reactor Coolant System, Reactor Vessel, and Steam Generators.
3.1.1-40	Steel with stainless steel or nickel alloy cladding; or stainless steel pressurizer components exposed to reactor coolant	Cracking due to cyclic loading	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry"	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of steel with stainless steel cladding pressurizer components exposed to reactor coolant in the Reactor Coolant System.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.1.1-40x	Nickel alloy core support pads; core guide lugs exposed to reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry"	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of nickel alloy reactor vessel (core support pads) exposed to reactor coolant in the Reactor Vessel.
3.1.1-41	BWR Only				
3.1.1-42	Steel with stainless steel or nickel alloy cladding or stainless steel primary side components; steam generator upper and lower heads, and tube sheet weld; or pressurizer components exposed to reactor coolant	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry"	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of steel with stainless steel cladding and stainless steel pressurizer, pressurizer components, and welds exposed to reactor coolant in the Reactor Coolant System.
3.1.1-43	BWR Only				

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.1.1-44	Steel steam generator secondary manways and handholds (cover only) exposed to air with leaking secondary-side water and/or steam	Loss of material due to erosion	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 2 components	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program will be used to manage loss of material of steel steam generator manway and handhole covers exposed to air with borated water leakage in the Steam Generators.
3.1.1-45	Nickel alloy and steel with nickel-alloy cladding reactor coolant pressure boundary components exposed to reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M1, "ASME Section XI ISI, IWB, IWC & IWD," and Chapter XI.M2, "Water Chemistry," and, for nickel-alloy, Chapter XI.M11B, "Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-induced Corrosion in RCPB Components (PWRs Only)"	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program, Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5) program, and Water Chemistry (B.2.1.2) program will be used to manage cracking of nickel alloy reactor coolant pressure boundary components exposed to reactor coolant in the Reactor Coolant System, Reactor Vessel, and Steam Generators.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-46	Stainless steel, nickel-alloy, nickel-alloy welds and/or buttering control rod drive head penetration pressure housing or nozzles safe ends and welds (inlet, outlet, safety injection) exposed to reactor coolant	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	Chapter XI.M1, "ASME Section XI ISI, IWB, IWC & IWD," and Chapter XI.M2, "Water Chemistry," and, for nickel-alloy, Chapter XI.M11B, "Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-induced corrosion in RCPB Components (PWRs Only)"	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1), Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5), and Water Chemistry (B.2.1.2) program will be used to manage cracking of nickel alloy and stainless steel reactor vessel, nozzles, nozzle safe ends, nozzle thermal sleeves, and welds exposed to reactor coolant and reactor coolant and neutron flux in the Reactor Vessel.
3.1.1-47	Stainless steel, nickel-alloy control rod drive head penetration pressure housing exposed to reactor coolant	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	Chapter XI.M1, "ASME Section XI ISI, IWB, IWC & IWD," and Chapter XI.M2, "Water Chemistry"	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of cast austenitic stainless steel and stainless steel control rod assemblies and pressure housings exposed to reactor coolant in the Reactor Coolant System and Reactor Vessel.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.1.1-48	Steel external surfaces: reactor vessel top head, reactor vessel bottom head, reactor coolant pressure boundary piping or components adjacent to dissimilar metal (Alloy 82/182) welds exposed to air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion," and Chapter XI.M11B, "Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)"	No	Consistent with NUREG-1801. The Boric Acid Corrosion (B.2.1.4) program and Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5) program will be used to manage loss of material of steel external surfaces of reactor vessel head and flange and lower head exposed to air with borated water leakage in the Reactor Vessel.
3.1.1-49	Steel reactor coolant pressure boundary external surfaces or closure bolting exposed to air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No	Consistent with NUREG-1801. The Boric Acid Corrosion (B.2.1.4) program will be used to manage loss of material of steel closure bolting, equipment supports, heat exchanger components, piping, piping components, piping elements, pressurizer components, steam generator components, and tanks exposed to air with borated water leakage in the Reactor Coolant System, Reactor Vessel, and Steam Generators.
3.1.1-50	Cast austenitic stainless steel Class 1 piping, piping component, and piping elements and control rod drive pressure housings exposed to reactor coolant >250 deg-C (>482 deg-F)	Loss of fracture toughness due to thermal aging embrittlement	Chapter XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No	Consistent with NUREG-1801. The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (B.2.1.6) program will be used to manage loss of fracture toughness of the cast austenitic stainless steel control rod assembly and reactor coolant pressure boundary components exposed to reactor coolant > 482°F in the Reactor Coolant System and Reactor Vessel.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-51	Stainless steel or nickel-alloy Babcock & Wilcox reactor internal components exposed to reactor coolant and neutron flux	Cracking due to stress corrosion cracking, irradiation-assisted stress corrosion cracking, or fatigue	Chapter XI.M16A, “PWR Vessel Internals," and Chapter XI.M2, “Water Chemistry”	No	Not Applicable. Babcock and Wilcox PWR Only.
3.1.1-52	Stainless steel or nickel-alloy Combustion Engineering reactor internal components exposed to reactor coolant and neutron flux	Cracking due to stress corrosion cracking, irradiation-assisted stress corrosion cracking, or fatigue	Chapter XI.M16A, “PWR Vessel Internals," and Chapter XI.M2, “Water Chemistry”	No	Not Applicable. Combustion Engineering PWR Only.
3.1.1-53	Stainless steel or nickel-alloy Westinghouse reactor internal components exposed to reactor coolant and neutron flux	Cracking due to stress corrosion cracking, irradiation-assisted stress corrosion cracking, or fatigue	Chapter XI.M16A, “PWR Vessel Internals," and Chapter XI.M2, “Water Chemistry”	No	Consistent with NUREG-1801 with exceptions. The PWR Vessel Internals (B.2.1.7) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of nickel alloy and stainless steel bolting, reactor vessel internals components, and bottom mounted instrument system flux thimble tubes exposed to reactor coolant and reactor coolant and neutron flux in the Reactor Coolant System and Reactor Vessel Internals. Exceptions apply to the NUREG-1801 recommendations for PWR Vessel Internals (B.2.1.7) program implementation.

Table 3.1.1	**Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System**				
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.1.1-54	Stainless steel bottom mounted instrument system flux thimble tubes (with or without chrome plating) exposed to reactor coolant and neutron flux	Loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals,” and Chapter XI.M37, "Flux Thimble Tube Inspection"	No	Consistent with NUREG-1801 with exceptions. The Flux Thimble Tube Inspection (B.2.1.24) program and PWR Vessel Internals (B.2.1.7) program will be used to manage loss of material of stainless steel bottom mounted instrument system flux thimble tubes exposed to reactor coolant and neutron flux in the Reactor Coolant System. Exceptions apply to the NUREG-1801 recommendations for PWR Vessel Internals (B.2.1.7) program implementation.
3.1.1-55	Stainless steel thermal shield assembly, thermal shield flexures exposed to reactor coolant and neutron flux	Cracking due to fatigue; Loss of material due to wear	Chapter XI.M16A, “PWR Vessel Internals”	No	Not Applicable. There are no stainless steel thermal shield assemblies or thermal shield flexures exposed to reactor coolant and neutron flux in Reactor Vessel, Internals, and Reactor Coolant System. BBS reactor vessel internals utilize neutron pads that are bolted to the core barrel.

Table 3.1.1	**Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System**				
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.1.1-56	Stainless steel or nickel-alloy Combustion Engineering reactor internal components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; or changes in dimension due to void swelling; or loss of preload due to thermal and irradiation enhanced stress relaxation; or loss of material due to wear	Chapter XI.M16A, "PWR Vessel Internals"	No	Not Applicable. Combustion Engineering PWR Only.
3.1.1-58	Stainless steel or nickel-alloy Babcock & Wilcox reactor internal components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; or changes in dimension due to void swelling; or loss of preload due to thermal and irradiation enhanced stress relaxation; or loss of material due to wear	Chapter XI.M16A, "PWR Vessel Internals"	No	Not Applicable. Babcock and Wilcox PWR Only.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-59	Stainless steel or nickel-alloy Westinghouse reactor internal components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement; or changes in dimension due to void swelling; or loss of preload due to thermal and irradiation enhanced stress relaxation; or loss of material due to wear	Chapter XI.M16A, "PWR Vessel Internals"	No	Consistent with NUREG-1801 with exceptions. The PWR Vessel Internals (B.2.1.7) program will be used to manage change in dimension, loss of fracture toughness, loss of material, and loss of preload of nickel alloy and stainless steel reactor vessel internals components exposed to reactor coolant and reactor coolant and neutron flux in the Reactor Vessel Internals. Exceptions apply to the NUREG-1801 recommendations for PWR Vessel Internals (B.2.1.7) program implementation.
3.1.1-60	BWR Only				
3.1.1-61	Steel steam generator steam nozzle and safe end, feedwater nozzle and safe end, AFW nozzles and safe ends exposed to secondary feedwater/steam	Wall thinning due to flow-accelerated corrosion	Chapter XI.M17, "Flow-Accelerated Corrosion"	No	Consistent with NUREG-1801. The Flow-Accelerated Corrosion (B.2.1.8) program will be used to manage wall thinning of steel feedwater nozzles and safe ends exposed to treated water in the Steam Generators.
3.1.1-62	High-strength, low alloy steel, or stainless steel closure bolting; stainless steel control rod drive head penetration flange bolting exposed to air with reactor coolant leakage	Cracking due to stress corrosion cracking	Chapter XI.M18, "Bolting Integrity"	No	Consistent with NUREG-1801. The Bolting Integrity (B.2.1.9) program will be used to manage cracking of stainless steel bolting exposed to air with borated water leakage in the Steam Generators.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-63	BWR Only				
3.1.1-64	Steel closure bolting exposed to air – indoor uncontrolled	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M18, "Bolting Integrity"	No	Consistent with NUREG-1801. The Bolting Integrity (B.2.1.9) program will be used to manage loss of material of steel bolting exposed to air with borated water leakage in the Reactor Coolant System, Reactor Vessel, and Steam Generators.
3.1.1-65	Stainless steel control rod drive head penetration flange bolting exposed to air with reactor coolant leakage	Loss of material due to wear	Chapter XI.M18, "Bolting Integrity"	No	Not Applicable. There is no stainless steel control rod drive head penetration flange bolting exposed to air with reactor coolant leakage in Reactor Vessel, Internals, and Reactor Coolant System. BBS utilizes stainless steel control rod drive head penetration flanges that are seal welded instead of bolted.
3.1.1-66	High-strength, low alloy steel, or stainless steel closure bolting; stainless steel control rod drive head penetration flange bolting exposed to air with reactor coolant leakage	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No	Consistent with NUREG-1801. The Bolting Integrity (B.2.1.9) program will be used to manage loss of preload of steel and stainless steel bolting exposed to air with borated water leakage in the Reactor Coolant System and Reactor Vessel.

Table 3.1.1	**Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System**				
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.1.1-67	Steel or stainless steel closure bolting exposed to air – indoor with potential for reactor coolant leakage	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No	Consistent with NUREG-1801. The Bolting Integrity (B.2.1.9) program will be used to manage loss of preload of steel and stainless steel bolting exposed to air with borated water leakage in the Steam Generators.
3.1.1-68	Nickel alloy steam generator tubes exposed to secondary feedwater or steam	Changes in dimension ("denting") due to corrosion of carbon steel tube support plate	Chapter XI.M19, "Steam Generators," and Chapter XI.M2, "Water Chemistry"	No	Not Applicable. There are no carbon steel tube support plates that are in contact with the nickel alloy steam generator tubes exposed to secondary feedwater or steam in Reactor Vessel, Internals, and Reactor Coolant System.
3.1.1-69	Nickel alloy steam generator tubes and sleeves exposed to secondary feedwater or steam	Cracking due to outer diameter stress corrosion cracking and intergranular attack	Chapter XI.M19, "Steam Generators," and Chapter XI.M2, "Water Chemistry"	No	Consistent with NUREG-1801 with exceptions. The Steam Generators (B.2.1.10) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of nickel alloy steam generator tubes exposed to treated water in the Steam Generators. Exceptions apply to the NUREG-1801 recommendations for Steam Generators (B.2.1.10) program implementation.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-70	Nickel alloy steam generator tubes, repair sleeves, and tube plugs exposed to reactor coolant	Cracking due to primary water stress corrosion cracking	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No	Consistent with NUREG-1801 with exceptions. The Steam Generators (B.2.1.10) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of steel with nickel alloy cladding and nickel alloy steam generator tube plugs, tube sheet, and tubes exposed to reactor coolant in the Steam Generators. Exceptions apply to the NUREG-1801 recommendations for Steam Generators (B.2.1.10) program implementation.
3.1.1-71	Steel, chrome plated steel, stainless steel, nickel alloy steam generator U-bend supports including anti-vibration bars exposed to secondary feedwater or steam	Cracking due to stress corrosion cracking or other mechanism(s); loss of material due general (steel only), pitting, and crevice corrosion	Chapter XI.M19, “Steam Generators,” and Chapter XI.M2, “Water Chemistry”	No	Consistent with NUREG-1801 with exceptions. The Steam Generators (B.2.1.10) program and Water Chemistry (B.2.1.2) program will be used to manage cracking and loss of material of steel, cast austenitic stainless steel, nickel alloy, and stainless steel steam generator components including feedwater ring and J-tubes, impingement plate, preheater baffles, internal supports and structures, tube support plates, U-bend supports, and steam generator tubes exposed to treated water in the Steam Generators. Exceptions apply to the NUREG-1801 recommendations for Steam Generators (B.2.1.10) program implementation.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-72	Steel steam generator tube support plate, tube bundle wrapper, supports and mounting hardware exposed to secondary feedwater or steam	Loss of material due to erosion, general, pitting, and crevice corrosion, ligament cracking due to corrosion	Chapter XI.M19, "Steam Generators," and Chapter XI.M2, "Water Chemistry"	No	Consistent with NUREG-1801 with exceptions. The Steam Generators (B.2.1.10) program and Water Chemistry (B.2.1.2) program will be used to manage loss of material of steel steam generator moisture separator components, tube bundle wrapper, and tube sheets exposed to treated water in the Steam Generators. Exceptions apply to the NUREG-1801 recommendations for Steam Generators (B.2.1.10) program implementation.
3.1.1-73	Nickel alloy steam generator tubes and sleeves exposed to phosphate chemistry in secondary feedwater or steam	Loss of material due to wastage and pitting corrosion	Chapter XI.M19, "Steam Generators," and Chapter XI.M2, "Water Chemistry"	No	Not Applicable. There are no nickel alloy steam generator tubes or sleeves exposed to phosphate chemistry in secondary feedwater or steam in Reactor Vessel, Internals, and Reactor Coolant System.
3.1.1-74	Steel steam generator upper assembly and separators including feedwater inlet ring and support exposed to secondary feedwater or steam	Wall thinning due to flow-accelerated corrosion	Chapter XI.M19, "Steam Generators," and Chapter XI.M2, "Water Chemistry"	No	Consistent with NUREG-1801 with exceptions. The Steam Generators (B.2.1.10) program and Water Chemistry (B.2.1.2) program will be used to manage wall thinning of steel steam generator moisture separator components exposed to treated water in the Steam Generators. Exceptions apply to the NUREG-1801 recommendations for Steam Generators (B.2.1.10) program implementation.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-75	Steel steam generator tube support lattice bars exposed to secondary feedwater or steam	Wall thinning due to flow-accelerated corrosion and general corrosion	Chapter XI.M19, "Steam Generators," and Chapter XI.M2, "Water Chemistry"	No	Not Applicable. There are no steel steam generator tube support lattice bars exposed to secondary feedwater or steam in Reactor Vessel, Internals, and Reactor Coolant System.
3.1.1-76	Steel, chrome plated steel, stainless steel, nickel alloy steam generator U-bend supports including anti-vibration bars exposed to secondary feedwater or steam	Loss of material due to fretting	Chapter XI.M19, "Steam Generators"	No	Consistent with NUREG-1801 with exceptions. The Steam Generators (B.2.1.10) program will be used to manage loss of material of steel, cast austenitic stainless steel, stainless steel, and nickel alloy steam generator internal supports, tube support plates, and U-bend supports exposed to treated water in the Steam Generators. Exceptions apply to the NUREG-1801 recommendations for Steam Generators (B.2.1.10) program implementation.
3.1.1-77	Nickel alloy steam generator tubes and sleeves exposed to secondary feedwater or steam	Loss of material due to wear and fretting	Chapter XI.M19, "Steam Generators"	No	Consistent with NUREG-1801 with exceptions. The Steam Generators (B.2.1.10) program will be used to manage loss of material of nickel alloy steam generator tubes exposed to treated water in the Steam Generators. Exceptions apply to the NUREG-1801 recommendations for Steam Generators (B.2.1.10) program implementation.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-78	Nickel alloy steam generator components such as, secondary side nozzles (vent, drain, and instrumentation) exposed to secondary feedwater or steam	Cracking due to stress corrosion cracking	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection," or Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD."	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of nickel alloy steam generator components, flow devices, nozzle thermal sleeves, and secondary side manway and handhole covers exposed to steam and treated water in the Main Steam System and Steam Generators.
3.1.1-79	BWR Only				
3.1.1-80	Stainless steel or steel with stainless steel cladding pressurizer relief tank: tank shell and heads, flanges, nozzles (none-ASME Section XI components) exposed to treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of stainless steel piping, piping components, and piping elements exposed to reactor coolant and treated borated water >140°F in the Reactor Coolant System, Reactor Vessel, and Steam Generators.
3.1.1-81	Stainless steel pressurizer spray head exposed to reactor coolant	Cracking due to stress corrosion cracking	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of stainless steel heat exchanger components exposed to reactor coolant in the Reactor Coolant System.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-82	Nickel alloy pressurizer spray head exposed to reactor coolant	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No	Not Applicable. There are no nickel alloy pressurizer spray heads exposed to reactor coolant in Reactor Vessel, Internals, and Reactor Coolant System.
3.1.1-83	Steel steam generator shell assembly exposed to secondary feedwater or steam	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage loss of material of steel piping, steam generator secondary side instrument nozzles, and manway and handhole covers exposed to treated water in the Steam Generators.
3.1.1-84	BWR Only				
3.1.1-85	BWR Only				
3.1.1-86	Stainless steel steam generator primary side divider plate exposed to reactor coolant	Cracking due to stress corrosion cracking	Chapter XI.M2, "Water Chemistry"	No	Not Applicable. There are no stainless steel steam generator primary side divider plates exposed to reactor coolant in Reactor Vessel, Internals, and Reactor Coolant System.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.1.1-87	Stainless steel or nickel-alloy PWR reactor internal components exposed to reactor coolant and neutron flux	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry”	No	Consistent with NUREG-1801. The Water Chemistry (B.2.1.2) program will be used to manage loss of material of nickel alloy and stainless steel bolting and reactor vessel internals components exposed to reactor coolant and reactor coolant and neutron flux in the Reactor Coolant System and Reactor Vessel Internals.
3.1.1-88	Stainless steel; steel with nickel-alloy or stainless steel cladding; and nickel-alloy reactor coolant pressure boundary components exposed to reactor coolant	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry”	No	Consistent with NUREG-1801. The Water Chemistry (B.2.1.2) program will be used to manage loss of material of nickel alloy and stainless steel reactor coolant pressure boundary components exposed to reactor coolant and reactor coolant and neutron flux in the Reactor Coolant System, Reactor Vessel, and Steam Generators.
3.1.1-89	Steel piping, piping components, and piping elements exposed to closed cycle cooling water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No	Consistent with NUREG-1801. The Closed Treated Water Systems (B.2.1.12) program will be used to manage loss of material of steel heat exchanger components exposed to closed cycle cooling water in the Reactor Coolant System.
3.1.1-90	Copper alloy piping, piping components, and piping elements exposed to closed cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No	Consistent with NUREG-1801. The Closed Treated Water Systems (B.2.1.12) program will be used to manage loss of material of copper alloy heat exchanger components exposed to closed cycle cooling water in the Reactor Coolant System.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-91	BWR Only				
3.1.1-92	High-strength low alloy steel closure head stud assembly exposed to air with potential for reactor coolant leakage	Cracking due to stress corrosion cracking; loss of material due to general, pitting, and crevice corrosion, or wear (PWR)	Chapter XI.M3, "Reactor Head Closure Stud Bolting"	No	Consistent with NUREG-1801 with exceptions. The Reactor Head Closure Stud Bolting (B.2.1.3) program will be used to manage cracking and loss of material of high strength low alloy steel bolting exposed to air with borated water leakage in the Reactor Vessel. Exceptions apply to the NUREG-1801 recommendations for Reactor Head Closure Stud Bolting (B.2.1.3) program implementation.
3.1.1-93	Copper alloy >15% Zn or > 8% Al piping, piping components, and piping elements exposed to closed cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, "Selective Leaching "	No	Not Applicable. There are no copper alloy greater than 15% zinc or greater than 8% aluminum piping, piping components, and piping elements exposed to closed cycle cooling water in Reactor Vessel, Internals, and Reactor Coolant System.
3.1.1-94	BWR Only				
3.1.1-95	BWR Only				
3.1.1-96	BWR Only				

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-97	BWR Only				
3.1.1-98	BWR Only				
3.1.1-99	BWR Only				
3.1.1-100	BWR Only				
3.1.1-101	BWR Only				
3.1.1-102	BWR Only				
3.1.1-103	BWR Only				
3.1.1-104	BWR Only				

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-105	Steel piping, piping components and piping element exposed to concrete	None	None, provided 1) attributes of the concrete are consistent with ACI 318 or ACI 349 (low water-to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG-1557, and 2) plant OE indicates no degradation of the concrete	No, if conditions are met.	Not Applicable. There are no steel piping, piping components, and piping elements exposed to concrete in Reactor Vessel, Internals, and Reactor Coolant System.
3.1.1-106	Nickel alloy piping, piping components and piping element exposed to air – indoor, uncontrolled, or air with borated water leakage	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.
3.1.1-107	Stainless steel piping, piping components and piping element exposed to gas, concrete, air with borated water leakage, air – indoors, uncontrolled	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.

Table 3.1.2-1
Reactor Coolant System
Summary of Aging Management Evaluation

Table 3.1.2-1 Reactor Coolant System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Accumulator	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.D.A-80	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.A-26	3.3.1-55	B
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.RP-167	3.1.1-49	A
					Bolting Integrity (B.2.1.9)	IV.C2.RP-166	3.1.1-64	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	IV.C2.R-12	3.1.1-66	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	V.E.EP-70	3.2.1-13	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	IV.C2.R-12	3.1.1-66	A
Bolting (Class 1)	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.RP-167	3.1.1-49	A
					Bolting Integrity (B.2.1.9)	IV.C2.RP-166	3.1.1-64	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	IV.C2.R-12	3.1.1-66	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1
				Loss of Material	Bolting Integrity (B.2.1.9)	V.E.EP-70	3.2.1-13	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	IV.C2.R-12	3.1.1-66	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bottom mounted instrument system: flux thimble tubes	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant and Neutron Flux	Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-301	3.1.1-53	D
					Water Chemistry (B.2.1.2)	IV.B2.RP-301	3.1.1-53	C
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
					Flux Thimble Tube Inspection (B.2.1.24)	IV.B2.RP-284	3.1.1-54	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-284	3.1.1-54	B
Bottom-mounted instrument guide tube (external to bottom head)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.RP-154	3.1.1-19	E, 2
					Water Chemistry (B.2.1.2)	IV.A2.RP-154	3.1.1-19	E, 2
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.RP-235	3.1.1-39	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Reactor Coolant	Cracking	One-Time Inspection of ASME Code Class 1 Small Bore-Piping (B.2.1.22)	IV.C2.RP-235	3.1.1-39	A
					Water Chemistry (B.2.1.2)	IV.C2.RP-235	3.1.1-39	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Equipment supports and foundations (RCP Motor Stand)	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
Filter Housing (PORV Air Filter - Byron Unit 1, Byron Unit 2, and Braidwood Unit 2 only)	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.A-26	3.3.1-55	A
Filter Housing (Reactor Coolant Pump Motor Oil Lift Component)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.A.EP-77	3.2.1-49	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Filter Housing (Reactor Coolant Pump Motor Oil Lift Component)	Leakage Boundary	Carbon Steel	Lubricating Oil (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-77	3.2.1-49	A
Heat Exchanger - (Reactor Coolant Pump Motor Lower Bearing Cooling Coil) Tubes	Pressure Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	IV.C2.RP-222	3.1.1-90	C
			Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.A.EP-76	3.2.1-50	C
					One-Time Inspection (B.2.1.20)	V.A.EP-76	3.2.1-50	C
Heat Exchanger - (Reactor Coolant Pump Motor Upper Bearing Oil Cooler) Shell Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-131	3.3.1-98	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-131	3.3.1-98	A
Heat Exchanger - (Reactor Coolant Pump Motor Upper Bearing Oil Cooler) Tube Sheet	Pressure Boundary	Carbon Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	IV.C2.RP-221	3.1.1-89	C
			Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-131	3.3.1-98	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-131	3.3.1-98	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Reactor Coolant Pump Motor Upper Bearing Oil Cooler) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	IV.C2.RP-221	3.1.1-89	C
Heat Exchanger - (Reactor Coolant Pump Motor Upper Bearing Oil Cooler) Tubes	Pressure Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	IV.C2.RP-222	3.1.1-90	C
			Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.A.EP-76	3.2.1-50	C
					One-Time Inspection (B.2.1.20)	V.A.EP-76	3.2.1-50	C
Heat Exchanger - (Reactor Coolant Pump Thermal Barrier, Class 1) Tubes	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	V.A.EP-93	3.2.1-31	A
			Reactor Coolant	Cracking	One-Time Inspection (B.2.1.20)	IV.C2.RP-41	3.1.1-81	C
					Water Chemistry (B.2.1.2)	IV.C2.RP-41	3.1.1-81	C
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	C, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	C
Nozzle Thermal Sleeves (Pressurizer)	Direct Flow	Stainless Steel	Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-25	3.1.1-42	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Nozzle Thermal Sleeves (Pressurizer)	Direct Flow	Stainless Steel	Reactor Coolant	Cracking	Water Chemistry (B.2.1.2)	IV.C2.R-25	3.1.1-42	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Nozzle Thermal Sleeves (Reactor Vessel Level Instrumentation System)	Direct Flow	Stainless Steel	Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-30	3.1.1-33	C
					Water Chemistry (B.2.1.2)	IV.C2.R-30	3.1.1-33	C
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Piping Element	Leakage Boundary	Glass	Air with Borated Water Leakage (External)	None	None	V.F.EP-65	3.2.1-60	A
			Lubricating Oil (Internal)	None	None	V.F.EP-16	3.2.1-60	A
			Treated Borated Water (Internal)	None	None	V.F.EP-30	3.2.1-60	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.A.EP-77	3.2.1-49	A
					One-Time Inspection (B.2.1.20)	V.A.EP-77	3.2.1-49	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Stainless Steel	Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	IV.C2.RP-383	3.1.1-80	C
					Water Chemistry (B.2.1.2)	IV.C2.RP-383	3.1.1-80	C
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.C.EP-63	3.2.1-18	A
					Water Chemistry (B.2.1.2)	V.C.EP-63	3.2.1-18	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.A-26	3.3.1-55	B
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.EP-81	3.2.1-48	A
			Reactor Coolant	Cracking	One-Time Inspection (B.2.1.20)	IV.C2.RP-383	3.1.1-80	C
					Water Chemistry (B.2.1.2)	IV.C2.RP-383	3.1.1-80	C

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Stainless Steel	Reactor Coolant	Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.C.EP-63	3.2.1-18	A
					Water Chemistry (B.2.1.2)	V.C.EP-63	3.2.1-18	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Air/Gas - Dry (Internal)	None	None	V.F.EP-7	3.2.1-64	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.A-26	3.3.1-55	B
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Air/Gas - Dry (Internal)	None	None	IV.E.RP-07	3.1.1-107	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.EP-81	3.2.1-48	A
Pressure Housings (Class 1)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.RP-55	3.1.1-47	A
					Water Chemistry (B.2.1.2)	IV.A2.RP-55	3.1.1-47	A
				Cumulative Fatigue Damage	TLAA	IV.A2.R-219	3.1.1-10	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.A2.RP-28	3.1.1-88	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pressurizer (Class 1)	Pressure Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A, 3
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-58	3.1.1-40	A
					Water Chemistry (B.2.1.2)	IV.C2.R-58	3.1.1-40	A
					ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-25	3.1.1-42	A
					Water Chemistry (B.2.1.2)	IV.C2.R-25	3.1.1-42	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Pressurizer (integral support - skirt)	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-19	3.1.1-36	A
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
Pressurizer instrumentation penetrations, heater sheaths and sleeves, heater bundle diaphragm plate, and manways and flanges (Class 1)	Pressure Boundary	Low Alloy Steel	Air with Borated Water Leakage (External)	Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pressurizer instrumentation penetrations, heater sheaths and sleeves, heater bundle diaphragm plate, and manways and flanges (Class 1)	Pressure Boundary	Low Alloy Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A, 3
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-217	3.1.1-33	C
					Water Chemistry (B.2.1.2)	IV.C2.R-217	3.1.1-33	C
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Pressurizer surge and steam space nozzles, and welds (Class 1)	Pressure Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A, 3
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.RP-344	3.1.1-33	A
					Water Chemistry (B.2.1.2)	IV.C2.RP-344	3.1.1-33	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
		Nickel Alloy	Air with Borated Water Leakage (External)	None	None	IV.E.RP-378	3.1.1-106	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pressurizer surge and steam space nozzles, and welds (Class 1)	Pressure Boundary	Nickel Alloy	Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.RP-156	3.1.1-45	A
					Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5)	IV.C2.RP-156	3.1.1-45	A
					Water Chemistry (B.2.1.2)	IV.C2.RP-156	3.1.1-45	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-25	3.1.1-42	A
					Water Chemistry (B.2.1.2)	IV.C2.R-25	3.1.1-42	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Pump Casing (Reactor Coolant Pump Class 1)	Pressure Boundary	Cast Austenitic Stainless Steel (CASS)	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-09	3.1.1-33	A
					Water Chemistry (B.2.1.2)	IV.C2.R-09	3.1.1-33	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Reactor Coolant Pump Class 1)	Pressure Boundary	Cast Austenitic Stainless Steel (CASS)	Reactor Coolant	Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Fracture Toughness	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-08	3.1.1-38	A
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-09	3.1.1-33	A
					Water Chemistry (B.2.1.2)	IV.C2.R-09	3.1.1-33	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Pump Casing (Reactor Coolant Pump Motor Oil Lift Pump)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.A.EP-77	3.2.1-49	A
					One-Time Inspection (B.2.1.20)	V.A.EP-77	3.2.1-49	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Reactor Coolant Pressure Boundary Components (Hot Leg, Intermediate Leg, Cold Leg, and Class 1 Piping >4" NPS)	Pressure Boundary	Cast Austenitic Stainless Steel (CASS)	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-56	3.1.1-35	A
						IV.C2.R-05	3.1.1-20	E, 2
					Water Chemistry (B.2.1.2)	IV.C2.R-05	3.1.1-20	E, 2
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Fracture Toughness	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (B.2.1.6)	IV.C2.R-52	3.1.1-50	A
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-56	3.1.1-35	A
						IV.C2.RP-344	3.1.1-33	A
					Water Chemistry (B.2.1.2)	IV.C2.RP-344	3.1.1-33	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Restricting Orifice	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Restricting Orifice	Pressure Boundary	Stainless Steel	Reactor Coolant	Cracking	One-Time Inspection (B.2.1.20)	IV.C2.RP-383	3.1.1-80	C
					Water Chemistry (B.2.1.2)	IV.C2.RP-383	3.1.1-80	C
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
	Throttle	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	One-Time Inspection (B.2.1.20)	IV.C2.RP-383	3.1.1-80	C
					Water Chemistry (B.2.1.2)	IV.C2.RP-383	3.1.1-80	C
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Restricting Orifice (Class 1)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.RP-235	3.1.1-39	A
					One-Time Inspection of ASME Code Class 1 Small Bore-Piping (B.2.1.22)	IV.C2.RP-235	3.1.1-39	A
					Water Chemistry (B.2.1.2)	IV.C2.RP-235	3.1.1-39	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
	Throttle	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.RP-235	3.1.1-39	A
					One-Time Inspection of ASME Code Class 1 Small Bore-Piping (B.2.1.22)	IV.C2.RP-235	3.1.1-39	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Restricting Orifice (Class 1)	Throttle	Stainless Steel	Reactor Coolant	Cracking	Water Chemistry (B.2.1.2)	IV.C2.RP-235	3.1.1-39	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Rupture Disks	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.C.EP-63	3.2.1-18	A
					Water Chemistry (B.2.1.2)	V.C.EP-63	3.2.1-18	A
Strainer Body (Reactor Coolant Pump Motor Oil Lift Component)	Leakage Boundary	Gray Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.A.EP-77	3.2.1-49	A
					One-Time Inspection (B.2.1.20)	V.A.EP-77	3.2.1-49	A
Tanks (Pressurizer Relief Tank)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	C
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.C.EP-63	3.2.1-18	C
					Water Chemistry (B.2.1.2)	V.C.EP-63	3.2.1-18	C
Tanks (Reactor Coolant Pump Motor Upper and Lower Oil Reservoirs, integral to motor)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Reactor Coolant Pump Motor Upper and Lower Oil Reservoirs, integral to motor)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.A.EP-77	3.2.1-49	C
					One-Time Inspection (B.2.1.20)	V.A.EP-77	3.2.1-49	C
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.A.EP-77	3.2.1-49	A
					One-Time Inspection (B.2.1.20)	V.A.EP-77	3.2.1-49	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.C.EP-63	3.2.1-18	A
					Water Chemistry (B.2.1.2)	V.C.EP-63	3.2.1-18	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Carbon Steel	Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.A-26	3.3.1-55	B
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.EP-81	3.2.1-48	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.C.EP-63	3.2.1-18	A
					Water Chemistry (B.2.1.2)	V.C.EP-63	3.2.1-18	A
	Structural Support	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Air/Gas - Dry (Internal)	None	None	IV.E.RP-07	3.1.1-107	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.EP-81	3.2.1-48	A
Valve Body (Class 1)	Pressure Boundary	Cast Austenitic Stainless Steel (CASS)	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-09	3.1.1-33	A
					Water Chemistry (B.2.1.2)	IV.C2.R-09	3.1.1-33	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Fracture Toughness	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-08	3.1.1-38	A
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body (Class 1)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-09	3.1.1-33	A
					Water Chemistry (B.2.1.2)	IV.C2.R-09	3.1.1-33	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A

Table 3.1.2-1 Reactor Coolant System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The TLAA designation in the Aging Management Programs column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3 and Section 4.7.

2. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program and the Water Chemistry (B.2.1.2) program are used to manage the aging effects applicable to this component type, material, and environment combination.

3. The carbon steel components of the pressurizer have an external temperature greater than 212 degrees Fahrenheit. Therefore, wetting due to condensation and moisture accumulation will not occur and loss of material (due to general, pitting, and crevice corrosion) is not applicable.

Table 3.1.2-2
Reactor Vessel
Summary of Aging Management Evaluation

Table 3.1.2-2 Reactor Vessel

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	V.E.EP-70	3.2.1-13	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	IV.C2.R-12	3.1.1-66	A
Bolting (Class 1)	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.RP-167	3.1.1-49	A
					Bolting Integrity (B.2.1.9)	IV.C2.RP-166	3.1.1-64	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	IV.C2.R-12	3.1.1-66	A
		High Strength Low Alloy Steel Bolting with Yield Strength of 150 ksi or Greater	Air with Borated Water Leakage (External)	Cracking	Reactor Head Closure Stud Bolting (B.2.1.3)	IV.A2.RP-52	3.1.1-92	B
				Cumulative Fatigue Damage	TLAA	IV.A2.RP-54	3.1.1-1	A, 1
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.RP-167	3.1.1-49	A
					Reactor Head Closure Stud Bolting (B.2.1.3)	IV.A2.RP-53	3.1.1-92	B
						IV.A2.RP-53	3.1.1-92	B
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.C2.RP-167	3.1.1-49	A
					Bolting Integrity (B.2.1.9)	IV.C2.RP-166	3.1.1-64	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	IV.C2.R-12	3.1.1-66	A

Table 3.1.2-2 Reactor Vessel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Class 1 Piping, Fittings and Branch Connections < NPS 4"	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.RP-235	3.1.1-39	A
					One-Time Inspection of ASME Code Class 1 Small Bore-Piping (B.2.1.22)	IV.C2.RP-235	3.1.1-39	A
					Water Chemistry (B.2.1.2)	IV.C2.RP-235	3.1.1-39	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Control Rod Assembly (Pressure Boundary Components including; latch housing, rod travel housing, cap, and CRDM adapter)	Pressure Boundary	Cast Austenitic Stainless Steel (CASS)	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	C
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.RP-55	3.1.1-47	A
					Water Chemistry (B.2.1.2)	IV.A2.RP-55	3.1.1-47	A
				Cumulative Fatigue Damage	TLAA	IV.A2.R-219	3.1.1-10	A, 1
				Loss of Fracture Toughness	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (B.2.1.6)	IV.A2.R-77	3.1.1-50	A

Table 3.1.2-2 Reactor Vessel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Control Rod Assembly (Pressure Boundary Components including; latch housing, rod travel housing, cap, and CRDM adapter)	Pressure Boundary	Cast Austenitic Stainless Steel (CASS)	Reactor Coolant	Loss of Material	Water Chemistry (B.2.1.2)	IV.A2.RP-28	3.1.1-88	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	C
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.RP-55	3.1.1-47	A
					Water Chemistry (B.2.1.2)	IV.A2.RP-55	3.1.1-47	A
				Cumulative Fatigue Damage	TLAA	IV.A2.R-219	3.1.1-10	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.A2.RP-28	3.1.1-88	A
Equipment supports and foundations (Integral Reactor Vessel Head Assembly)	Missile Barrier	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.A2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.A2.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A

Table 3.1.2-2 Reactor Vessel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Nozzle (Bottom Mounted Instrumentation and Welds)	Pressure Boundary	Nickel Alloy	Air with Borated Water Leakage (External)	None	None	IV.E.RP-378	3.1.1-106	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.RP-59	3.1.1-45	A
					Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5)	IV.A2.RP-59	3.1.1-45	A
					Water Chemistry (B.2.1.2)	IV.A2.RP-59	3.1.1-45	A
				Cumulative Fatigue Damage	TLAA	IV.A2.R-219	3.1.1-10	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Nozzle (RPV Head Nozzles; CRDM Housing, Instrumentation, and Welds)	Pressure Boundary	Nickel Alloy	Air with Borated Water Leakage (External)	None	None	IV.E.RP-378	3.1.1-106	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.RP-186	3.1.1-45	A
					Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5)	IV.A2.RP-186	3.1.1-45	A

Table 3.1.2-2 Reactor Vessel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Nozzle (RPV Head Nozzles; CRDM Housing, Instrumentation, and Welds)	Pressure Boundary	Nickel Alloy	Reactor Coolant	Cracking	Water Chemistry (B.2.1.2)	IV.A2.RP-186	3.1.1-45	A
				Cumulative Fatigue Damage	TLAA	IV.A2.R-219	3.1.1-10	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
					ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.B2.RP-382	3.1.1-32	C
Nozzle (RPV Head Vent, Flange Leakage Monitoring Tubes, and Welds)	Pressure Boundary	Nickel Alloy	Air with Borated Water Leakage (External)	None	None	IV.E.RP-378	3.1.1-106	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.R-90	3.1.1-45	A
					Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5)	IV.A2.R-90	3.1.1-45	A
					Water Chemistry (B.2.1.2)	IV.A2.R-90	3.1.1-45	A
				Cumulative Fatigue Damage	TLAA	IV.A2.R-219	3.1.1-10	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Nozzle Safe Ends and Welds	Pressure Boundary	Nickel Alloy	Air with Borated Water Leakage (External)	None	None	IV.E.RP-378	3.1.1-106	A

Table 3.1.2-2 Reactor Vessel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Nozzle Safe Ends and Welds	Pressure Boundary	Nickel Alloy	Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.RP-234	3.1.1-46	A
					Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5)	IV.A2.RP-234	3.1.1-46	A
					Water Chemistry (B.2.1.2)	IV.A2.RP-234	3.1.1-46	A
				Cumulative Fatigue Damage	TLAA	IV.A2.R-219	3.1.1-10	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.A2.RP-28	3.1.1-88	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.RP-234	3.1.1-46	A
					Water Chemistry (B.2.1.2)	IV.A2.RP-234	3.1.1-46	A
				Cumulative Fatigue Damage	TLAA	IV.A2.R-219	3.1.1-10	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.A2.RP-28	3.1.1-88	A
Nozzle Thermal Sleeves	Direct Flow	Stainless Steel	Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.RP-234	3.1.1-46	C
					Water Chemistry (B.2.1.2)	IV.A2.RP-234	3.1.1-46	C
				Cumulative Fatigue Damage	TLAA	IV.A2.R-219	3.1.1-10	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.A2.RP-28	3.1.1-88	C

Table 3.1.2-2 Reactor Vessel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Nozzle Thermal Sleeves	Direct Flow	Stainless Steel	Reactor Coolant	Loss of Material	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.B2.RP-382	3.1.1-32	C
Piping, piping components, and piping elements	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	IV.C2.RP-383	3.1.1-80	C
					Water Chemistry (B.2.1.2)	IV.C2.RP-383	3.1.1-80	C
				Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	A
	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.R-74	3.1.1-19	E, 3
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	A
			Treated Borated Water > 140 F (Internal)	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.RP-231	3.1.1-34	C
					Water Chemistry (B.2.1.2)	IV.C2.RP-231	3.1.1-34	C
				Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	A

Table 3.1.2-2 Reactor Vessel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	A
Reactor Vessel (Beltline components; primary inlet and outlet nozzles, nozzle shell forging, intermediate shell forging, lower shell forging, and welds)	Pressure Boundary	Carbon or Low Alloy Steel with Nickel Alloy Cladding	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.A2.R-17	3.1.1-49	A
			Reactor Coolant and Neutron Flux	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.RP-234	3.1.1-46	C
					Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5)	IV.A2.RP-234	3.1.1-46	C
					Water Chemistry (B.2.1.2)	IV.A2.RP-234	3.1.1-46	C
				Cumulative Fatigue Damage	TLAA	IV.A2.R-219	3.1.1-10	A, 1
				Loss of Fracture Toughness	Reactor Vessel Surveillance (B.2.1.19)	IV.A2.RP-229	3.1.1-14	A
					TLAA	IV.A2.R-84	3.1.1-13	A, 2
				Loss of Material	Water Chemistry (B.2.1.2)	IV.A2.RP-28	3.1.1-88	A
		Carbon or Low Alloy Steel with Stainless Steel Cladding	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.A2.R-17	3.1.1-49	A

Table 3.1.2-2 Reactor Vessel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Reactor Vessel (Beltline components; primary inlet and outlet nozzles, nozzle shell forging, intermediate shell forging, lower shell forging, and welds)	Pressure Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Reactor Coolant and Neutron Flux	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.RP-234	3.1.1-46	C
					Water Chemistry (B.2.1.2)	IV.A2.RP-234	3.1.1-46	C
				Cumulative Fatigue Damage	TLAA	IV.A2.R-219	3.1.1-10	A, 1
				Loss of Fracture Toughness	Reactor Vessel Surveillance (B.2.1.19)	IV.A2.RP-229	3.1.1-14	A
					TLAA	IV.A2.R-84	3.1.1-13	A, 2
				Loss of Material	Water Chemistry (B.2.1.2)	IV.A2.RP-28	3.1.1-88	A
Reactor Vessel (Core Support Pads)	Structural Support	Nickel Alloy	Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.RP-57	3.1.1-40x	A
					Water Chemistry (B.2.1.2)	IV.A2.RP-57	3.1.1-40x	A
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	C
Reactor Vessel (RPV Head and Flange)	Pressure Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.A2.RP-379	3.1.1-48	A
					Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5)	IV.A2.RP-379	3.1.1-48	A

Table 3.1.2-2 Reactor Vessel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Reactor Vessel (RPV Head and Flange)	Pressure Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.RP-234	3.1.1-46	C
					Water Chemistry (B.2.1.2)	IV.A2.RP-234	3.1.1-46	C
				Cumulative Fatigue Damage	TLAA	IV.A2.R-219	3.1.1-10	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.A2.RP-28	3.1.1-88	A
					ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.R-87	3.1.1-37	A
Reactor Vessel (Reactor Vessel Flange, Lower Head Dutchman, Lower Head Center Disc, and Welds)	Pressure Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.A2.RP-379	3.1.1-48	A
					Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5)	IV.A2.RP-379	3.1.1-48	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.RP-234	3.1.1-46	C
					Water Chemistry (B.2.1.2)	IV.A2.RP-234	3.1.1-46	C
				Cumulative Fatigue Damage	TLAA	IV.A2.R-219	3.1.1-10	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.A2.RP-28	3.1.1-88	A

Table 3.1.2-2 Reactor Vessel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Reactor Vessel (Reactor Vessel Flange, Lower Head Dutchman, Lower Head Center Disc, and Welds)	Pressure Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Reactor Coolant	Loss of Material	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.A2.R-87	3.1.1-37	A
Valve Body	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-09	3.1.1-33	A
					Water Chemistry (B.2.1.2)	IV.C2.R-09	3.1.1-33	A
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Valve Body (Class 1)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-09	3.1.1-33	A
					Water Chemistry (B.2.1.2)	IV.C2.R-09	3.1.1-33	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A

Table 3.1.2-2 Reactor Vessel (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The TLAA designation in the Aging Management Program column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3 and Section 4.7.

2. The TLAA designation in the Aging Management Program column indicates that loss of fracture toughness for this component is evaluated in Section 4.2.

3. NUREG-1801 specifies a plant-specific program for the vessel flange leak detection line. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program is used to manage the aging effect(s) applicable to the component type, material, and environment combination.

Table 3.1.2-3
Reactor Vessel Internals
Summary of Aging Management Evaluation

Table 3.1.2-3 Reactor Vessel Internals

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Alignment and Interfacing Components: Internals Hold Down Spring	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-276	3.1.1-53	D
					Water Chemistry (B.2.1.2)	IV.B2.RP-276	3.1.1-53	C
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-297	3.1.1-59	D, 4
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-300	3.1.1-59	B
				Loss of Preload	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-300	3.1.1-59	B, 4
Alignment and Interfacing Components: Upper Core Plate Alignment Pins	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-301	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-301	3.1.1-53	A
				Cumulative Fatigue Damage	TLAA	IV.B2.RP-303	3.1.1-3	A, 2
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-288	3.1.1-59	D

Table 3.1.2-3 Reactor Vessel Internals (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Alignment and Interfacing Components: Upper Core Plate Alignment Pins	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
					ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.B2.RP-382	3.1.1-32	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-299	3.1.1-59	B
Baffle-to-Former Assembly: Accessible Baffle-to-Former Bolts	Structural Support to maintain core configuration and flow distribution	Stainless Steel Bolting	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-272	3.1.1-59	B
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-271	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-271	3.1.1-53	A
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-272	3.1.1-59	B
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
				Loss of Preload	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-272	3.1.1-59	B
Baffle-to-Former Assembly: Baffle and Former Plates	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	B
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-276	3.1.1-53	D
					Water Chemistry (B.2.1.2)	IV.B2.RP-276	3.1.1-53	C
				Cumulative Fatigue Damage	TLAA	IV.B2.RP-303	3.1.1-3	A, 2
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-272	3.1.1-59	D

Table 3.1.2-3 Reactor Vessel Internals (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Baffle-to-Former Assembly: Baffle and Former Plates	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
Baffle-to-Former Assembly: Barrel-to-Former Bolts	Structural Support to maintain core configuration and flow distribution	Stainless Steel Bolting	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-272	3.1.1-59	B
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-271	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-271	3.1.1-53	A
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-272	3.1.1-59	B
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
				Loss of Preload	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-272	3.1.1-59	B
Bottom-Mounted Instrumentation System: Bottom-Mounted Instrumentation (BMI) Column Bodies	Structural Support	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-293	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-293	3.1.1-53	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-387	3.1.1-53	D
					Water Chemistry (B.2.1.2)	IV.B2.RP-387	3.1.1-53	C
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-292	3.1.1-59	B
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A

Table 3.1.2-3 Reactor Vessel Internals (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Control Rod (Short-lived)	None - Short Lived	Not Applicable - Short Lived	Not Applicable - Short Lived	None	None			1
Control Rod Guide Tube (CRGT) Assemblies: C-tubes, Sheaths, and Flanges	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-387	3.1.1-53	D
					Water Chemistry (B.2.1.2)	IV.B2.RP-387	3.1.1-53	C
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-290	3.1.1-59	D
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-386	3.1.1-59	B
Control Rod Guide Tube (CRGT) Assemblies: CRGT Guide Plates (cards)	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-276	3.1.1-53	D
					Water Chemistry (B.2.1.2)	IV.B2.RP-276	3.1.1-53	C
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-297	3.1.1-59	D
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-296	3.1.1-59	B
Control Rod Guide Tube (CRGT) Assemblies: CRGT Lower Flange Welds (accessible)	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D

Table 3.1.2-3 Reactor Vessel Internals (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Control Rod Guide Tube (CRGT) Assemblies: CRGT Lower Flange Welds (accessible)	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-298	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-298	3.1.1-53	A
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-297	3.1.1-59	B
						IV.B2.RP-297	3.1.1-59	B
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
Control Rod Guide Tube Assemblies: Guide Tube Support Pins	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-274	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-346	3.1.1-53	D
					Water Chemistry (B.2.1.2)	IV.B2.RP-346	3.1.1-53	C
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-274	3.1.1-59	D
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-299	3.1.1-59	D
Core Barrel Assembly (Barrel Plates and Nozzles)	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-274	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-278	3.1.1-53	D
					Water Chemistry (B.2.1.2)	IV.B2.RP-278	3.1.1-53	C
				Cumulative Fatigue Damage	TLAA	IV.B2.RP-303	3.1.1-3	A, 2
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-274	3.1.1-59	D

Table 3.1.2-3 Reactor Vessel Internals (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Core Barrel Assembly (Barrel Plates and Nozzles)	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
Core Barrel Assembly: Core Barrel Axial Welds	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-387	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-387	3.1.1-53	A
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-388	3.1.1-59	B
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
Core Barrel Assembly: Core Barrel Flange	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-282	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-282	3.1.1-53	A
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-292	3.1.1-59	D
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
					ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.B2.RP-382	3.1.1-32	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-345	3.1.1-59	B
Core Barrel Assembly: Core Barrel Outlet Nozzle Welds	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D

Table 3.1.2-3 Reactor Vessel Internals (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Core Barrel Assembly: Core Barrel Outlet Nozzle Welds	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-278	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-278	3.1.1-53	A
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-281	3.1.1-59	D
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
Core Barrel Assembly: Lower Core Barrel Flange Weld	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-280	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-280	3.1.1-53	A
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-281	3.1.1-59	B
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
Core Barrel Assembly: Upper Core Barrel Flange Weld	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-276	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-276	3.1.1-53	A
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-297	3.1.1-59	D
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
Fuel Assembly (Short-lived)	None - Short Lived	Not Applicable - Short Lived	Not Applicable - Short Lived	None	None			1

Table 3.1.2-3 Reactor Vessel Internals (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Lower Internals Assembly: Clevis Insert Bolts	Structural Support to maintain core configuration and flow distribution	Nickel Alloy	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-267	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-265	3.1.1-53	D
					Water Chemistry (B.2.1.2)	IV.B2.RP-265	3.1.1-53	C
				Cumulative Fatigue Damage	TLAA	IV.B2.RP-303	3.1.1-3	A, 2
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-267	3.1.1-59	D
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
					ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.B2.RP-382	3.1.1-32	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-285	3.1.1-59	B
				Loss of Preload	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-267	3.1.1-59	D
Lower Internals Assembly: Lower Core Plate and Extra-Long (XL) Lower Core Plate	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D
				Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.B2.RP-382	3.1.1-32	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-289	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-289	3.1.1-53	A
				Cumulative Fatigue Damage	TLAA	IV.B2.RP-303	3.1.1-3	A, 2

Table 3.1.2-3 Reactor Vessel Internals (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Lower Internals Assembly: Lower Core Plate and Extra-Long (XL) Lower Core Plate	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-288	3.1.1-59	B
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
					ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.B2.RP-382	3.1.1-32	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-288	3.1.1-59	B
Lower Support Assembly: Lower Support Column Bodies (non-cast)	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-294	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-294	3.1.1-53	A
				Cumulative Fatigue Damage	TLAA	IV.B2.RP-303	3.1.1-3	A, 2
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-295	3.1.1-59	B
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
Lower Support Assembly: Lower Support Column Bolts	Structural Support to maintain core configuration and flow distribution	Stainless Steel Bolting	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-286	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-286	3.1.1-53	A
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-287	3.1.1-59	B

Table 3.1.2-3 Reactor Vessel Internals (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Lower Support Assembly: Lower Support Column Bolts	Structural Support to maintain core configuration and flow distribution	Stainless Steel Bolting	Reactor Coolant and Neutron Flux	Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
				Loss of Preload	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-287	3.1.1-59	B
Reactor Vessel Internals Components (Manway Cover, Nuts, and Pins)	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D
				Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.B2.RP-382	3.1.1-32	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-289	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-289	3.1.1-53	A
				Cumulative Fatigue Damage	TLAA	IV.B2.RP-303	3.1.1-3	A, 2
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-288	3.1.1-59	B
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
					ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.B2.RP-382	3.1.1-32	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-288	3.1.1-59	B
Reactor Vessel Internals Components (Neutron Pads, Bolting, and Pins)	Absorb Neutrons	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-267	3.1.1-59	B

Table 3.1.2-3 Reactor Vessel Internals (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Reactor Vessel Internals Components (Neutron Pads, Bolting, and Pins)	Absorb Neutrons	Stainless Steel	Reactor Coolant and Neutron Flux	Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-265	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-265	3.1.1-53	A
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-267	3.1.1-59	B
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
	Structural Support	Stainless Steel Bolting	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-267	3.1.1-59	B
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-265	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-265	3.1.1-53	A
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-267	3.1.1-59	B
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
				Loss of Preload	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-267	3.1.1-59	B
Reactor Vessel Internals Components (Primary, Expansion, or Existing program - inaccessible locations)	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-269	3.1.1-24	B
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-268	3.1.1-23	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-268	3.1.1-23	A
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-269	3.1.1-24	B

Table 3.1.2-3 Reactor Vessel Internals (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Reactor Vessel Internals Components (Primary, Expansion, or Existing program - inaccessible locations)	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Loss of Material	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-269	3.1.1-24	B
				Loss of Preload	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-269	3.1.1-24	B
Upper Internals Assembly (Thermocouple Columns)	Structural Support	Stainless Steel	Reactor Coolant	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-267	3.1.1-59	B
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-265	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-265	3.1.1-53	A
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-267	3.1.1-59	B
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
Upper Internals Assembly (Upper Core Plate)	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant and Neutron Flux	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-274	3.1.1-59	D
				Cracking	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-387	3.1.1-53	D
					Water Chemistry (B.2.1.2)	IV.B2.RP-387	3.1.1-53	C
				Cumulative Fatigue Damage	TLAA	IV.B2.RP-303	3.1.1-3	A, 2
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-292	3.1.1-59	D
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A

Table 3.1.2-3 Reactor Vessel Internals (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Upper Internals Assembly: Upper Support Ring or Skirt	Structural Support to maintain core configuration and flow distribution	Stainless Steel	Reactor Coolant	Change in Dimension	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-270	3.1.1-59	D
				Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.B2.RP-382	3.1.1-32	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-346	3.1.1-53	B
					Water Chemistry (B.2.1.2)	IV.B2.RP-346	3.1.1-53	A
				Cumulative Fatigue Damage	TLAA	IV.B2.RP-303	3.1.1-3	A, 2
				Loss of Fracture Toughness	PWR Vessel Internals (B.2.1.7)	IV.B2.RP-288	3.1.1-59	D, 3
				Loss of Material	Water Chemistry (B.2.1.2)	IV.B2.RP-24	3.1.1-87	A
					PWR Vessel Internals (B.2.1.7)	IV.B2.RP-288	3.1.1-59	D

Table 3.1.2-3 Reactor Vessel Internals (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Control Rod and Fuel Assemblies are subject to replacement in accordance with the Core Reload Process. As such, they are short-lived components and not subject to aging management.

2. The TLAA designation in the Aging Management Program column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3.

3. The upper support plate assembly for Byron Units 1 and 2 is a single piece casting made of cast austenitic stainless steel rather than a welded assembly made up of stainless steel plates and forgings, therefore, the Byron Units 1 and 2 “upper support ring or skirt” is an integral part of the upper support plate assembly. An evaluation of the susceptibility to loss of fracture toughness due to thermal aging embrittlement determined that the component was not susceptible to a loss of fracture toughness due to thermal aging embrittlement, therefore the material of the component can be considered equivalent to stainless steel. See Appendix C Applicant/Licensee Action Items 2 and 7 for more detail.

4. The Alignment and Interfacing Components: Internals Hold Down Spring at Byron and Braidwood stations are fabricated from 403 stainless steel, which is a martensitic stainless steel and not susceptible to thermal relaxation. Martensitic stainless steel is susceptible to loss of fracture toughness due to thermal aging embrittlement. Hold down springs, fabricated from 403 stainless steel, are classified as no additional measures per MRP-191 Table 6-5.

Table 3.1.2-4
Steam Generators
Summary of Aging Management Evaluation

Table 3.1.2-4 Steam Generators

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VIII.H.SP-84	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VIII.H.SP-83	3.4.1-10	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.D1.R-17	3.1.1-49	A
					Bolting Integrity (B.2.1.9)	VIII.H.SP-84	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	IV.D1.RP-46	3.1.1-67	A
		Stainless Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VIII.H.SP-84	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VIII.H.SP-83	3.4.1-10	A
			Air with Borated Water Leakage (External)	Cracking	Bolting Integrity (B.2.1.9)	IV.C2.R-11	3.1.1-62	A
				Loss of Material	Bolting Integrity (B.2.1.9)	VIII.H.SP-84	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	IV.D1.RP-46	3.1.1-67	A
Bolting (Class 1)	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.D1.R-17	3.1.1-49	A
					Bolting Integrity (B.2.1.9)	IV.C2.RP-166	3.1.1-64	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	IV.D1.RP-46	3.1.1-67	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Class 1 Piping, Fittings and Branch Connections < NPS 4" (Steam Generator Drain - Byron Unit 1 and Braidwood Unit 1 only)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.RP-235	3.1.1-39	A, 9
					Water Chemistry (B.2.1.2)	IV.C2.RP-235	3.1.1-39	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Condensing Chamber	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.D1.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	IV.D1.RP-372	3.1.1-83	C
					Water Chemistry (B.2.1.2)	IV.D1.RP-372	3.1.1-83	C
Flow Device (Feedwater Flow Limiter - Byron Unit 2 and Braidwood Unit 2 only)	Throttle	Nickel Alloy	Treated Water (External)	Cracking	One-Time Inspection (B.2.1.20)	IV.D2.R-36	3.1.1-78	C
					Water Chemistry (B.2.1.2)	IV.D2.R-36	3.1.1-78	C
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-157	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-157	3.4.1-16	C

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Flow Device (Feedwater Flow Limiter - Byron Unit 2 and Braidwood Unit 2 only)	Throttle	Nickel Alloy	Treated Water (Internal)	Cracking	One-Time Inspection (B.2.1.20)	IV.D2.R-36	3.1.1-78	C
					Water Chemistry (B.2.1.2)	IV.D2.R-36	3.1.1-78	C
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-157	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-157	3.4.1-16	C
Heat Exchanger - (Steam Generator Blowdown Condenser) Shell Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-78	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-78	3.4.1-14	A
Nozzle Thermal Sleeves (Aux Feedwater)	Direct Flow	Nickel Alloy	Treated Water (External)	Cracking	One-Time Inspection (B.2.1.20)	IV.D2.R-36	3.1.1-78	C
					Water Chemistry (B.2.1.2)	IV.D2.R-36	3.1.1-78	C
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-157	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-157	3.4.1-16	C
			Treated Water (Internal)	Cracking	One-Time Inspection (B.2.1.20)	IV.D2.R-36	3.1.1-78	C
					Water Chemistry (B.2.1.2)	IV.D2.R-36	3.1.1-78	C
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-157	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-157	3.4.1-16	C

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Nozzle Thermal Sleeves (Feedwater)	Direct Flow	Carbon Steel - (Byron Unit 2 and Braidwood Unit 2 only)	Treated Water (External)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-74	3.4.1-13	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-74	3.4.1-13	C
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-74	3.4.1-13	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-74	3.4.1-13	C
		Low Alloy Steel - (Byron Unit 1 and Braidwood Unit 1 only)	Treated Water (External)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-74	3.4.1-13	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-74	3.4.1-13	C
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-74	3.4.1-13	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-74	3.4.1-13	C
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Cumulative Fatigue Damage	TLAA	IV.D1.R-33	3.1.1-5	C, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-74	3.4.1-13	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.F.S-16	3.4.1-5	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-87	3.4.1-16	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.F.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-88	3.4.1-11	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			H, 2
					One-Time Inspection (B.2.1.20)	VIII.F.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-87	3.4.1-16	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Cumulative Fatigue Damage	TLAA	IV.D1.R-33	3.1.1-5	C, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-74	3.4.1-13	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.F.S-16	3.4.1-5	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.RP-344	3.1.1-33	C
					Water Chemistry (B.2.1.2)	IV.C2.RP-344	3.1.1-33	C
				Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	IV.C2.RP-383	3.1.1-80	C
					Water Chemistry (B.2.1.2)	IV.C2.RP-383	3.1.1-80	C
				Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.F.SP-88	3.4.1-11	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Stainless Steel	Treated Water > 140 F (Internal)	Cracking	Water Chemistry (B.2.1.2)	VIII.F.SP-88	3.4.1-11	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-87	3.4.1-16	A
	Structural Support	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Air/Gas - Dry (Internal)	None	None	VIII.I.SP-4	3.4.1-59	A
Pump Casing (Steam Generator Blowdown Condenser Hotwell Pump)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-87	3.4.1-16	A
Pump Casing (Wet Layup Pump - Byron Unit 1 and Braidwood Unit 1 only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.F.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-88	3.4.1-11	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Wet Layup Pump - Byron Unit 1 and Braidwood Unit 1 only)	Leakage Boundary	Stainless Steel	Treated Water > 140 F (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-87	3.4.1-16	A
Steam Generators (Feedwater Ring and J-Tubes - Byron Unit 1 and Braidwood Unit 1 only)	Direct Flow	Low Alloy Steel	Treated Water (External)	Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-226	3.1.1-71	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	C
			Treated Water (Internal)	Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-226	3.1.1-71	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	C
		Nickel Alloy	Treated Water (External)	Cracking	Steam Generators (B.2.1.10)	IV.D1.RP-384	3.1.1-71	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-384	3.1.1-71	C
				Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-226	3.1.1-71	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	C
			Treated Water (Internal)	Cracking	Steam Generators (B.2.1.10)	IV.D1.RP-384	3.1.1-71	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-384	3.1.1-71	C
				Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-226	3.1.1-71	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	C

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steam Generators (Impingement Plate and Preheater Baffles - Byron Unit 2 and Braidwood Unit 2 only)	Direct Flow	Nickel Alloy	Treated Water (External)	Cracking	Steam Generators (B.2.1.10)	IV.D1.RP-384	3.1.1-71	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-384	3.1.1-71	C
				Cumulative Fatigue Damage	TLAA	IV.D1.R-221	3.1.1-8	C, 1
				Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-226	3.1.1-71	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	C
		Stainless Steel	Treated Water > 140 F (External)	Cracking	Steam Generators (B.2.1.10)	IV.D1.RP-384	3.1.1-71	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-384	3.1.1-71	C
				Cumulative Fatigue Damage	TLAA	IV.D1.R-221	3.1.1-8	C
				Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-226	3.1.1-71	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	C
Steam Generators (Internal Supports and Structures)	Structural Support	Carbon Steel	Treated Water (External)	Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-225	3.1.1-76	B
						IV.D1.RP-226	3.1.1-71	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	A
		Cast Austenitic Stainless Steel (CASS) - (Byron Unit 1 and Braidwood Unit 1 only)	Treated Water > 482 F (External)	Cracking	Steam Generators (B.2.1.10)	IV.D1.RP-384	3.1.1-71	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-384	3.1.1-71	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steam Generators (Internal Supports and Structures)	Structural Support	Cast Austenitic Stainless Steel (CASS) - (Byron Unit 1 and Braidwood Unit 1 only)	Treated Water > 482 F (External)	Loss of Fracture Toughness	Steam Generators (B.2.1.10)			H, 3
				Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-225	3.1.1-76	B
						IV.D1.RP-226	3.1.1-71	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	A
		Stainless Steel - (Byron Unit 1 and Braidwood Unit 1 only)	Treated Water > 140 F (External)	Cracking	Steam Generators (B.2.1.10)	IV.D1.RP-384	3.1.1-71	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-384	3.1.1-71	A
				Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-225	3.1.1-76	B
						IV.D1.RP-226	3.1.1-71	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	A
Steam Generators (Moisture Separators)	Direct Flow	Carbon Steel - (Byron Unit 2 and Braidwood Unit 2 only)	Treated Water (External)	Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-161	3.1.1-72	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-161	3.1.1-72	C
				Wall Thinning	Steam Generators (B.2.1.10)	IV.D1.RP-49	3.1.1-74	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-49	3.1.1-74	A
			Treated Water (Internal)	Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-161	3.1.1-72	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-161	3.1.1-72	C
				Wall Thinning	Steam Generators (B.2.1.10)	IV.D1.RP-49	3.1.1-74	B

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steam Generators (Moisture Separators)	Direct Flow	Carbon Steel - (Byron Unit 2 and Braidwood Unit 2 only)	Treated Water (Internal)	Wall Thinning	Water Chemistry (B.2.1.2)	IV.D1.RP-49	3.1.1-74	A
		Low Alloy Steel - (Byron Unit 1 and Braidwood Unit 1 only)	Treated Water (External)	Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-161	3.1.1-72	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-161	3.1.1-72	C
				Wall Thinning	Steam Generators (B.2.1.10)	IV.D1.RP-49	3.1.1-74	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-49	3.1.1-74	A
			Treated Water (Internal)	Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-161	3.1.1-72	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-161	3.1.1-72	C
				Wall Thinning	Steam Generators (B.2.1.10)	IV.D1.RP-49	3.1.1-74	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-49	3.1.1-74	A
Steam Generators (Primary Head Drain Penetration and Weld)	Pressure Boundary	Nickel Alloy	Air with Borated Water Leakage (External)	None	None	IV.E.RP-378	3.1.1-106	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.D1.RP-36	3.1.1-45	A
					Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5)	IV.D1.RP-36	3.1.1-45	A
					Water Chemistry (B.2.1.2)	IV.D1.RP-36	3.1.1-45	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steam Generators (Primary Head Drain Penetration and Weld)	Pressure Boundary	Nickel Alloy	Reactor Coolant	Cumulative Fatigue Damage	TLAA	IV.D1.R-221	3.1.1-8	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
		Stainless Steel - (Byron Unit 2 and Braidwood Unit 2 only)	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	C
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.D1.RP-232	3.1.1-33	A
					Water Chemistry (B.2.1.2)	IV.D1.RP-232	3.1.1-33	A
				Cumulative Fatigue Damage	TLAA	IV.D1.R-221	3.1.1-8	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
Steam Generators (Primary Head, Integral Inlet and Outlet Nozzles, Nozzle Closure Ring, Manway Nozzle, Safe Ends, and Welds)	Pressure Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.D1.R-17	3.1.1-49	A, 4
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.D1.RP-232	3.1.1-33	A
					Water Chemistry (B.2.1.2)	IV.D1.RP-232	3.1.1-33	A
				Cumulative Fatigue Damage	TLAA	IV.D1.R-221	3.1.1-8	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steam Generators (Primary Head, Integral Inlet and Outlet Nozzles, Nozzle Closure Ring, Manway Nozzle, Safe Ends, and Welds)	Pressure Boundary	Nickel Alloy	Air with Borated Water Leakage (External) - (Byron Unit 2 and Braidwood Unit 2 only)	None	None	IV.E.RP-378	3.1.1-106	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.D1.RP-36	3.1.1-45	A
					Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5)	IV.D1.RP-36	3.1.1-45	A
					Water Chemistry (B.2.1.2)	IV.D1.RP-36	3.1.1-45	A
				Cumulative Fatigue Damage	TLAA	IV.D1.R-221	3.1.1-8	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A
		Stainless Steel - (Byron Unit 1 and Braidwood Unit 1 only)	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.D1.RP-232	3.1.1-33	A
					Water Chemistry (B.2.1.2)	IV.D1.RP-232	3.1.1-33	A
				Cumulative Fatigue Damage	TLAA	IV.D1.R-221	3.1.1-8	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steam Generators (Primary Manway Cover and Insert)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.D1.R-17	3.1.1-49	A, 4
		Nickel Alloy - (Byron Unit 1 and Braidwood Unit 1 only)	Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.D1.RP-36	3.1.1-45	A
					Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (B.2.1.5)	IV.D1.RP-36	3.1.1-45	A
					Water Chemistry (B.2.1.2)	IV.D1.RP-36	3.1.1-45	A
				Cumulative Fatigue Damage	TLAA	IV.D1.R-221	3.1.1-8	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	C
		Stainless Steel - (Byron Unit 2 and Braidwood Unit 2 only)	Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.D1.RP-232	3.1.1-33	A
					Water Chemistry (B.2.1.2)	IV.D1.RP-232	3.1.1-33	A
				Cumulative Fatigue Damage	TLAA	IV.D1.R-221	3.1.1-8	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	C
Steam Generators (Primary Side Components: Divider Plate)	Direct Flow	Nickel Alloy	Reactor Coolant	Cracking	Steam Generators (B.2.1.10)	IV.D1.RP-367	3.1.1-25	E, 5
					Water Chemistry (B.2.1.2)	IV.D1.RP-367	3.1.1-25	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steam Generators (Primary Side Components: Divider Plate)	Direct Flow	Nickel Alloy	Reactor Coolant	Cumulative Fatigue Damage	TLAA	IV.D1.R-221	3.1.1-8	C, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	C
Steam Generators (Secondary Side Instrument Nozzles (Bosses))	Pressure Boundary	Low Alloy Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.D1.R-17	3.1.1-49	A, 4
			Treated Water (Internal)	Cumulative Fatigue Damage	TLAA	IV.D1.R-33	3.1.1-5	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	IV.D1.RP-372	3.1.1-83	C
					Water Chemistry (B.2.1.2)	IV.D1.RP-372	3.1.1-83	C
Steam Generators (Secondary Side Manway and Handhole Covers)	Pressure Boundary	Low Alloy Steel	Air with Borated Water Leakage (External)	Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	C, 1
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.D1.R-17	3.1.1-49	A, 4
					ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.D2.R-31	3.1.1-44	A
			Treated Water (Internal) - (Byron Unit 2 and Braidwood Unit 2 only)	Cumulative Fatigue Damage	TLAA	IV.D1.R-33	3.1.1-5	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	IV.D1.RP-372	3.1.1-83	C
					Water Chemistry (B.2.1.2)	IV.D1.RP-372	3.1.1-83	C
		Nickel Alloy - (Byron Unit 1 and Braidwood Unit 1 only)	Treated Water (Internal)	Cracking	One-Time Inspection (B.2.1.20)	IV.D2.R-36	3.1.1-78	C

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steam Generators (Secondary Side Manway and Handhole Covers)	Pressure Boundary	Nickel Alloy - (Byron Unit 1 and Braidwood Unit 1 only)	Treated Water (Internal)	Cracking	Water Chemistry (B.2.1.2)	IV.D2.R-36	3.1.1-78	C
				Cumulative Fatigue Damage	TLAA	IV.D1.R-46	3.1.1-2	C, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-157	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-157	3.4.1-16	C
Steam Generators (Secondary Side Nozzles, Steam Outlet, Feedwater Inlet, Safe Ends, and Welds)	Pressure Boundary	Low Alloy Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.D1.R-17	3.1.1-49	A, 4
			Steam (Internal)	Cumulative Fatigue Damage	TLAA	IV.D1.R-33	3.1.1-5	A, 1
				Loss of Material	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.D1.RP-368	3.1.1-12	C
					Water Chemistry (B.2.1.2)	IV.D1.RP-368	3.1.1-12	C
			Treated Water (Internal)	Cumulative Fatigue Damage	TLAA	IV.D1.R-33	3.1.1-5	A, 1
				Loss of Material	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.D1.RP-368	3.1.1-12	C
					Water Chemistry (B.2.1.2)	IV.D1.RP-368	3.1.1-12	C
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	IV.D1.R-37	3.1.1-61	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steam Generators (Secondary Side Nozzles, Steam Outlet, Feedwater Inlet, Safe Ends, and Welds)	Pressure Boundary	Nickel Alloy - (Byron Unit 1 and Braidwood Unit 1 only)	Air with Borated Water Leakage (External)	None	None	IV.E.RP-378	3.1.1-106	A
			Steam (Internal)	Cracking	One-Time Inspection (B.2.1.20)	IV.D2.R-36	3.1.1-78	C
					Water Chemistry (B.2.1.2)	IV.D2.R-36	3.1.1-78	C
				Cumulative Fatigue Damage	TLAA	IV.D1.R-46	3.1.1-2	C, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-157	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-157	3.4.1-16	C
			Treated Water (Internal)	Cracking	One-Time Inspection (B.2.1.20)	IV.D2.R-36	3.1.1-78	C
					Water Chemistry (B.2.1.2)	IV.D2.R-36	3.1.1-78	C
				Cumulative Fatigue Damage	TLAA	IV.D1.R-46	3.1.1-2	C, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-157	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-157	3.4.1-16	C
Steam Generators (Secondary Side Shell and Head)	Pressure Boundary	Low Alloy Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.D1.R-17	3.1.1-49	A, 4
			Steam (Internal)	Cumulative Fatigue Damage	TLAA	IV.D1.R-33	3.1.1-5	A, 1
				Loss of Material	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.D1.RP-368	3.1.1-12	A
					Water Chemistry (B.2.1.2)	IV.D1.RP-368	3.1.1-12	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steam Generators (Secondary Side Shell and Head)	Pressure Boundary	Low Alloy Steel	Treated Water (Internal)	Cumulative Fatigue Damage	TLAA	IV.D1.R-33	3.1.1-5	A, 1
				Loss of Material	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.D1.RP-368	3.1.1-12	A
					Water Chemistry (B.2.1.2)	IV.D1.RP-368	3.1.1-12	A
Steam Generators (Supports - Pads, Lugs, and Trunnions)	Structural Support	Low Alloy Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	IV.D1.R-17	3.1.1-49	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
Steam Generators (Tube Bundle Wrapper (Shroud))	Direct Flow	Carbon Steel	Treated Water (External)	Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-161	3.1.1-72	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-161	3.1.1-72	A
					Steam Generators (B.2.1.10)	IV.D1.RP-161	3.1.1-72	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-161	3.1.1-72	A
			Treated Water (Internal)	Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-161	3.1.1-72	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-161	3.1.1-72	A
					Steam Generators (B.2.1.10)	IV.D1.RP-161	3.1.1-72	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-161	3.1.1-72	A
Steam Generators (Tube Plugs)	Pressure Boundary	Nickel Alloy	Reactor Coolant	Cracking	Steam Generators (B.2.1.10)	IV.D1.R-40	3.1.1-70	B
					Water Chemistry (B.2.1.2)	IV.D1.R-40	3.1.1-70	A
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	C

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steam Generators (Tube Sheet)	Pressure Boundary	Carbon or Low Alloy Steel with Nickel Alloy Cladding	Reactor Coolant	Cracking	Steam Generators (B.2.1.10)	IV.D1.R-44	3.1.1-70	D
					Water Chemistry (B.2.1.2)	IV.D1.R-44	3.1.1-70	C
				Cumulative Fatigue Damage	TLAA	IV.D1.R-221	3.1.1-8	C, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	C
			Treated Water (External)	Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-161	3.1.1-72	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-161	3.1.1-72	C
Steam Generators (Tube Support Plates and U-Bend Supports)	Structural Support	Carbon Steel - (Byron Unit 1 and Braidwood Unit 1 only)	Treated Water (External)	Cracking	Steam Generators (B.2.1.10)	IV.D1.RP-384	3.1.1-71	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-384	3.1.1-71	A
				Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-225	3.1.1-76	B
						IV.D1.RP-226	3.1.1-71	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	A
		Cast Austenitic Stainless Steel (CASS) - (Byron Unit 1 and Braidwood Unit 1 only)	Treated Water > 482 F (External)	Cracking	Steam Generators (B.2.1.10)	IV.D1.RP-384	3.1.1-71	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-384	3.1.1-71	A
				Loss of Fracture Toughness	Steam Generators (B.2.1.10)			H, 3
				Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-225	3.1.1-76	B
						IV.D1.RP-226	3.1.1-71	B

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steam Generators (Tube Support Plates and U-Bend Supports)	Structural Support	Cast Austenitic Stainless Steel (CASS) - (Byron Unit 1 and Braidwood Unit 1 only)	Treated Water > 482 F (External)	Loss of Material	Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	A
		Nickel Alloy	Treated Water (External)	Cracking	Steam Generators (B.2.1.10)	IV.D1.RP-384	3.1.1-71	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-384	3.1.1-71	A
				Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-225	3.1.1-76	B
						IV.D1.RP-226	3.1.1-71	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	A
		Stainless Steel	Treated Water > 140 F (External) - (Byron Unit 2 and Braidwood Unit 2 only)	Cracking	Steam Generators (B.2.1.10)	IV.D1.RP-384	3.1.1-71	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-384	3.1.1-71	A
				Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-225	3.1.1-76	B
						IV.D1.RP-226	3.1.1-71	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	A
			Treated Water > 482 F (External) - (Byron Unit 1 and Braidwood Unit 1 only)	Cracking	Steam Generators (B.2.1.10)	IV.D1.RP-384	3.1.1-71	B
					Water Chemistry (B.2.1.2)	IV.D1.RP-384	3.1.1-71	A
				Loss of Fracture Toughness	Steam Generators (B.2.1.10)			H, 6
				Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-225	3.1.1-76	B
						IV.D1.RP-226	3.1.1-71	B

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steam Generators (Tube Support Plates and U-Bend Supports)	Structural Support	Stainless Steel	Treated Water > 482 F (External) - (Byron Unit 1 and Braidwood Unit 1 only)	Loss of Material	Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	A
Steam Generators (Tube-to-Tube Sheet Weld - Byron Unit 1 and Braidwood Unit 1 only)	Pressure Boundary	Nickel Alloy	Reactor Coolant	Cracking	Steam Generators (B.2.1.10)	IV.D1.RP-385	3.1.1-25	E, 7
					Water Chemistry (B.2.1.2)	IV.D1.RP-385	3.1.1-25	A
				Cumulative Fatigue Damage	TLAA	IV.D1.R-221	3.1.1-8	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	C
Steam Generators (Tubes)	Heat Transfer	Nickel Alloy	Reactor Coolant	Cracking	Steam Generators (B.2.1.10)	IV.D1.R-44	3.1.1-70	B
					Water Chemistry (B.2.1.2)	IV.D1.R-44	3.1.1-70	A
				Cumulative Fatigue Damage	TLAA	IV.D1.R-46	3.1.1-2	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	C
			Treated Water (External)	Cracking	Steam Generators (B.2.1.10)	IV.D1.R-48	3.1.1-69	B
					Water Chemistry (B.2.1.2)	IV.D1.R-48	3.1.1-69	A
					Steam Generators (B.2.1.10)	IV.D1.R-47	3.1.1-69	B
					Water Chemistry (B.2.1.2)	IV.D1.R-47	3.1.1-69	A
				Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-233	3.1.1-77	B
						IV.D1.RP-226	3.1.1-71	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	C
				Reduction of Heat Transfer	Steam Generators (B.2.1.10)			H, 8

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steam Generators (Tubes)	Heat Transfer	Nickel Alloy	Treated Water (External)	Reduction of Heat Transfer	Water Chemistry (B.2.1.2)			H, 8
	Pressure Boundary	Nickel Alloy	Reactor Coolant	Cracking	Steam Generators (B.2.1.10)	IV.D1.R-44	3.1.1-70	B
					Water Chemistry (B.2.1.2)	IV.D1.R-44	3.1.1-70	A
				Cumulative Fatigue Damage	TLAA	IV.D1.R-46	3.1.1-2	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	C
			Treated Water (External)	Cracking	Steam Generators (B.2.1.10)	IV.D1.R-48	3.1.1-69	B
					Water Chemistry (B.2.1.2)	IV.D1.R-48	3.1.1-69	A
					Steam Generators (B.2.1.10)	IV.D1.R-47	3.1.1-69	B
					Water Chemistry (B.2.1.2)	IV.D1.R-47	3.1.1-69	A
				Loss of Material	Steam Generators (B.2.1.10)	IV.D1.RP-233	3.1.1-77	B
						IV.D1.RP-226	3.1.1-71	D
					Water Chemistry (B.2.1.2)	IV.D1.RP-226	3.1.1-71	C
Tanks (Steam Generator Blowdown Condenser Hotwell Tank)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-74	3.4.1-13	C
					Water Chemistry (B.2.1.2)	VIII.F.SP-74	3.4.1-13	C
Valve Body	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-74	3.4.1-13	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-87	3.4.1-16	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.F.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-88	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-87	3.4.1-16	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-74	3.4.1-13	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	IV.C2.RP-383	3.1.1-80	C
					Water Chemistry (B.2.1.2)	IV.C2.RP-383	3.1.1-80	C
				Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.F.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-88	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-87	3.4.1-16	A
Valve Body (Class 1 Steam Generator Drain - Byron Unit 1 and Braidwood Unit 1 only)	Pressure Boundary	Cast Austenitic Stainless Steel (CASS)	Air with Borated Water Leakage (External)	None	None	IV.E.RP-05	3.1.1-107	A
			Reactor Coolant	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-09	3.1.1-33	A

Table 3.1.2-4 Steam Generators (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body (Class 1 Steam Generator Drain - Byron Unit 1 and Braidwood Unit 1 only)	Pressure Boundary	Cast Austenitic Stainless Steel (CASS)	Reactor Coolant	Cracking	Water Chemistry (B.2.1.2)	IV.C2.R-09	3.1.1-33	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-223	3.1.1-9	A, 1
				Loss of Fracture Toughness	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	IV.C2.R-08	3.1.1-38	A
				Loss of Material	Water Chemistry (B.2.1.2)	IV.C2.RP-23	3.1.1-88	A

Table 3.1.2-4 Steam Generators (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The TLAA designation in the Aging Management Programs column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3 and Section 4.7.

2. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage the loss of material due to erosion in stainless steel pipe in a treated water >140 F environment.

Table 3.1.2-4 Steam Generators (Continued)

Plant Specific Notes: (continued)

3. The aging effect/mechanism of loss of fracture toughness due to thermal aging embrittlement is not in NUREG-1801 for this component, material, environment combination. Steam generator tube support lattice bar attachment components are fabricated from SA-351 CF3M cast austenitic stainless steel and potentially susceptible to loss of fracture toughness due to thermal aging embrittlement. These components are structural components internal to the secondary side of the steam generator and exposed to temperatures greater than 482 degrees Fahrenheit. The steam generator tube support lattice bar attachment components are a redundant set of components where the intended function of the overlying assembly does not rely upon and will not be impacted by a single component failure in the component population. The components are not Class 1 pressure boundary components, therefore, these components are not included in the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (B.2.1.6) program. Loss of fracture toughness will be indirectly managed by the Steam Generators (B.2.1.10) program which will visually inspect the steam generator tube support lattice structure for gross cracking, deformation, or damage indicating a loss of fracture toughness. Eddy current testing of the steam generator tubes is also used to detect any abnormal or adverse interaction between the steam generator tube support lattice structure and the steam generator tubes.

4. The carbon steel components of the Steam Generators, including the shell, nozzles, instrument bosses, and manways, have an external temperature greater than 212 degrees Fahrenheit and are at a higher temperature than the air-indoor (uncontrolled) environment/air with borated water leakage. Therefore, wetting due to condensation and moisture accumulation will not occur and loss of material (due to general, pitting, and crevice corrosion) does not apply.

5. NUREG-1801 specifies a plant-specific program. The Steam Generators (B.2.1.10) program will be used to verify the effectiveness of the Water Chemistry (B.2.1.2) program to ensure that cracking due to stress corrosion cracking/primary water stress corrosion cracking is not occurring.

6. The aging effect/mechanism of loss of fracture toughness due to thermal aging embrittlement is not in NUREG-1801 for this component, material, environment combination. Steam generator tube support lattice bars are fabricated from SA-240 410S martensitic stainless steel and potentially susceptible to loss of fracture toughness due to thermal aging embrittlement. These components are structural components internal to the secondary side of the steam generator and exposed to temperatures greater than 482 degrees Fahrenheit. The steam generator tube support lattice bars are a redundant set of components where the intended function of the overlying assembly does not rely upon and will not be impacted by a single component failure in the component population. The components are not Class 1 pressure boundary components, therefore, these components are not included in the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (B.2.1.6) program. Loss of fracture toughness will be indirectly managed by the Steam Generators (B.2.1.10) program which will visually inspect the steam generator tube support lattice structure for gross cracking, deformation, or damage indicating a loss of fracture toughness. Eddy current testing of the steam generator tubes is also used to detect any abnormal or adverse interaction between the steam generator tube support lattice structure and the steam generator tubes.

7. NUREG-1801 specifies a plant-specific program. The Steam Generators (B.2.1.10) program will be used to verify the effectiveness of the Water Chemistry (B.2.1.2) program to ensure that cracking due to stress corrosion cracking/primary water stress corrosion cracking is not occurring. This item is only applicable to Unit 1 since a license amendment (Adams Accession Number: ML12262A360), approved by the NRC, redefined the Unit 2 steam generator pressure boundary in which the tube-to-tubesheet welds are no longer included and do not perform a license renewal intended function. Therefore the Unit 2 steam generator tube-to-tubesheet welds are not in scope for license renewal.

Table 3.1.2-4 Steam Generators (Continued)

Plant Specific Notes: (continued)

8. The aging effect/mechanism of reduction of heat transfer due to fouling in not in NUREG-1801 for this component, material, and environment, however, it is applicable to this combination. The Water Chemistry (B.2.1.2) program and Steam Generators (B.2.1.10) program are used to manage the aging effects for this component, material, and environment combination.

9. The Unit 1 steam generator Class 1 drain line is ¾ inches NPS which is outside the scope of the One-Time Inspection of ASME Code Class 1 Small Bore-Piping aging management program which is limited to piping and systems less than 4 inches NPS and greater than or equal to 1 inch NPS. The aging effect of cracking will be managed by the ASME Section XI Inservice Inspection, IWB, IWC, and IWD (B.2.1.1) program and Water Chemistry (B.2.1.2) program.

3.2 AGING MANAGEMENT OF ENGINEERED SAFETY FEATURES

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

3.2.1 INTRODUCTION

This section provides the results of the aging management review for those components identified in Section 2.3.2, Engineered Safety Features, as being subject to aging management review. The systems, or portions of systems, which are addressed in this section are described in the indicated sections.

- Combustible Gas Control System (2.3.2.1)
- Containment Spray System (2.3.2.2)
- Residual Heat Removal System (2.3.2.3)
- Safety Injection System (2.3.2.4)

3.2.2 RESULTS

The following tables summarize the results of the aging management review for Engineered Safety Features.

Table 3.2.2-1 Combustible Gas Control System - Summary of Aging Management Evaluation

Table 3.2.2-2 Containment Spray System - Summary of Aging Management Evaluation

Table 3.2.2-3 Residual Heat Removal System - Summary of Aging Management Evaluation

Table 3.2.2-4 Safety Injection System - Summary of Aging Management Evaluation

3.2.2.1 Materials, Environments, Aging Effects Requiring Management And Aging Management Programs

3.2.2.1.1 Combustible Gas Control System

Materials

The materials of construction for the Combustible Gas Control System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Stainless Steel
- Stainless Steel Bolting

Environments

The Combustible Gas Control System components are exposed to the following environments:

- Air with Borated Water Leakage
- Condensation

Aging Effect Requiring Management

The following aging effects associated with the Combustible Gas Control System components require management:

- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Combustible Gas Control System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)

3.2.2.1.2 Containment Spray System

Materials

The materials of construction for the Containment Spray System components are:

- Aluminum Alloy
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Stainless Steel
- Stainless Steel Bolting

Environments

The Containment Spray System components are exposed to the following environments:

- Air with Borated Water Leakage
- Air/Gas - Dry
- Condensation
- Treated Borated Water

- Treated Water
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Containment Spray System components require management:

- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Containment Spray System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- One-Time Inspection (B.2.1.20)
- Water Chemistry (B.2.1.2)

3.2.2.1.3 Residual Heat Removal System

Materials

The materials of construction for the Residual Heat Removal System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Carbon or Low Alloy Steel with Stainless Steel Cladding
- Glass
- Stainless Steel
- Stainless Steel Bolting

Environments

The Residual Heat Removal System components are exposed to the following environments:

- Air with Borated Water Leakage
- Treated Borated Water > 140°F
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Residual Heat Removal System components require management:

- Cracking
- Cumulative Fatigue Damage
- Loss of Material
- Loss of Preload
- Reduction of Heat Transfer

Aging Management Programs

The following aging management programs manage the aging effects for the Residual Heat Removal System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- One-Time Inspection (B.2.1.20)
- TLAA
- Water Chemistry (B.2.1.2)

3.2.2.1.4 Safety Injection System

Materials

The materials of construction for the Safety Injection System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Carbon or Low Alloy Steel with Stainless Steel Cladding
- Copper Alloy with less than 15% Zinc
- Glass
- Gray Cast Iron
- Nickel Alloy
- Stainless Steel
- Stainless Steel Bolting

Environments

The Safety Injection System components are exposed to the following environments:

- Air - Outdoor
- Air with Borated Water Leakage
- Air/Gas - Dry
- Concrete
- Condensation
- Lubricating Oil
- Treated Borated Water
- Treated Borated Water > 140°F
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Safety Injection System components require management:

- Cracking
- Cumulative Fatigue Damage
- Loss of Material
- Loss of Preload
- Reduction of Heat Transfer

Aging Management Programs

The following aging management programs manage the aging effects for the Safety Injection System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- Lubricating Oil Analysis (B.2.1.26)
- One-Time Inspection (B.2.1.20)
- TLAA
- Water Chemistry (B.2.1.2)

3.2.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

NUREG-1801 provides the basis for identifying those programs that warrant further evaluation by the reviewer in the license renewal application. For the Engineered Safety Features, those programs are addressed in the following subsections.

3.2.2.2.1 Cumulative Fatigue Damage

Fatigue is a time-limited aging analysis (TLAA) as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). This TLAA is addressed separately in Section 4.3, "Metal Fatigue Analysis," of this SRP-LR.

Cumulative fatigue damage is an aging effect assessed by a fatigue time-limited aging analysis (TLAA). The fatigue TLAA is required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of the fatigue TLAA for the Residual Heat Removal System is discussed in Section 4.3, "Metal Fatigue" and Section 4.7 "Other Plant-Specific Time-Limited Aging Analysis." The evaluation of the fatigue TLAA for the Safety Injection System is discussed in Section 4.3, "Metal Fatigue."

3.2.2.2.2 Loss of Material due to Cladding Breach

Loss of material due to cladding breach could occur for PWR steel pump casings with stainless steel cladding exposed to treated borated water. The GALL Report references NRC Information Notice 94-63, Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks, and recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

Item Number 3.2.1-2 is not applicable to BBS. There are no steel with stainless steel cladding charging pump casings exposed to treated borated water in the Engineered Safety Features systems.

3.2.2.2.3 Loss of Material due to Pitting and Crevice Corrosion

1. *Loss of material due to pitting and crevice corrosion could occur in partially encased stainless steel tanks exposed to raw water due to cracking of the perimeter seal from weathering. The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed. The GALL Report recommends that a plant-specific AMP be evaluated because moisture and water can egress under the tank if the perimeter seal is degraded. Acceptance criteria are described in Branch Technical Position RSLB-1.*

Item Number 3.2.1-3 is not applicable to BBS. There are no partially encased stainless steel tanks with perimeter seals that protect the external embedded stainless surfaces from exposure to raw water in the Engineered Safety Features systems.

2. *Loss of material due to pitting and crevice corrosion could occur for stainless steel piping, piping components, piping elements, and tanks exposed to outdoor air. The possibility of pitting and crevice corrosion also extends to components exposed to air which has recently been introduced into buildings, i.e., components near intake vents. Pitting and crevice corrosion is only known to occur in environments containing sufficient halides (primarily chlorides) and in which condensation or deliquescence is possible. Condensation or deliquescence should generally be assumed to be possible. Applicable outdoor air environments (and associated indoor air environments) include, but are not limited to, those within approximately 5 miles of a saltwater coastline, those within 1/2 mile of a highway which is treated with salt in the wintertime, those areas in which the soil contains more than trace chlorides, those plants having cooling towers where the water is treated with chlorine or chlorine compounds, and those areas subject to chloride contamination from other agricultural or industrial sources. This item is applicable for the environments described above.*

   GALL AMP XI.M36, "External Surfaces Monitoring," is an acceptable method to manage the aging effect. The applicant may demonstrate that this item is not applicable by describing the outdoor air environment present at the plant and demonstrating that external pitting or crevice corrosion is not expected. The GALL Report recommends further evaluation to determine whether an aging management program is needed to manage this aging effect based on the environmental conditions applicable to the plant and requirements applicable to the components.

   Byron and Braidwood Stations will implement the External Surfaces Monitoring of Mechanical Components (B.2.1.23) program to manage the loss of material in stainless steel piping, piping components, and piping elements exposed to an outdoor air environment in the Safety Injection System. There are no stainless steel tanks exposed to an outdoor air environment in the scope of license renewal at Byron and Braidwood Stations. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program provides for management of aging effects through periodic visual inspection of external surfaces for evidence of loss of material. Visual inspection activities will be performed by qualified personnel in accordance with site controlled procedures and processes. Any visible evidence of loss of material will be evaluated for acceptability of continued service. Deficiencies will be documented in accordance with the 10 CFR Part 50, Appendix B Corrective Action Program. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program is described in Appendix B.

3.2.2.2.4 Loss of Material due to Erosion

Loss of material due to erosion could occur in the stainless steel high-pressure safety injection (HPSI) pump miniflow recirculation orifice exposed to treated borated water.

The GALL Report recommends a plant-specific AMP be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. The GALL Report references Licensee Event Report (LER) 50-275/94-023 for evidence of erosion. Further evaluation is recommended to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1.

Byron and Braidwood Stations will implement a One-Time Inspection (B.2.1.20) program to verify the effectiveness of the Water Chemistry (B.2.1.2) program to manage the loss of material due to erosion in stainless steel high-pressure charging pump minimum flow recirculation orifices exposed to treated borated water in the Chemical & Volume Control System. BBS will perform a one-time inspection of one orifice on each unit associated with the centrifugal charging pump minimum flow recirculation orifice prior to entering the period of extended operation. This inspection will verify the effectiveness of the Water Chemistry (B.2.1.2) program. The Water Chemistry (B.2.1.2) program and One-Time Inspection (B.2.1.20) program are described in Appendix B.

3.2.2.2.5 Loss of Material due to General Corrosion and Fouling that Leads to Corrosion

Loss of material due to general corrosion and fouling that leads to corrosion can occur for steel drywell and suppression chamber spray system nozzle and flow orifice internal surfaces exposed to air - indoor uncontrolled. This could result in plugging of the spray nozzles and flow orifices. This aging mechanism and effect will apply since the spray nozzles and flow orifices are occasionally wetted, even though the majority of the time this system is on standby. The wetting and drying of these components can accelerate corrosion and fouling. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RSLB-1.

Item Number 3.2.1-6 is applicable to BWRs only and not used for Byron and Braidwood Stations. There are no steel drywell and suppression chamber spray system flow orifices or spray nozzles exposed to air – indoor uncontrolled in Engineered Safety Features Systems. The spray nozzles in the Containment Spray System are stainless steel exposed to condensation and evaluated in Item Number 3.2.1-48.

3.2.2.2.6 Cracking due to Stress Corrosion Cracking

Cracking due to stress corrosion cracking could occur for stainless steel piping, piping components, piping elements and tanks exposed to outdoor air. The possibility of cracking also extends to components exposed to air which has recently been introduced into buildings, i.e., components near intake vents. Cracking is only known to occur in environments containing sufficient halides (primarily chlorides) and in which condensation or deliquescence is possible. Condensation or deliquescence should generally be assumed to be possible. Applicable outdoor air environments (and associated indoor air environments) include, but are not limited to, those within approximately 5 miles of a saltwater coastline, those within 1/2 mile of a highway which is treated with salt in the wintertime, those areas in which the soil contains more than trace chlorides, those plants having cooling towers where the water is treated with chlorine or chlorine compounds, and those areas subject to chloride contamination from *other agricultural or industrial sources. This item is applicable for the environments described above.*

GALL AMP XI.M36, "External Surfaces Monitoring," is an acceptable method to manage the aging effect. The applicant may demonstrate that this item is not applicable by describing the outdoor air environment present at the plant and demonstrating that external chloride stress corrosion cracking is not expected. The GALL Report recommends further evaluation to determine whether an aging management program is needed to manage this aging effect based on the environmental conditions applicable to the plant and requirements applicable to the components.

The only stainless steel components exposed to outdoor air in the Engineered Safety Features Systems are insulated portions of the piping vent line for the refueling water storage tank in the Safety Injection System. There are no stainless steels tanks exposed to an outdoor air environment in the scope of license renewal at Byron and Braidwood Stations (BBS). Stress corrosion cracking of these components is not expected to occur, however, should cracking occur the function of these components would not be affected since an exhaust path for the refueling water storage tank would still be provided.

The thermal insulation utilized for the refueling water storage tank vent line piping acts as a barrier to prevent the accumulation of halide contamination due to environmental sources. The insulation used for the Safety Injection System is fiberglass insulation designed to meet the requirements of Regulatory Guide 1.36, "Nonmetallic Thermal Insulation for Austenitic Stainless Steel." Therefore, halide contamination due to leaching of contaminants from insulation is not expected to occur.

A large buildup of halide contamination increases the probability of cracking due to stress corrosion cracking which has the potential to lead to loss of component intended function. As explained below, significant halide contamination of stainless steel piping, piping components, and piping elements exposed to outdoor air or exposed to air which has recently been introduced into buildings is not expected at BBS. Additionally, an elevated temperature increases the likelihood of cracking. Experimental studies and industry operating experience in chloride-containing (coastal) environments have shown that stainless steel exposed to an outdoor air environment can crack at temperatures as low as 104°F to 120°F, depending on humidity, component surface temperature, and contaminant concentration and composition. The highest temperatures recorded at BBS over the 10-year period between June 1, 2001 and June 1, 2012 were 94.4°F at Byron Station and 98.2°F at Braidwood Station. A review of historical temperature data since construction for areas surrounding BBS indicates that temperatures rarely exceed 100°F. UFSAR Section 2.3.2.1.2 identifies long-term average temperatures of approximately 50°F for BBS. Therefore, stress corrosion cracking of stainless steel piping, piping components, and piping elements exposed to outdoor air or exposed to air which has recently been introduced into buildings is not expected to occur at BBS.

Halide surface contamination is significant in areas where there are greater concentrations of halides such as near the seacoast where salt spray is prevalent or near industrial facilities. Byron and Braidwood Stations are not located near the seacoast. They are located inland, in central Illinois. Both Byron and Braidwood are located in areas where industrial halide concentrations are low, since they are located in rural areas with no heavy industry nearby.

Byron and Braidwood Stations are not located within one half mile of a highway treated with salt in the wintertime. Major highways in the vicinity of Byron Station include interstate I-90 northeast of the site approximately 11 miles away, interstate I-39 east of the site approximately 11 miles away, and interstate I-88 south of the site approximately 14 miles away. The only major highway in the vicinity of Braidwood Station is interstate I-55 northwest of the site approximately three quarters of a mile away.

The cooling towers at Byron Station are treated with sodium hypochlorite. However, chloride contamination of stainless steel components located outdoors is not expected since the prevailing wind direction is west to east and is directed away from the site. Braidwood Station does not have cooling towers.

Halide contamination of stainless steel components from soil containing more than trace chlorides or from agricultural sources is not expected. However, should halide contamination occur, any potential buildup of halide contamination would be gradual and such contamination would be periodically washed away by rainfall or snow. Cracking due to cumulative build up of halides on stainless steel components located outdoors at BBS has not been experienced and is not expected. The smooth surfaces of the stainless steel components aid the removal of potential halide contamination. Therefore, the concentration of contaminants necessary to initiate stress corrosion cracking of stainless steel is not expected.

Based on the collective environmental conditions, as described above, and confirmed by a review of operating experience, cracking due to stress corrosion cracking of stainless steel components exposed to outdoor air is not expected to occur. Therefore, aging management activities for cracking due to stress corrosion cracking for stainless steel components exposed to outdoor air are not required for the period of extended operation.

3.2.2.2.7 Quality Assurance for Aging Management of Nonsafety-Related Components

QA provisions applicable to License Renewal are discussed in Section B.1.3.

3.2.2.3 Time-Limited Aging Analysis

The time-limited aging analyses identified below are associated with the Engineered Safety Features components:

- Section 4.3, Metal Fatigue
- Section 4.7, Other Plant-Specific Time-Limited Aging Analysis

3.2.3 CONCLUSION

The Engineered Safety Features piping, fittings, and components that are subject to aging management review have been identified in accordance with the requirements of 10 CFR 54.4. The aging management programs selected to manage aging effects for the Engineered Safety Features components are identified in the summaries in Section 3.2.2.1 above.

A description of these aging management programs is provided in Appendix B, along with the demonstration that the identified aging effects will be managed for the period of extended operation.

Therefore, based on the conclusions provided in Appendix B, the effects of aging associated with the Engineered Safety Features components will be adequately managed so that there is reasonable assurance that the intended functions are maintained consistent with the current licensing basis during the period of extended operation.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-1	Stainless steel, Steel Piping, piping components, and piping elements exposed to Treated water (borated)	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA	Cumulative fatigue damage is an aging effect assessed by a fatigue TLAA. Further evaluation is documented in subsection 3.2.2.2.1.
3.2.1-2	Steel (with stainless steel cladding) Pump casings exposed to Treated water (borated)	Loss of material due to cladding breach	A plant-specific aging management program is to be evaluated Reference NRC Information Notice 94-63, "Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks."	Yes, verify that plant-specific program addresses clad breach	Not Applicable. See subsection 3.2.2.2.2.
3.2.1-3	Stainless steel Partially-encased tanks with breached moisture barrier exposed to Raw water	Loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated for pitting and crevice corrosion of tank bottom because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	Yes, plant-specific	Not Applicable. See subsection 3.2.2.2.3.1.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-4	Stainless steel Piping, piping components, and piping elements; tanks exposed to Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated	Consistent with NUREG-1801. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program will be used to manage loss of material of stainless steel piping, piping components, and piping elements exposed to air - outdoor. See subsection 3.2.2.2.3.2.
3.2.1-5	Stainless steel Orifice (miniflow recirculation) exposed to Treated water (borated)	Loss of material due to erosion	A plant-specific aging management program is to be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. See LER 50-275/94-023 for evidence of erosion.	Yes, plant-specific	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage loss of material of the stainless steel orifice (mini-flow recirculation) exposed to treated borated water. See subsection 3.2.2.2.4.
3.2.1-6	BWR Only				

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-7	Stainless steel Piping, piping components, and piping elements; tanks exposed to Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated	Based on the evaluation of the environmental conditions at BBS and a review of operating experience, cracking is not an applicable aging effect for the stainless steel piping, piping components, and piping elements exposed to air - outdoor. See subsection 3.2.2.2.6.
3.2.1-8	Aluminum, Copper alloy (>15% Zn or >8% Al) Piping, piping components, and piping elements exposed to Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No	Consistent with NUREG-1801. The Boric Acid Corrosion (B.2.1.4) program will be used to manage loss of material of aluminum alloy valve bodies exposed to air with borated water leakage in the Containment Spray System.
3.2.1-9	Steel External surfaces, Bolting exposed to Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No	Consistent with NUREG-1801. The Boric Acid Corrosion (B.2.1.4) program will be used to manage loss of material of steel bolting, ducting and components, heat exchanger components, piping, piping components, piping elements, and tanks exposed to air with borated water leakage in the Combustible Gas Control System, Containment Spray System, Residual Heat Removal System, and Safety Injection System.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-10	Cast austenitic stainless steel Piping, piping components, and piping elements exposed to Treated water (borated) >250°C (>482°F), Treated water >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	Chapter XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No	Not Applicable. There are no cast austenitic stainless steel piping, piping components, and piping elements exposed to treated borated water > 482°F or treated water > 482°F in the Engineered Safety Features systems.
3.2.1-11	BWR Only				
3.2.1-12	Steel, high-strength Closure bolting exposed to Air with steam or water leakage	Cracking due to cyclic loading, stress corrosion cracking	Chapter XI.M18, "Bolting Integrity"	No	Not Applicable. There is no steel, high-strength closure bolting exposed to air with steam or water leakage in the Engineered Safety Features systems.
3.2.1-13	Steel; stainless steel Bolting, Closure bolting exposed to Air – outdoor (External), Air – indoor, uncontrolled (External)	Loss of material due to general (steel only), pitting, and crevice corrosion	Chapter XI.M18, "Bolting Integrity"	No	Consistent with NUREG-1801. The Bolting Integrity (B.2.1.9) program will be used to manage loss of material of steel, stainless steel bolting, and Class 1 stainless steel bolting exposed to air with borated water leakage in the Combustible Gas Control System, Containment Spray System, Reactor Coolant System, and Reactor Vessel, Residual Heat Removal System, and Safety Injection System.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-14	Steel Closure bolting exposed to Air with steam or water leakage	Loss of material due to general corrosion	Chapter XI.M18, "Bolting Integrity"	No	Not Applicable. There is no steel closure bolting exposed to air with steam or water leakage in the Engineered Safety Features systems. AMR methodology conservatively assumes wetting due to leakage for all bolting in an air – indoor environment. Steel closure bolting exposed to air – indoor is addressed by Item Number 3.2.1-13.
3.2.1-15	Copper alloy, Nickel alloy, Steel; stainless steel, Stainless steel, Steel; stainless steel Bolting, Closure bolting exposed to Any environment, Air – outdoor (External), Raw water, Treated borated water, Fuel oil, Treated water, Air – indoor, uncontrolled (External)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No	Consistent with NUREG-1801. The Bolting Integrity (B.2.1.9) program will be used to manage loss of preload of steel and stainless steel bolting exposed to air with borated water leakage in the Combustible Gas Control System, Containment Spray System, Residual Heat Removal System, and Safety Injection System.
3.2.1-16	Steel Containment isolation piping and components (Internal surfaces), Piping, piping components, and piping elements exposed to Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No	Not Applicable. There are no steel containment isolation piping and components, piping, piping components, and piping elements exposed to treated water in the Engineered Safety Features systems.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.2.1-17	BWR Only				
3.2.1-18	Stainless steel Containment isolation piping and components (Internal surfaces) exposed to Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage loss of material of stainless steel piping, piping components, piping elements, and tanks exposed to treated water in the Containment Spray System and Reactor Coolant System.
3.2.1-19	Stainless steel Heat exchanger tubes exposed to Treated water, Treated water (borated)	Reduction of heat transfer due to fouling	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage reduction of heat transfer of stainless steel heat exchanger tubes exposed to treated borated water > 140°F in the Residual Heat Removal System.
3.2.1-20	Stainless steel Piping, piping components, and piping elements; tanks exposed to Treated water (borated) >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry”, and Chapter XI.M32, “One-Time Inspection”	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of stainless steel heat exchanger components, piping, piping components, and piping elements exposed to treated borated water > 140°F in the Residual Heat Removal System and Safety Injection System.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.2.1-21	Steel (with stainless steel or nickel-alloy cladding) Safety injection tank (accumulator) exposed to Treated water (borated) >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, "Water Chemistry" , and Chapter XI.M32, "One-Time Inspection"	No	Not Applicable. There are no steel with stainless steel or nickel-alloy cladding safety injection tanks exposed to treated borated water > 140°F in the Engineered Safety Features systems.
3.2.1-22	Stainless steel Piping, piping components, and piping elements; tanks exposed to Treated water (borated)	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry" , and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage loss of material of stainless steel heat exchanger components, piping, piping components, piping elements, and tanks exposed to treated borated water in the Containment Spray System, Reactor Coolant System, Reactor Vessel, Residual Heat Removal System, Safety Injection System, and Steam Generators.
3.2.1-23	Steel Heat exchanger components, Containment isolation piping and components (Internal surfaces) exposed to Raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Not Applicable. There are no steel heat exchanger components or containment isolation piping and components exposed to raw water in the Engineered Safety Features systems.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-24	Stainless steel Piping, piping components, and piping elements exposed to Raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Not Applicable. There are no stainless steel piping, piping components, and piping elements exposed to raw water in the Engineering Safety Features systems. The components of the Engineering Safety Features heat exchangers that are exposed to raw water are evaluated in the Service Water System. Loss of material of these components is managed by the Open-Cycle Cooling Water (B.2.1.11) program and is addressed by Item Number 3.3.1-41.
3.2.1-25	Stainless steel Heat exchanger components, Containment isolation piping and components (Internal surfaces) exposed to Raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Not Applicable. There are no stainless steel heat exchanger components or containment isolation piping and components exposed to raw water in the Engineered Safety Features systems.
3.2.1-26	BWR Only				
3.2.1-27	Stainless steel, Steel Heat exchanger tubes exposed to Raw water	Reduction of heat transfer due to fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Not Applicable. There are stainless steel or steel heat exchanger tubes exposed to raw water in the Engineered Safety Features systems.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-28	Stainless steel Piping, piping components, and piping elements exposed to Closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M21A, "Closed Treated Water Systems"	No	Not Applicable. There are no stainless steel piping, piping components, and piping elements exposed to closed cycle cooling water > 140°F in the Engineered Safety Features systems.
3.2.1-29	Steel Piping, piping components, and piping elements exposed to Closed-cycle cooling water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No	Not Applicable. There are no steel piping, piping components, and piping elements exposed to closed cycle cooling water in the Engineered Safety Features systems.
3.2.1-30	Steel Heat exchanger components exposed to Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No	Not Applicable. There are no steel heat exchanger components exposed to closed cycle cooling water in the Engineered Safety Features systems. The components of the Engineering Safety Features heat exchangers that are exposed to closed cycle cooling water are evaluated in the Component Cooling System. Loss of material of these components is managed by the Closed Treated Water Systems (B.2.1.12) program and is addressed by Item Number 3.3.1-46.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-31	Stainless steel Heat exchanger components, Piping, piping components, and piping elements exposed to Closed-cycle cooling water	Loss of material due to pitting and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No	Consistent with NUREG-1801. The Closed Treated Water Systems (B.2.1.12) program will be used to manage loss of material of stainless steel heat exchanger components exposed to closed cycle cooling water in the Reactor Coolant System. The components of the Engineering Safety Features heat exchangers that are exposed to closed cycle cooling water are evaluated in the Component Cooling System. Loss of material of these components is managed by the Closed Treated Water Systems (B.2.1.12) program and is addressed by Item Number 3.3.1-49.
3.2.1-32	Copper alloy Heat exchanger components, Piping, piping components, and piping elements exposed to Closed-cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No	Not Applicable. There are no copper alloy heat exchanger components, piping, piping components, and piping elements exposed to closed cycle cooling water in the Engineered Safety Features systems.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.2.1-33	Copper alloy, Stainless steel Heat exchanger tubes exposed to Closed-cycle cooling water	Reduction of heat transfer due to fouling	Chapter XI.M21A, "Closed Treated Water Systems"	No	Not Applicable. There are no copper alloy or stainless steel heat exchanger tubes exposed to closed cycle cooling water in the Engineered Safety Features systems. The components of the Engineering Safety Features heat exchangers that are exposed to closed cycle cooling water are evaluated in the Component Cooling System. Reduction of heat transfer of these components is managed by the Closed Treated Water Systems (B.2.1.12) program and is addressed by Item Number 3.3.1-50.
3.2.1-34	Copper alloy (>15% Zn or >8% Al) Piping, piping components, and piping elements, Heat exchanger components exposed to Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No	Not Applicable. There are no copper alloy (greater than 15% Zn or greater than 8% Al) piping, piping components, piping elements, and heat exchanger components exposed to closed cycle cooling water in the Engineered Safety Features systems.
3.2.1-35	Gray cast iron Motor cooler exposed to Treated water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No	Not Applicable. There are no gray cast iron motor coolers exposed to treated water in the Engineered Safety Features systems.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-36	Gray cast iron Piping, piping components, and piping elements exposed to Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No	Not Applicable. There are no gray cast iron piping, piping components, and piping elements exposed to closed cycle cooling water in the Engineered Safety Features systems.
3.2.1-37	Gray cast iron Piping, piping components, and piping elements exposed to Soil	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No	Not Applicable. There are no gray cast iron piping, piping components, and piping elements exposed to soil in the Engineered Safety Features systems.
3.2.1-38	BWR Only				
3.2.1-39	Steel Containment isolation piping and components (External surfaces) exposed to Condensation (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Not Applicable. There are no steel containment isolation piping and components exposed to condensation in the Engineered Safety Features systems.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-40	Steel Ducting, piping, and components (External surfaces), Ducting, closure bolting, Containment isolation piping and components (External surfaces) exposed to Air – indoor, uncontrolled (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Consistent with NUREG-1801. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program will be used to manage loss of material of steel encapsulation components, equipment supports and foundations, heat exchanger components, piping, piping components, piping elements, and tanks exposed to air – indoor uncontrolled and air with borated water leakage in the Auxiliary Building, Containment Spray System, Reactor Coolant System, Reactor Vessel, Residual Heat Removal System, Safety Injection System, and Steam Generators.
3.2.1-41	Steel External surfaces exposed to Air – outdoor (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Not Applicable. There are no steel external surfaces exposed to air – outdoor in the Engineered Safety Features systems.
3.2.1-42	Aluminum Piping, piping components, and piping elements exposed to Air - outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Not Applicable. There are no aluminum alloy piping, piping components, and piping elements exposed to air - outdoor in the Engineered Safety Features systems.
3.2.1-43	BWR Only				

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-44	Steel Piping and components (Internal surfaces), Ducting and components (Internal surfaces) exposed to Air – indoor, uncontrolled (Internal)	Loss of material due to general corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage loss of material of steel piping, piping components, and piping elements exposed to air – indoor uncontrolled in the Auxiliary Building, Auxiliary Feedwater System, and Fire Protection System.
3.2.1-45	Steel Encapsulation components exposed to Air – indoor, uncontrolled (Internal)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Not Applicable. There are no steel encapsulation components exposed to air – indoor uncontrolled in the Engineered Safety Features systems.
3.2.1-46	BWR Only				
3.2.1-47	Steel Encapsulation components exposed to Air with borated water leakage (Internal)	Loss of material due to general, pitting, crevice, and boric acid corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage loss of material of steel encapsulation components exposed to air with borated water leakage in the Auxiliary Building.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-48	Stainless steel Piping, piping components, and piping elements (Internal surfaces); tanks exposed to Condensation (Internal)	Loss of material due to pitting and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage loss of material of stainless steel heat exchanger components, piping, piping components, and piping elements exposed to condensation in the Combustible Gas Control System, Containment Spray System, Reactor Coolant System, and Safety Injection System.
3.2.1-49	Steel Piping, piping components, and piping elements exposed to Lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No	Consistent with NUREG-1801. The Lubricating Oil Analysis (B.2.1.26) program and One-Time Inspection (B.2.1.20) program will be used to manage loss of material of steel piping, piping components, piping elements, and tanks exposed to lubricating oil in the Reactor Coolant System and Safety Injection System.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.2.1-50	Copper alloy, Stainless steel Piping, piping components, and piping elements exposed to Lubricating oil	Loss of material due to pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The Lubricating Oil Analysis (B.2.1.26) program and One-Time Inspection (B.2.1.20) program will be used to manage loss of material of the copper alloy and stainless steel heat exchanger components, piping, piping components, and piping elements exposed to lubricating oil in the Reactor Coolant System and Safety Injection System.
3.2.1-51	Steel, Copper alloy, Stainless steel Heat exchanger tubes exposed to Lubricating oil	Reduction of heat transfer due to fouling	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The Lubricating Oil Analysis (B.2.1.26) program and One-Time Inspection (B.2.1.20) program will be used to manage reduction of heat transfer of copper alloy heat exchanger tubes exposed to lubricating oil in the Chemical & Volume Control System and Safety Injection System.
3.2.1-52	Steel (with coating or wrapping) Piping, piping components, and piping elements exposed to Soil or Concrete	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Not Applicable. There are no steel piping, piping components, and piping elements exposed to soil or concrete in the Engineered Safety Features systems.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-53	Stainless steel Piping, piping components, and piping elements exposed to Soil or Concrete	Loss of material due to pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Not Applicable. There are no stainless steel piping, piping components, and piping elements exposed to soil or concrete in the Engineered Safety Features systems.
3.2.1-53x	Steel; stainless steel Underground piping, piping components, and piping elements exposed to air-indoor uncontrolled or condensation (external)	Loss of material due to general (steel only), pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Not Applicable. There are no steel or stainless steel underground piping, piping components, and piping elements exposed to air-indoor uncontrolled or condensation in the Engineered Safety Features systems.
3.2.1-54	BWR Only				
3.2.1-55	Steel Piping, piping components, and piping elements exposed to Concrete	None	None, provided 1) attributes of the concrete are consistent with ACI 318 or ACI 349 (low water-to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG-1557, and 2) plant OE indicates no degradation of the concrete	No, if conditions are met.	Consistent with NUREG-1801. The attributes of the concrete are consistent with ACI 318. Plant operating experience indicates no degradation of the steel piping, piping components, and piping elements as a result of exposure to the concrete environment. Plant operating experience indicates no degradation of concrete that would lead to degradation of the embedded steel piping, piping components, and piping elements (see subsection 3.5.2.2.2.1).

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-56	Aluminum Piping, piping components, and piping elements exposed to Air – indoor, uncontrolled (Internal/External)	None	None	NA - No AEM or AMP	Not Applicable. There are no aluminum piping, piping components, and piping elements exposed to air – indoor uncontrolled in the Engineered Safety Features systems.
3.2.1-57	Copper alloy Piping, piping components, and piping elements exposed to Air – indoor, uncontrolled (External), Gas	None	None	NA - No AEM or AMP	Not Applicable. There are no copper alloy piping, piping components, and piping elements exposed to air – indoor uncontrolled or gas in the Engineered Safety Features systems.
3.2.1-58	Copper alloy (≤15% Zn and ≤8% Al) Piping, piping components, and piping elements exposed to Air with borated water leakage	None	None	NA - No AEM or AMP	Not Applicable. There are no copper alloy piping, piping components, and piping elements exposed air with borated water leakage in the Engineered Safety Features systems.
3.2.1-59	Galvanized steel Ducting, piping, and components exposed to Air – indoor, controlled (External)	None	None	NA - No AEM or AMP	Not Applicable. There is no galvanized steel ducting, piping, and components exposed to air – indoor controlled in the Engineered Safety Features systems.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-60	Glass Piping elements exposed to Air – indoor, uncontrolled (External), Lubricating oil, Raw water, Treated water, Treated water (borated), Air with borated water leakage, Condensation (Internal/External), Gas, Closed-cycle cooling water, Air – outdoor	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.
3.2.1-61	Nickel alloy Piping, piping components, and piping elements exposed to Air – indoor, uncontrolled (External)	None	None	NA - No AEM or AMP	Not Applicable. There are no nickel alloy piping, piping components, and piping elements exposed to air – indoor uncontrolled in the Engineered Safety Features systems.
3.2.1-62	Nickel alloy Piping, piping components, and piping elements exposed to Air with borated water leakage	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.2.1-63	Stainless steel Piping, piping components, and piping elements exposed to Air – indoor, uncontrolled (External), Air with borated water leakage, Concrete, Gas, Air – indoor, uncontrolled (Internal)	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.
3.2.1-64	Steel Piping, piping components, and piping elements exposed to Air – indoor, controlled (External), Gas	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.

Table 3.2.2-1
Combustible Gas Control System
Summary of Aging Management Evaluation

Table 3.2.2-1 Combustible Gas Control System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.E.E-41	3.2.1-9	A
					Bolting Integrity (B.2.1.9)	V.E.EP-70	3.2.1-13	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	V.E.EP-69	3.2.1-15	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	V.E.EP-70	3.2.1-13	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	V.E.EP-69	3.2.1-15	A
Fan Housing	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	C
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.A-10	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	A
Flow Device	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.D1.EP-81	3.2.1-48	A
Heat Exchanger - (Recombiner Air Blast Heat Exchanger) Tubes	Heat Transfer	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	C

Table 3.2.2-1 Combustible Gas Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Recombiner Air Blast Heat Exchanger) Tubes	Heat Transfer	Stainless Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.D1.EP-81	3.2.1-48	C
	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.D1.EP-81	3.2.1-48	C
Heat Exchanger - (Recombiner Preheater) Tubes	Heat Transfer	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.D1.EP-81	3.2.1-48	C
	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.D1.EP-81	3.2.1-48	C
Piping, piping components, and piping elements	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VIII.G.SP-60	3.4.1-37	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A

Table 3.2.2-1 Combustible Gas Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Stainless Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.D1.EP-81	3.2.1-48	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VIII.G.SP-60	3.4.1-37	A
Recombiners	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.D1.EP-81	3.2.1-48	C
Valve Body	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VIII.G.SP-60	3.4.1-37	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.D1.EP-81	3.2.1-48	A

Table 3.2.2-1 Combustible Gas Control System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

None.

Table 3.2.2-2
Containment Spray System
Summary of Aging Management Evaluation

Table 3.2.2-2 Containment Spray System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.E.E-41	3.2.1-9	A
					Bolting Integrity (B.2.1.9)	V.E.EP-70	3.2.1-13	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	V.E.EP-69	3.2.1-15	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	V.E.EP-70	3.2.1-13	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	V.E.EP-69	3.2.1-15	A
Eductor	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	C
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	C
					Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	C
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.A.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A

Table 3.2.2-2 Containment Spray System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Stainless Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Air/Gas - Dry (Internal)	None	None	V.F.EP-22	3.2.1-63	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.EP-81	3.2.1-48	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.C.EP-63	3.2.1-18	A
					Water Chemistry (B.2.1.2)	V.C.EP-63	3.2.1-18	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.A.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Air/Gas - Dry (Internal)	None	None	V.F.EP-7	3.2.1-64	A
Pump Casing (Containment Spray Pump)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	A
Restricting Orifice	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A

Table 3.2.2-2 Containment Spray System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Restricting Orifice	Pressure Boundary	Stainless Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.EP-81	3.2.1-48	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	A
	Throttle	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.EP-81	3.2.1-48	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	A
Sensor Element (Containment Pressure)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.EP-81	3.2.1-48	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Spray Nozzles (Containment Spray)	Spray	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.EP-81	3.2.1-48	A

Table 3.2.2-2 Containment Spray System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Spray Additive Tank)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	C
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.C.EP-63	3.2.1-18	C
					Water Chemistry (B.2.1.2)	V.C.EP-63	3.2.1-18	C
Valve Body	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Air/Gas - Dry (Internal)	None	None	V.F.EP-22	3.2.1-63	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.A.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.A.EP-41	3.2.1-22	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.C.EP-63	3.2.1-18	A
					Water Chemistry (B.2.1.2)	V.C.EP-63	3.2.1-18	A
	Structural Support	Aluminum Alloy	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.EP-101	3.2.1-8	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-134	3.3.1-113	A
		Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.A.E-28	3.2.1-9	A
			Air/Gas - Dry (Internal)	None	None	V.F.EP-7	3.2.1-64	A

Table 3.2.2-2 Containment Spray System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

None.

Table 3.2.2-3
Residual Heat Removal System
Summary of Aging Management Evaluation

Table 3.2.2-3 Residual Heat Removal System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.E.E-41	3.2.1-9	A
					Bolting Integrity (B.2.1.9)	V.E.EP-70	3.2.1-13	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	V.E.EP-69	3.2.1-15	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	V.E.EP-70	3.2.1-13	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	V.E.EP-69	3.2.1-15	A
Heat Exchanger - (Residual Heat Removal Pump Seal Cooler) Tube Side Components	Pressure Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	C
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	C
				Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	C
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	C
Heat Exchanger - (Residual Heat Removal Pump Seal Cooler) Tubes	Heat Transfer	Stainless Steel	Treated Borated Water > 140 F (Internal)	Reduction of Heat Transfer	One-Time Inspection (B.2.1.20)	V.D1.E-20	3.2.1-19	A
					Water Chemistry (B.2.1.2)	V.D1.E-20	3.2.1-19	A

Table 3.2.2-3 Residual Heat Removal System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Residual Heat Removal Pump Seal Cooler) Tubes	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	C
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	C
				Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	C
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	C
Heat Exchanger - (Residual Heat Removal) Tube Sheet	Pressure Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	C
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	C
				Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	C
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	C
Heat Exchanger - (Residual Heat Removal) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	C
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	C
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	C
				Cumulative Fatigue Damage	TLAA	V.D1.E-13	3.2.1-1	C, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	C
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	C
Heat Exchanger - (Residual Heat Removal) Tubes	Heat Transfer	Stainless Steel	Treated Borated Water > 140 F (Internal)	Reduction of Heat Transfer	One-Time Inspection (B.2.1.20)	V.D1.E-20	3.2.1-19	A
					Water Chemistry (B.2.1.2)	V.D1.E-20	3.2.1-19	A

Table 3.2.2-3 Residual Heat Removal System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Residual Heat Removal) Tubes	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	C
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	C
				Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	C
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	C
Piping Element	Leakage Boundary	Glass	Air with Borated Water Leakage (External)	None	None	V.F.EP-65	3.2.1-60	A
			Waste Water (Internal)	None	None	VII.J.AP-277	3.3.1-119	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A

Table 3.2.2-3 Residual Heat Removal System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Carbon Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	A
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	A
				Cumulative Fatigue Damage	TLAA	V.D1.E-13	3.2.1-1	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Residual Heat Removal)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	A
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	A
				Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
Restricting Orifice	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A

Table 3.2.2-3 Residual Heat Removal System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Restricting Orifice	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	A
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	A
				Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
	Throttle	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	A
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	A
				Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
Strainer Body	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	A
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	A
				Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
Sump Screen	Filter	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A

Table 3.2.2-3 Residual Heat Removal System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	A
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	A
				Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.2.2-3 **Residual Heat Removal System** **(Continued)**

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The TLAA designation in the Aging Management Programs column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3 and Section 4.7.

Table 3.2.2-4
Safety Injection System
Summary of Aging Management Evaluation

Table 3.2.2-4 **Safety Injection System**

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Accumulator	Pressure Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.E.E-41	3.2.1-9	A
					Bolting Integrity (B.2.1.9)	V.E.EP-70	3.2.1-13	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	V.E.EP-69	3.2.1-15	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	V.E.EP-70	3.2.1-13	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	V.E.EP-69	3.2.1-15	A
Electric Heaters (Refueling Water Storage Tank)	Leakage Boundary	Carbon Steel - (Braidwood only)	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)			G, 1
					Water Chemistry (B.2.1.2)			G, 1

Table 3.2.2-4 Safety Injection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Electric Heaters (Refueling Water Storage Tank)	Leakage Boundary	Nickel Alloy	Air with Borated Water Leakage (External)	None	None	V.F.EP-115	3.2.1-62	C
			Treated Borated Water (External)	Loss of Material	One-Time Inspection (B.2.1.20)			G, 1
					Water Chemistry (B.2.1.2)			G, 1
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	C
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	C
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	C
Filter Element	Filter	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-76	3.2.1-50	A
					One-Time Inspection (B.2.1.20)	V.D1.EP-76	3.2.1-50	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-76	3.2.1-50	A
					One-Time Inspection (B.2.1.20)	V.D1.EP-76	3.2.1-50	A
Filter Housing	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-77	3.2.1-49	A
					One-Time Inspection (B.2.1.20)	V.D1.EP-77	3.2.1-49	A
		Gray Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A

Table 3.2.2-4 Safety Injection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Filter Housing	Pressure Boundary	Gray Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-77	3.2.1-49	A
					One-Time Inspection (B.2.1.20)	V.D1.EP-77	3.2.1-49	A
Heat Exchanger - (SI Pump Bearing Oil Cooler) Shell Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	C
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-80	3.2.1-50	C
					One-Time Inspection (B.2.1.20)	V.D1.EP-80	3.2.1-50	C
Heat Exchanger - (SI Pump Bearing Oil Cooler) Tube Sheet	Pressure Boundary	Stainless Steel	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-80	3.2.1-50	C
					One-Time Inspection (B.2.1.20)	V.D1.EP-80	3.2.1-50	C
Heat Exchanger - (SI Pump Bearing Oil Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Reduction of Heat Transfer	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-78	3.2.1-51	A
					One-Time Inspection (B.2.1.20)	V.D1.EP-78	3.2.1-51	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-76	3.2.1-50	C
					One-Time Inspection (B.2.1.20)	V.D1.EP-76	3.2.1-50	C
Piping Element	Leakage Boundary	Glass	Air with Borated Water Leakage (External)	None	None	V.F.EP-65	3.2.1-60	A
			Lubricating Oil (Internal)	None	None	V.F.EP-16	3.2.1-60	A

Table 3.2.2-4 Safety Injection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping Element	Leakage Boundary	Glass	Waste Water (Internal)	None	None	VII.J.AP-277	3.3.1-119	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Air/Gas - Dry (Internal)	None	None	V.F.EP-7	3.2.1-64	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-77	3.2.1-49	A
					One-Time Inspection (B.2.1.20)	V.D1.EP-77	3.2.1-49	A
		Stainless Steel	Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.D1.EP-107	3.2.1-4	A

Table 3.2.2-4 Safety Injection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Stainless Steel	Air - Outdoor (External)	None	None	V.D1.EP-103	3.2.1-7	I, 2
			Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Air/Gas - Dry (Internal)	None	None	V.F.EP-22	3.2.1-63	A
			Concrete (External)	None	None	V.F.EP-20	3.2.1-63	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.D1.EP-81	3.2.1-48	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-80	3.2.1-50	A
					One-Time Inspection (B.2.1.20)	V.D1.EP-80	3.2.1-50	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	A
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	A
				Cumulative Fatigue Damage	TLAA	V.D1.E-13	3.2.1-1	A, 3
				Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Air/Gas - Dry (Internal)	None	None	V.F.EP-7	3.2.1-64	A

Table 3.2.2-4 Safety Injection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Refueling Water Storage Tank Heating)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
Pump Casing (Safety Injection)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
Restricting Orifice	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	A
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	A
				Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
	Throttle	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	A
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	A

Table 3.2.2-4 Safety Injection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Restricting Orifice	Throttle	Stainless Steel	Treated Borated Water > 140 F (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
Strainer Body	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
Tanks (Refueling Water Storage)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Concrete (External)	None	None	V.F.EP-20	3.2.1-63	C, 4
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
Tanks (Safety Injection Pump Oil Reservoir)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-77	3.2.1-49	C
					One-Time Inspection (B.2.1.20)	V.D1.EP-77	3.2.1-49	C
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A

Table 3.2.2-4 Safety Injection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Air/Gas - Dry (Internal)	None	None	V.F.EP-7	3.2.1-64	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-77	3.2.1-49	A
					One-Time Inspection (B.2.1.20)	V.D1.EP-77	3.2.1-49	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	V.F.EP-19	3.2.1-63	A
			Air/Gas - Dry (Internal)	None	None	V.F.EP-22	3.2.1-63	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-80	3.2.1-50	A
					One-Time Inspection (B.2.1.20)	V.D1.EP-80	3.2.1-50	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	V.D1.E-12	3.2.1-20	A
					Water Chemistry (B.2.1.2)	V.D1.E-12	3.2.1-20	A

Table 3.2.2-4 Safety Injection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.EP-41	3.2.1-22	A
					Water Chemistry (B.2.1.2)	V.D1.EP-41	3.2.1-22	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	V.D1.E-28	3.2.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A
			Air/Gas - Dry (Internal)	None	None	V.F.EP-7	3.2.1-64	A

Table 3.2.2-4 Safety Injection System (Continued)

Notes	**Definition of Note**
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Environment not in NUREG-1801 for this component and material. The Water Chemistry (B.2.1.2) program and One-Time Inspection (B.2.1.20) program are used to manage the aging effect(s) applicable to this component type, material, and environment combination.

2. Based on an evaluation of the environmental conditions at BBS and a review of operating experience, cracking due to stress corrosion cracking is not an applicable aging effect for stainless steel in an Air-Outdoor environment. For more information see LRA Section 3.3.2.2.3.

3. The TLAA designation in the Aging Management Programs column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3.

4. The external concrete portion of the refueling water storage tank structure is evaluated with the RWST Tank and Foundation.

3.3 AGING MANAGEMENT OF AUXILIARY SYSTEMS

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

3.3.1 INTRODUCTION

This section provides the results of the aging management review for those components identified in Section 2.3.3, Auxiliary Systems, as being subject to aging management review. The systems, or portions of systems, which are addressed in this section are described in the indicated sections.

- Auxiliary Building Ventilation System (2.3.3.1)
- Chemical & Volume Control System (2.3.3.2)
- Chilled Water System (2.3.3.3)
- Circulating Water System (2.3.3.4)
- Component Cooling System (2.3.3.5)
- Compressed Air System (2.3.3.6)
- Containment Ventilation System (2.3.3.7)
- Control Area Ventilation System (2.3.3.8)
- Cranes and Hoists (2.3.3.9)
- Demineralized Water System (2.3.3.10)
- Emergency Diesel Generator & Auxiliaries System (2.3.3.11)
- Fire Protection System (2.3.3.12)
- Fresh Water System (2.3.3.13)
- Fuel Handling & Fuel Storage System (2.3.3.14)
- Fuel Oil System (2.3.3.15)
- Heating Water and Heating Steam System (2.3.3.16)
- Non-Radioactive Drain System (2.3.3.17)
- Radiation Monitoring System (2.3.3.18)
- Radioactive Drain System (2.3.3.19)
- Radwaste System (2.3.3.20)
- Sampling System (2.3.3.21)
- Service Water System (2.3.3.22)
- Spent Fuel Cooling System (2.3.3.23)

3.3.2 RESULTS

The following tables summarize the results of the aging management review for Auxiliary Systems.

Table 3.3.2-1 Auxiliary Building Ventilation System - Summary of Aging Management Evaluation

Table 3.3.2-2 Chemical & Volume Control System - Summary of Aging Management Evaluation

Table 3.3.2-3 Chilled Water System - Summary of Aging Management Evaluation

Table 3.3.2-4 Circulating Water System - Summary of Aging Management Evaluation

Table 3.3.2-5 Component Cooling System - Summary of Aging Management Evaluation

Table 3.3.2-6 Compressed Air System - Summary of Aging Management Evaluation

Table 3.3.2-7 Containment Ventilation System - Summary of Aging Management Evaluation

Table 3.3.2-8 Control Area Ventilation System - Summary of Aging Management Evaluation

Table 3.3.2-9 Cranes and Hoists - Summary of Aging Management Evaluation

Table 3.3.2-10 Demineralized Water System - Summary of Aging Management Evaluation

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System - Summary of Aging Management Evaluation

Table 3.3.2-12 Fire Protection System - Summary of Aging Management Evaluation

Table 3.3.2-13 Fresh Water System - Summary of Aging Management Evaluation

Table 3.3.2-14 Fuel Handling & Fuel Storage System - Summary of Aging Management Evaluation

Table 3.3.2-15 Fuel Oil System - Summary of Aging Management Evaluation

Table 3.3.2-16 Heating Water and Heating Steam System - Summary of Aging Management Evaluation

Table 3.3.2-17 Non-Radioactive Drain System - Summary of Aging Management Evaluation

Table 3.3.2-18 Radiation Monitoring System - Summary of Aging Management Evaluation

Table 3.3.2-19 Radioactive Drain System - Summary of Aging Management Evaluation

Table 3.3.2-20 Radwaste System - Summary of Aging Management Evaluation

Table 3.3.2-21 Sampling System - Summary of Aging Management Evaluation

Table 3.3.2-22 Service Water System - Summary of Aging Management Evaluation

Table 3.3.2-23 Spent Fuel Cooling System - Summary of Aging Management Evaluation

3.3.2.1 Materials, Environments, Aging Effects Requiring Management And Aging Management Programs

3.3.2.1.1 Auxiliary Building Ventilation System

Materials

The materials of construction for the Auxiliary Building Ventilation System components are:

- Aluminum Alloy
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Copper Alloy with less than 15% Zinc
- Elastomers
- Galvanized Steel
- Glass
- Stainless Steel
- Stainless Steel Bolting

Environments

The Auxiliary Building Ventilation System components are exposed to the following environments:

- Air - Outdoor
- Air with Borated Water Leakage
- Condensation
- Treated Water
- Treated Water > 140°F
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Auxiliary Building Ventilation System components require management:

- Cracking
- Hardening and Loss of Strength
- Loss of Material
- Loss of Preload
- Reduction of Heat Transfer

Aging Management Programs

The following aging management programs manage the aging effects for the Auxiliary Building Ventilation System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- One-Time Inspection (B.2.1.20)
- Water Chemistry (B.2.1.2)

3.3.2.1.2 Chemical & Volume Control System

Materials

The materials of construction for the Chemical & Volume Control System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Carbon or Low Alloy Steel with Stainless Steel Cladding
- Copper Alloy with 15% Zinc or More
- Copper Alloy with less than 15% Zinc
- Glass
- Gray Cast Iron
- Stainless Steel
- Stainless Steel Bolting

Environments

The Chemical & Volume Control System components are exposed to the following environments:

- Air with Borated Water Leakage
- Air/Gas - Dry
- Condensation
- Lubricating Oil
- Treated Borated Water
- Treated Borated Water > 140°F
- Treated Water
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Chemical & Volume Control System components require management:

- Cracking
- Cumulative Fatigue Damage
- Loss of Material
- Loss of Preload
- Reduction of Heat Transfer

Aging Management Programs

The following aging management programs manage the aging effects for the Chemical & Volume Control System components:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)
- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Closed Treated Water Systems (B.2.1.12)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- Lubricating Oil Analysis (B.2.1.26)
- One-Time Inspection (B.2.1.20)

- TLAA
- Water Chemistry (B.2.1.2)

3.3.2.1.3 Chilled Water System

Materials

The materials of construction for the Chilled Water System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Copper Alloy with less than 15% Zinc
- Glass
- Gray Cast Iron
- Stainless Steel

Environments

The Chilled Water System components are exposed to the following environments:

- Air with Borated Water Leakage
- Air/Gas - Dry
- Closed Cycle Cooling Water
- Condensation
- Lubricating Oil
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Chilled Water System components require management:

- Loss of Material
- Loss of Preload
- Reduction of Heat Transfer

Aging Management Programs

The following aging management programs manage the aging effects for the Chilled Water System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Closed Treated Water Systems (B.2.1.12)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)

- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- Lubricating Oil Analysis (B.2.1.26)
- One-Time Inspection (B.2.1.20)
- Selective Leaching (B.2.1.21)

3.3.2.1.4 Circulating Water System

Materials

The materials of construction for the Circulating Water System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Polymers
- Stainless Steel
- Stainless Steel Bolting

Environments

The Circulating Water System components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Raw Water

Aging Effect Requiring Management

The following aging effects associated with the Circulating Water System components require management:

- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Circulating Water System components:

- Bolting Integrity (B.2.1.9)
- Buried and Underground Piping (B.2.1.28)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Open-Cycle Cooling Water System (B.2.1.11)

3.3.2.1.5 Component Cooling System

Materials

The materials of construction for the Component Cooling System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Carbon or Low Alloy Steel with Nickel Alloy Cladding
- Carbon or Low Alloy Steel with Stainless Steel Cladding
- Copper Alloy with less than 15% Zinc
- Glass
- Stainless Steel
- Stainless Steel Bolting

Environments

The Component Cooling System components are exposed to the following environments:

- Air with Borated Water Leakage
- Closed Cycle Cooling Water
- Condensation
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Component Cooling System components require management:

- Loss of Material
- Loss of Preload
- Reduction of Heat Transfer

Aging Management Programs

The following aging management programs manage the aging effects for the Component Cooling System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Closed Treated Water Systems (B.2.1.12)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)

- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)

3.3.2.1.6 Compressed Air System

Materials

The materials of construction for the Compressed Air System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Copper Alloy with 15% Zinc or More
- Copper Alloy with less than 15% Zinc
- Stainless Steel
- Stainless Steel Bolting

Environments

The Compressed Air System components are exposed to the following environments:

- Air - Indoor Uncontrolled – (Byron only)
- Air with Borated Water Leakage
- Air/Gas - Dry
- Condensation
- Waste Water – (Byron only)

Aging Effect Requiring Management

The following aging effects associated with the Compressed Air System components require management:

- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Compressed Air System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Compressed Air Monitoring (B.2.1.14)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)

3.3.2.1.7 Containment Ventilation System

Materials

The materials of construction for the Containment Ventilation System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Copper Alloy with less than 15% Zinc
- Elastomers
- Galvanized Steel
- Stainless Steel
- Stainless Steel Bolting

Environments

The Containment Ventilation System components are exposed to the following environments:

- Air - Outdoor
- Air with Borated Water Leakage
- Condensation
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Containment Ventilation System components require management:

- Hardening and Loss of Strength
- Loss of Material
- Loss of Preload
- Reduction of Heat Transfer

Aging Management Programs

The following aging management programs manage the aging effects for the Containment Ventilation System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)

3.3.2.1.8 Control Area Ventilation System

Materials

The materials of construction for the Control Area Ventilation System components are:

- Aluminum Alloy
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Copper Alloy with less than 15% Zinc
- Elastomers
- Galvanized Steel
- Glass
- Stainless Steel
- Stainless Steel Bolting
- PVC

Environments

The Control Area Ventilation System components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Condensation
- Treated Water
- Treated Water > 140°F
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Control Area Ventilation System components require management:

- Cracking
- Hardening and Loss of Strength
- Loss of Material
- Loss of Preload
- Reduction of Heat Transfer

Aging Management Programs

The following aging management programs manage the aging effects for the Control Area Ventilation System components:

- Bolting Integrity (B.2.1.9)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- One-Time Inspection (B.2.1.20)
- Water Chemistry (B.2.1.2)

3.3.2.1.9 Cranes and Hoists

Materials

The materials of construction for the Cranes and Hoists components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting

Environments

The Cranes and Hoists components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Air with Borated Water Leakage

Aging Effect Requiring Management

The following aging effects associated with the Cranes and Hoists components require management:

- Cumulative Fatigue Damage
- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Cranes and Hoists components:

- Boric Acid Corrosion (B.2.1.4)
- Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)

- Structures Monitoring (B.2.1.34)
- TLAA

3.3.2.1.10 Demineralized Water System

Materials

The materials of construction for the Demineralized Water System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Copper Alloy with less than 15% Zinc - (Braidwood only)
- Gray Cast Iron – (Byron only)
- Stainless Steel
- Stainless Steel Bolting

Environments

The Demineralized Water System components are exposed to the following environments:

- Air - Outdoor - (Byron only)
- Air with Borated Water Leakage
- Raw Water - (Byron only)
- Soil - (Byron only)
- Treated Water
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Demineralized Water System components require management:

- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Demineralized Water System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Buried and Underground Piping (B.2.1.28)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)

- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- One-Time Inspection (B.2.1.20)
- Open-Cycle Cooling Water System (B.2.1.11)
- Selective Leaching (B.2.1.21)
- Water Chemistry (B.2.1.2)

3.3.2.1.11 Emergency Diesel Generator & Auxiliaries System

Materials

The materials of construction for the Emergency Diesel Generator & Auxiliaries System components are:

- Aluminum Alloy
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Copper Alloy with 15% Zinc or More
- Copper Alloy with less than 15% Zinc
- Ductile Cast Iron
- Glass
- Gray Cast Iron
- Stainless Steel
- Stainless Steel Bolting - (Braidwood Unit 1 only)
- Zinc

Environments

The Emergency Diesel Generator & Auxiliaries System components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Closed Cycle Cooling Water
- Condensation
- Diesel Exhaust
- Fuel Oil
- Lubricating Oil
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Emergency Diesel Generator & Auxiliaries System components require management:

- Cracking
- Cumulative Fatigue Damage
- Loss of Material
- Loss of Preload
- Reduction of Heat Transfer

Aging Management Programs

The following aging management programs manage the aging effects for the Emergency Diesel Generator & Auxiliaries System components:

- Bolting Integrity (B.2.1.9)
- Closed Treated Water Systems (B.2.1.12)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Fuel Oil Chemistry (B.2.1.18)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- Lubricating Oil Analysis (B.2.1.26)
- One-Time Inspection (B.2.1.20)
- Selective Leaching (B.2.1.21)
- TLAA

3.3.2.1.12 Fire Protection System

Materials

The materials of construction for the Fire Protection System components are:

- Aluminum Alloy
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Ceramic Fiber
- Concrete Block
- Copper Alloy with 15% Zinc or More
- Copper Alloy with less than 15% Zinc
- Ductile Cast Iron

- Elastomers
- Galvanized Steel
- Galvanized Steel Bolting
- Gray Cast Iron
- Grout
- Gypsum
- Mineral Fiber
- Pyrocrete
- Reinforced Concrete
- Soil, Rip-Rap, Sand, Gravel
- Stainless Steel
- Stainless Steel Bolting

Environments

The Fire Protection System components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Air with Borated Water Leakage
- Air/Gas - Dry
- Condensation
- Diesel Exhaust
- Raw Water
- Soil
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Fire Protection System components require management:

- Concrete Cracking and Spalling
- Cracking
- Cracking, Loss of Material, and Loss of Bond
- Cumulative Fatigue Damage
- Hardening, Loss of Strength, and Loss of Sealing
- Loss of Form

- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Fire Protection System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Buried and Underground Piping (B.2.1.28)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Fire Protection (B.2.1.15)
- Fire Water System (B.2.1.16)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- Masonry Walls (B.2.1.33)
- Selective Leaching (B.2.1.21)
- Structures Monitoring (B.2.1.34)
- TLAA

3.3.2.1.13 Fresh Water System

Materials

The materials of construction for the Fresh Water System components are:

- Carbon Steel
- Copper Alloy with less than 15% Zinc

Environments

The Fresh Water System components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air with Borated Water Leakage
- Raw Water

Aging Effect Requiring Management

The following aging effects associated with the Fresh Water System components require management:

- Loss of Material

Aging Management Programs

The following aging management programs manage the aging effects for the Fresh Water System components:

- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)

3.3.2.1.14 Fuel Handling & Fuel Storage System

Materials

The materials of construction for the Fuel Handling & Fuel Storage System components are:

- Boral
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Stainless Steel
- Stainless Steel Bolting

Environments

The Fuel Handling & Fuel Storage System components are exposed to the following environments:

- Air with Borated Water Leakage
- Condensation
- Treated Borated Water

Aging Effect Requiring Management

The following aging effects associated with the Fuel Handling & Fuel Storage System components require management:

- Cumulative Fatigue Damage
- Loss of Material
- Loss of Preload
- Reduction of Neutron Absorbing Capacity; Change in Dimensions and Loss of Material

Aging Management Programs

The following aging management programs manage the aging effects for the Fuel Handling & Fuel Storage System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)
- Monitoring of Neutron-Absorbing Materials Other than Boraflex (B.2.1.27)
- One-Time Inspection (B.2.1.20)
- Structures Monitoring (B.2.1.34)
- TLAA
- Water Chemistry (B.2.1.2)

3.3.2.1.15 Fuel Oil System

Materials

The materials of construction for the Fuel Oil System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Gray Cast Iron
- Stainless Steel
- Stainless Steel Bolting

Environments

The Fuel Oil System components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Air with Borated Water Leakage
- Condensation
- Fuel Oil

Aging Effect Requiring Management

The following aging effects associated with the Fuel Oil System components require management:

- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Fuel Oil System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Fuel Oil Chemistry (B.2.1.18)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- One-Time Inspection (B.2.1.20)

3.3.2.1.16 Heating Water and Heating Steam System

Materials

The materials of construction for the Heating Water and Heating Steam System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Copper Alloy with less than 15% Zinc
- Glass
- Stainless Steel

Environments

The Heating Water and Heating Steam System components are exposed to the following environments:

- Air with Borated Water Leakage
- Closed Cycle Cooling Water
- Closed Cycle Cooling Water > 140°F
- Condensation
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Heating Water and Heating Steam System components require management:

- Cracking
- Cumulative Fatigue Damage
- Loss of Material
- Loss of Preload
- Wall Thinning

Aging Management Programs

The following aging management programs manage the aging effects for the Heating Water and Heating Steam System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Closed Treated Water Systems (B.2.1.12)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Flow-Accelerated Corrosion (B.2.1.8)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- TLAA

3.3.2.1.17 Non-Radioactive Drain System

Materials

The materials of construction for the Non-Radioactive Drain System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting

Environments

The Non-Radioactive Drain System components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air with Borated Water Leakage
- Raw Water
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Non-Radioactive Drain System components require management:

- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Non-Radioactive Drain System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- Open-Cycle Cooling Water System (B.2.1.11)

3.3.2.1.18 Radiation Monitoring System

Materials

The materials of construction for the Radiation Monitoring System components are:

- Aluminum Alloy
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Glass
- Stainless Steel

Environments

The Radiation Monitoring System components are exposed to the following environments:

- Air with Borated Water Leakage
- Air/Gas – Dry
- Closed Cycle Cooling Water
- Condensation
- Raw Water
- Treated Borated Water

- Treated Water
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Radiation Monitoring System components require management:

- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Radiation Monitoring System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Closed Treated Water Systems (B.2.1.12)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- One-Time Inspection (B.2.1.20)
- Open-Cycle Cooling Water System (B.2.1.11)
- Water Chemistry (B.2.1.2)

3.3.2.1.19 Radioactive Drain System

Materials

The materials of construction for the Radioactive Drain System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Ductile Cast Iron
- Glass
- Stainless Steel
- Stainless Steel Bolting

Environments

The Radioactive Drain System components are exposed to the following environments:

- Air with Borated Water Leakage
- Air/Gas - Dry

- Condensation
- Lubricating Oil
- Waste Water
- Waste Water > 140°F

Aging Effect Requiring Management

The following aging effects associated with the Radioactive Drain System components require management:

- Cracking
- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Radioactive Drain System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- Lubricating Oil Analysis (B.2.1.26)
- One-Time Inspection (B.2.1.20)

3.3.2.1.20 Radwaste System

Materials

The materials of construction for the Radwaste System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Carbon or Low Alloy Steel with Stainless Steel Cladding
- Carbon or Low Alloy Steel with Titanium Cladding
- Copper Alloy with less than 15% Zinc
- Ductile Cast Iron
- Glass
- Gray Cast Iron
- Stainless Steel

Environments

The Radwaste System components are exposed to the following environments:

- Air with Borated Water Leakage
- Air/Gas - Dry
- Condensation
- Treated Water
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Radwaste System components require management:

- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Radwaste System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- One-Time Inspection (B.2.1.20)
- Selective Leaching (B.2.1.21)
- Water Chemistry (B.2.1.2)

3.3.2.1.21 Sampling System

Materials

The materials of construction for the Sampling System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Copper Alloy with 15% Zinc or More
- Ductile Cast Iron
- Stainless Steel
- Stainless Steel Bolting

Environments

The Sampling System components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air with Borated Water Leakage
- Air/Gas – Dry – (Braidwood only)
- Closed Cycle Cooling Water
- Condensation
- Raw Water - (Byron only)
- Treated Borated Water
- Treated Borated Water > 140°F
- Treated Water
- Treated Water > 140°F
- Waste Water
- Waste Water > 140°F

Aging Effect Requiring Management

The following aging effects associated with the Sampling System components require management:

- Cracking
- Cumulative Fatigue Damage
- Loss of Material
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Sampling System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Closed Treated Water Systems (B.2.1.12)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- One-Time Inspection (B.2.1.20)
- Open-Cycle Cooling Water System (B.2.1.11)

- Selective Leaching (B.2.1.21)
- TLAA
- Water Chemistry (B.2.1.2)

3.3.2.1.22 Service Water System

Materials

The materials of construction for the Service Water System components are:

- Aluminum Alloy – (Byron only)
- Carbon Steel
- Carbon Steel with Polymer Lining
- Carbon and Low Alloy Steel Bolting
- Carbon or Low Alloy Steel with Copper Alloy (<15% Zinc) Cladding
- Carbon or Low Alloy Steel with Nickel Alloy Cladding
- Carbon or Low Alloy Steel with Stainless Steel Cladding
- Copper Alloy with 15% Zinc or More
- Copper Alloy with less than 15% Zinc
- Elastomers - (Braidwood only)
- Glass
- Gray Cast Iron
- Polymers
- Stainless Steel
- Stainless Steel Bolting
- Titanium Alloy - (Braidwood only)

Environments

The Service Water System components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Air with Borated Water Leakage
- Air/Gas - Dry
- Closed Cycle Cooling Water - (Byron only)
- Concrete
- Condensation - (Byron only)
- Diesel Exhaust - (Byron only)

- Fuel Oil - (Byron only)
- Lubricating Oil
- Raw Water
- Soil
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Service Water System components require management:

- Cracking
- Cumulative Fatigue Damage
- Hardening and Loss of Strength
- Loss of Material
- Loss of Preload
- Reduction of Heat Transfer

Aging Management Programs

The following aging management programs manage the aging effects for the Service Water System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Buried and Underground Piping (B.2.1.28)
- Closed Treated Water Systems (B.2.1.12)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Fuel Oil Chemistry (B.2.1.18)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- Lubricating Oil Analysis (B.2.1.26)
- One-Time Inspection (B.2.1.20)
- Open-Cycle Cooling Water System (B.2.1.11)
- Selective Leaching (B.2.1.21)
- TLAA

3.3.2.1.23 Spent Fuel Cooling System

Materials

The materials of construction for the Spent Fuel Cooling System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Glass
- Stainless Steel
- Stainless Steel Bolting

Environments

The Spent Fuel Cooling System components are exposed to the following environments:

- Air with Borated Water Leakage
- Treated Borated Water
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Spent Fuel Cooling System components require management:

- Loss of Material
- Loss of Preload
- Reduction of Heat Transfer

Aging Management Programs

The following aging management programs manage the aging effects for the Spent Fuel Cooling System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- One-Time Inspection (B.2.1.20)
- Water Chemistry (B.2.1.2)

3.3.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

NUREG-1801 provides the basis for identifying those programs that warrant further evaluation by the reviewer in the license renewal application. For the Auxiliary Systems, those programs are addressed in the following subsections.

3.3.2.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). This TLAA is addressed separately in Section 4.3, "Metal Fatigue Analysis," or Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses," of this SRP-LR.

Cumulative fatigue damage is an aging effect assessed by a fatigue time-limited aging analysis (TLAA). The fatigue TLAA is required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of the fatigue TLAA for the Chemical & Volume Control System, Emergency Diesel Generator & Auxiliaries System, Fire Protection System, Fuel Handling & Fuel Storage System, Heating Water and Heating Steam System, Main Condensate and Feedwater System, Sampling System, and Service Water System is discussed in Section 4.3, "Metal Fatigue." The evaluation of the fatigue TLAA for the Cranes and Hoists and Fuel Handling & Fuel Storage System is discussed in Section 4.7.2, "Cranes."

3.3.2.2.2 Cracking due to Stress Corrosion Cracking and Cyclic Loading

Cracking due to SCC and cyclic loading could occur in stainless steel PWR non-regenerative heat exchanger components exposed to treated borated water greater than 60°C (>140°F) in the chemical and volume control system. The existing aging management program on monitoring and control of primary water chemistry in PWRs manages the aging effects of cracking due to SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic loading. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that cracking is not occurring. The GALL Report recommends that a plant-specific aging management program be evaluated to verify the absence of cracking due to SCC and cyclic loading to ensure that these aging effects are managed adequately. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.

BBS will implement the Water Chemistry (B.2.1.2) program to manage cracking due to stress corrosion cracking and cyclic loading for stainless steel non-regenerative heat exchanger components exposed to treated borated water greater than 140°F in the Chemical & Volume Control System, and verify the effectiveness of the Water Chemistry (B.2.1.2) program by temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes. The One-Time Inspection (B.2.1.20) program will utilize eddy current testing of the heat exchanger tubes to verify the absence of cracking. The Closed Treated Water Systems (B.2.1.12) program includes activities to monitor the temperature and radioactivity of the shell side water. Deficiencies will be documented in accordance with the 10 CFR Part 50, Appendix B Corrective Action Program. The One-Time Inspection (B.2.1.20) program and the Closed Treated Water Systems (B.2.1.12) program are described in Appendix B.

3.3.2.2.3 Cracking due to Stress Corrosion Cracking

Cracking due to stress corrosion cracking could occur for stainless steel piping, piping components, piping elements and tanks exposed to outdoor air. The possibility of cracking also extends to components exposed to air which has recently been introduced into buildings, i.e., components near intake vents. Cracking is only known to occur in environments containing sufficient halides (primarily chlorides) and in which condensation or deliquescence is possible. Condensation or deliquescence should generally be assumed to be possible. Applicable outdoor air environments (and associated indoor air environments) include, but are not limited to, those within approximately 5 miles of a saltwater coastline, those within 1/2 mile of a highway which is treated with salt in the wintertime, those areas in which the soil contains more than trace chlorides, those plants having cooling towers where the water is treated with chlorine or chlorine compounds, and those areas subject to chloride contamination from other agricultural or industrial sources. This item is applicable for the environments described above.

GALL AMP XI.M36, "External Surfaces Monitoring," is an acceptable method to manage the aging effect. The applicant may demonstrate that this item is not applicable by describing the outdoor air environment present at the plant and demonstrating that external chloride stress corrosion cracking is not expected. The GALL Report recommends further evaluation to determine whether an adequate aging management program is used to manage this aging effect based on the environmental conditions applicable to the plant and ASME Code Section XI requirements applicable to the components.

The only stainless steel components exposed to outdoor air in the Auxiliary Systems are (1) portions of the exhaust lines for the diesel generators and diesel-driven pumps in the Emergency Diesel Generators & Auxiliaries System, Fire Protection System, and Service Water System (Byron only); (2) portions of the Service Water System and Demineralized Water System located within vaults or pits; and (3) an insulated length of Auxiliary Building Ventilation System piping that provides a vent path from the refueling water storage tank to the Auxiliary Building filtered vent header. There are no stainless steel tanks exposed to an outdoor air environment in the scope of license renewal at Byron and Braidwood Stations (BBS). Stress corrosion cracking of the diesel exhaust line components due to halide contamination is not expected to occur, however, should cracking occur the function of these components would not be affected since an exhaust path for the diesels would still be provided. In addition to the diesel generator and diesel-driven fire pump exhaust lines; stainless steel portions of the Service Water System, the Demineralized Water System (Byron only), and the Auxiliary Building Ventilation System are considered to have an outdoor air external environment. However, these components are either contained in vaults or pits (Service Water System and Demineralized Water System), or are insulated (Auxiliary Building Ventilation System) and, therefore, the surface of these components is protected from potential halide contamination from environmental sources.

Thermal insulation is utilized for the Auxiliary Building Ventilation System and Emergency Diesel Generators & Auxiliaries System piping exposed to outdoor air. The insulation exposed to outdoor air for the Emergency Diesel Generators & Auxiliaries System is located in a pipe chase and, as such, is not directly exposed to weather effects that could cause wetting and potential leaching of contaminants. The insulation used for the Auxiliary Building Ventilation System is fiberglass insulation designed to meet the Regulatory Guide 1.36, “Nonmetallic Thermal Insulation for Austenitic Stainless Steel” requirements for leachable halide levels. Therefore, halide contamination due to the leaching of contaminants from insulation is not expected to occur for insulated piping in the Auxiliary Building Ventilation System and the Emergency Diesel Generators & Auxiliaries System.

A large buildup of halide contamination increases the probability of cracking due to stress corrosion cracking which has the potential to lead to loss of component intended function. As explained below, significant halide contamination of stainless steel piping, piping components, and piping elements exposed to outdoor air or exposed to air which has recently been introduced into buildings is not expected at BBS. Additionally, an elevated temperature increases the likelihood of cracking. Experimental studies and industry operating experience in chloride-containing (coastal) environments have shown that stainless steel exposed to an outdoor air environment can crack at temperatures as low as 104°F to 120°F, depending on humidity, component surface temperature, and contaminant concentration and composition. The highest temperatures recorded at BBS over the 10-year period between June 1, 2001 and June 1, 2012 were 94.4°F at Byron Station and 98.2°F at Braidwood Station. A review of historical temperature data since construction for areas surrounding BBS indicates that temperatures rarely exceed 100°F. UFSAR Section 2.3.2.1.2 identifies long-term average temperatures of approximately 50°F for BBS. Therefore, stress corrosion cracking of stainless steel piping, piping components, and piping elements exposed to outdoor air or exposed to air which has recently been introduced into buildings is not expected to occur at BBS.

Halide surface contamination is significant in areas where there are greater concentrations of halides such as near the seacoast where salt spray is prevalent or near industrial facilities. Byron and Braidwood Stations are not located near the seacoast. They are located inland, in central Illinois. Both Byron and Braidwood are located in areas where industrial halide concentrations are low, since they are located in rural areas with no heavy industry nearby.

Byron and Braidwood Stations are not located within one half mile of a highway treated with salt in the wintertime. Major highways in the vicinity of Byron Station include interstate I-90 northeast of the site approximately 11 miles away, interstate I-39 west of the site approximately 11 miles away, and interstate I-88 south of the site approximately 14 miles away. The only major highway in the vicinity of Braidwood Station is interstate I-55 northwest of the site approximately three quarters of a mile away.

The cooling towers at Byron Station are treated with sodium hypochlorite. However, chloride contamination of stainless steel components located outdoors is not expected since the prevailing wind direction is west to east and is directed away from the site. Braidwood Station does not have cooling towers.

Halide contamination of stainless steel components from soil containing more than trace chlorides or from agricultural sources is not expected. However, should halide contamination occur, any potential buildup of halide contamination would be gradual and such contamination would be periodically washed away by rainfall or snow. Cracking due to cumulative build up of halides on stainless steel components located outdoors at BBS has not been experienced and is not expected. The smooth surfaces of the stainless steel components aid the removal of potential halide contamination. Therefore, the concentration of contaminants necessary to initiate stress corrosion cracking of stainless steel is not expected.

Based on the collective environmental conditions, as described above, and confirmed by a review of operating experience, cracking due to stress corrosion cracking of stainless steel components exposed to outdoor air is not expected to occur. Therefore, aging management activities for cracking due to stress corrosion cracking for stainless steel components exposed to outdoor air are not required for the period of extended operation.

3.3.2.2.4 Loss of Material due to Cladding Breach

Loss of material due to cladding breach could occur for PWR steel charging pump casings with stainless steel cladding exposed to treated borated water. The GALL Report references NRC Information Notice 94-63, "Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks," and recommends further evaluation of a plant-specific aging management program to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.

Item Number 3.3.1-5 is not applicable to BBS. There are no steel with stainless steel or nickel alloy cladding charging pump casings exposed to treated borated water in the Auxiliary Systems.

3.3.2.2.5 Loss of Material due to Pitting and Crevice Corrosion

Loss of material due to pitting and crevice corrosion could occur for stainless steel piping, piping components, piping elements, and tanks exposed to outdoor air. The possibility of pitting and crevice corrosion also extends to components exposed to air which has recently been introduced into buildings, i.e., components near intake vents. Pitting and crevice corrosion is only known to occur in environments containing sufficient halides (primarily chlorides) and in which condensation or deliquescence is possible. Condensation or deliquescence should generally be assumed to be possible. Applicable outdoor air environments (and associated indoor air environments) include, but are not limited to, those within approximately 5 miles of a saltwater coastline, those within 1/2 mile of a highway which is treated with salt in the wintertime, those areas in which the *soil contains more than trace chlorides, those plants having cooling towers where the water is treated with chlorine or chlorine compounds, and those areas subject to chloride contamination from other agricultural or industrial sources. This item is applicable for the environments described above.*

GALL AMP XI.M36, "External Surfaces Monitoring," is an acceptable method to manage the aging effect. The applicant may demonstrate that this item is not applicable by describing the outdoor air environment present at the plant and demonstrating that external pitting or crevice corrosion is not expected. The GALL Report recommends further evaluation to determine whether an adequate aging management program is used to manage this aging effect based on the environmental conditions applicable to the plant and ASME Code Section XI requirements Quality Assurance for Aging Management of Nonsafety-Related Components.

BBS will implement the External Surfaces Monitoring of Mechanical Components (B.2.1.23) program to manage the loss of material in stainless steel piping, piping components, and piping elements exposed to an outdoor air environment in the Auxiliary Building Ventilation System, Emergency Diesel Generator & Auxiliaries System, Fire Protection System, and Service Water System. There are no stainless steel tanks exposed to an outdoor air environment in the scope of license renewal at BBS. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program provides for management of aging effects through periodic visual inspection of external surfaces for evidence of loss of material. Visual inspection activities will be performed by qualified personnel in accordance with site controlled procedures and processes. Any visible evidence of loss of material will be evaluated for acceptability of continued service. Deficiencies will be documented in accordance with the 10 CFR Part 50, Appendix B Corrective Action Program. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program is described in Appendix B.

3.3.2.2.6 Quality Assurance for Aging Management of Nonsafety-Related Components

QA provisions applicable to License Renewal are discussed in Section B.1.3.

3.3.2.3 Time-Limited Aging Analysis

The time-limited aging analyses identified below are associated with the Auxiliary Systems components:

- Section 4.3, Metal Fatigue

- Section 4.7, Other Plant-Specific Time-Limited Aging Analysis

3.3.3 CONCLUSION

The Auxiliary Systems piping, fittings, and components that are subject to aging management review have been identified in accordance with the requirements of 10 CFR 54.4. The aging management programs selected to manage aging effects for the Auxiliary Systems components are identified in the summaries in Section 3.3.2.1 above.

A description of these aging management programs is provided in Appendix B, along with the demonstration that the identified aging effects will be managed for the period of extended operation.

Therefore, based on the conclusions provided in Appendix B, the effects of aging associated with the Auxiliary Systems components will be adequately managed so that there is reasonable assurance that the intended functions are maintained consistent with the current licensing basis during the period of extended operation.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems					
Item Number	**Component**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.3.1-1	Steel Cranes: structural girders exposed to Air – indoor, uncontrolled (External)	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for structural girders of cranes that fall within the scope of 10 CFR 54 (Standard Review Plan, Section 4.7, “Other Plant-Specific Time-Limited Aging Analyses,” for generic guidance for meeting the requirements of 10 CFR 54.21(c)(1))	Yes, TLAA	Cumulative fatigue damage is an aging effect assessed by a fatigue TLAA. Further evaluation is documented in subsection 3.3.2.2.1.
3.3.1-2	Stainless steel, Steel Heat exchanger components and tubes, Piping, piping components, and piping elements exposed to Treated borated water, Air - indoor, uncontrolled, Treated water	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA	Cumulative fatigue damage is an aging effect assessed by a fatigue TLAA. Further evaluation is documented in subsection 3.3.2.2.1.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-3	Stainless steel Heat exchanger components, non-regenerative exposed to Treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking; cyclic loading	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	Yes, plant-specific	Consistent with NUREG-1801. The Water Chemistry (B.2.1.2) program will be used to manage cracking of stainless steel heat exchanger components exposed to treated borated water > 140°F. NUREG-1801 specifies a plant-specific program to verify the absence of cracking. The One-Time Inspection (B.2.1.20) program will utilize eddy current testing of the tubes to verify the absence of cracking. The Closed Treated Water Systems (B.2.1.12) program includes activities to monitor the temperature and radioactivity of the shell side water to verify the absence of cracking of the tubes and tube sheet. See subsection 3.3.2.2.2.
3.3.1-4	Stainless steel Piping, piping components, and piping elements; tanks exposed to Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated	Based on the evaluation of the environmental conditions at BBS and a review of operating experience, cracking is not an applicable aging effect for stainless steel piping, piping components, and piping elements exposed to air - outdoor. See subsection 3.3.2.2.3.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems					
Item Number	**Component**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.3.1-5	Steel (with stainless steel or nickel-alloy cladding) Pump Casings exposed to Treated borated water	Loss of material due to cladding breach	A plant-specific aging management program is to be evaluated. Reference NRC Information Notice 94-63, “Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks."	Yes, verify that plant-specific program addresses clad cracking	Not Applicable. There are no steel with stainless steel or nickel alloy cladding pump casings exposed to treated borated water in the Auxiliary Systems. See subsection 3.3.2.2.4.
3.3.1-6	Stainless steel Piping, piping components, and piping elements; tanks exposed to Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated	Consistent with NUREG-1801. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program will be used to manage loss of material of stainless steel piping, piping components, and piping elements exposed to air - outdoor. See subsection 3.3.2.2.5.
3.3.1-7	Stainless steel High-pressure pump, casing exposed to Treated borated water	Cracking due to cyclic loading	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program will be used to manage cracking of stainless centrifugal charging pumps exposed to treated borated water in the Chemical & Volume Control System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-8	Stainless steel Heat exchanger components and tubes exposed to Treated borated water >60°C (>140°F)	Cracking due to cyclic loading	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program will be used to manage cracking of stainless heat exchanger components exposed to treated borated water > 140°F in the Chemical & Volume Control System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems					
Item Number	**Component**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.3.1-9	Steel, Aluminum, Copper alloy (>15% Zn or >8% Al) External surfaces, Piping, piping components, and piping elements, Bolting exposed to Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No	Consistent with NUREG-1801. The Boric Acid Corrosion (B.2.1.4) program will be used to manage loss of material of steel, aluminum alloy, and copper alloy with 15% zinc or more bolting, crane/hoist components, doors, ducting and components, fuel storage racks, gas bottles, gearboxes, heat exchanger components, piping, piping components, piping elements, and tanks exposed to air with borated water leakage in the Auxiliary Building Ventilation System, Auxiliary Feedwater System, Chemical & Volume Control System, Chilled Water System, Component Cooling System, Compressed Air System, Containment Ventilation System, Cranes and Hoists, Demineralized Water System, Fire Protection System, Fuel Handling & Fuel Storage System, Fuel Oil System, Heating Water and Heating Steam System, Non-Radioactive Drain System, Radiation Monitoring System, Radioactive Drain System, Radwaste System, Sampling System, Service Water System, and Spent Fuel Cooling System.
3.3.1-10	Steel, high-strength Closure bolting exposed to Air with steam or water leakage	Cracking due to stress corrosion cracking; cyclic loading	Chapter XI.M18, "Bolting Integrity"	No	Not Applicable. There is no high strength steel closure bolting exposed to air with steam or water leakage in the Auxiliary Systems.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-11	Steel, high-strength High-pressure pump, closure bolting exposed to Air with steam or water leakage	Cracking due to stress corrosion cracking; cyclic loading	Chapter XI.M18, "Bolting Integrity"	No	Not Applicable. There is no high strength steel pump closure bolting exposed to air with steam or water leakage in the Auxiliary Systems.
3.3.1-12	Steel; stainless steel Closure bolting, Bolting exposed to Condensation, Air – indoor, uncontrolled (External), Air – outdoor (External)	Loss of material due to general (steel only), pitting, and crevice corrosion	Chapter XI.M18, "Bolting Integrity"	No	Consistent with NUREG-1801. The Bolting Integrity (B.2.1.9) program will be used to manage loss of material of steel and stainless steel bolting and steel heat exchanger tie bars exposed to air – indoor uncontrolled, air – outdoor, air with borated water leakage, and condensation in the Auxiliary Building Ventilation System, Auxiliary Feedwater System, Chemical & Volume Control System, Chilled Water System, Circulating Water System, Component Cooling System, Compressed Air System, Containment Ventilation System, Control Area Ventilation System, Demineralized Water System, Emergency Diesel Generator & Auxiliaries System, Fire Protection System, Fuel Handling & Fuel Storage System, Fuel Oil System, Heating Water and Heating Steam System, Non-Radioactive Drain System, Radiation Monitoring System, Radioactive Drain System, Radwaste System, Sampling System, Service Water System, and Spent Fuel Cooling System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-13	Steel Closure bolting exposed to Air with steam or water leakage	Loss of material due to general corrosion	Chapter XI.M18, "Bolting Integrity"	No	Not Applicable. There is no steel closure bolting exposed to air with steam or water leakage in the Auxiliary Systems. AMR methodology conservatively assumes wetting due to leakage for all bolting in an air – indoor environment. Steel closure bolting exposed to air – indoor is addressed by Item Number 3.3.1-12.
3.3.1-14	Steel, Stainless Steel Bolting exposed to Soil	Loss of preload	Chapter XI.M18, "Bolting Integrity"	No	Consistent with NUREG-1801. The Bolting Integrity (B.2.1.9) program will be used to manage loss of preload of steel bolting exposed to soil in the Fire Protection System and Service Water System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-15	Steel; stainless steel, Copper alloy, Nickel alloy, Stainless steel Closure bolting, Bolting exposed to Air – indoor, uncontrolled (External), Any environment, Air – outdoor (External), Raw water, Treated borated water, Fuel oil, Treated water	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No	Consistent with NUREG-1801. The Bolting Integrity (B.2.1.9) program will be used to manage loss of preload of steel, copper alloy, and stainless steel bolting and heat exchanger tie bars exposed to air – indoor uncontrolled, air – outdoor, air with borated water leakage, condensation, and raw water in the Auxiliary Building Ventilation System, Auxiliary Feedwater System, Chemical & Volume Control System, Chilled Water System, Circulating Water System, Component Cooling System, Compressed Air System, Containment Ventilation System, Control Area Ventilation System, Demineralized Water System, Emergency Diesel Generator & Auxiliaries System, Fire Protection System, Fuel Handling & Fuel Storage System, Fuel Oil System, Heating Water and Heating Steam System, Non-Radioactive Drain System, Radiation Monitoring System, Radioactive Drain System, Radwaste System, Sampling System, Service Water System, and Spent Fuel Cooling System. The Structures Monitoring (B.2.1.34) program has been substituted and will be used to manage loss of preload of stainless steel piping and component support bolting exposed to raw water in the Component Supports Commodity Group.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-16	BWR Only				
3.3.1-17	Stainless steel Heat exchanger tubes exposed to Treated water, Treated borated water	Reduction of heat transfer due to fouling	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection"	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage reduction of heat transfer of stainless steel heat exchanger tubes exposed to treated borated water in the Chemical & Volume Control System and Spent Fuel Cooling System.
3.3.1-18	Stainless steel High-pressure pump, casing, Piping, piping components, and piping elements exposed to Treated borated water >60°C (>140°F), Sodium pentaborate solution >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No	Not Applicable. There are no stainless steel high-pressure pumps exposed to treated borated water > 140°F or piping, piping components, and piping elements exposed to sodium pentaborate solution > 140°F in the Auxiliary Systems. Cracking of stainless steel piping, piping components, and piping elements exposed to treated borated water > 140°F in the Chemical & Volume Control System and Sampling System is managed by the Water Chemistry (B.2.1.2) program and the One-Time Inspection (B.2.1.20) program and is addressed by Item Number 3.3.1-20.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-19	Stainless steel Regenerative heat exchanger components exposed to Treated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No	Not Applicable. The stainless steel regenerative heat exchanger components exposed to treated water > 140°F in the Auxiliary Systems are addressed by Item Number 3.3.1-20.
3.3.1-20	Stainless steel, Stainless steel; steel with stainless steel cladding Heat exchanger components exposed to Treated borated water >60°C (>140°F), Treated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of stainless steel heat exchanger components, piping, piping components, and piping elements exposed to treated borated water > 140°F in the Chemical & Volume Control System and Sampling System.
3.3.1-21	BWR Only				
3.3.1-22	BWR Only				
3.3.1-23	Aluminum Piping, piping components, and piping elements exposed to Treated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No	Not Applicable. There are no aluminum alloy piping, piping components, and piping elements exposed to treated water in the Auxiliary Systems.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-24	BWR Only				
3.3.1-25	BWR Only				
3.3.1-26	Steel (with elastomer lining), Steel (with elastomer lining or stainless steel cladding) Piping, piping components, and piping elements exposed to Treated water	Loss of material due to pitting and crevice corrosion (only for steel after lining/cladding degradation)	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No	Not Applicable. There are no steel (with elastomer lining) or steel (with elastomer lining or stainless steel cladding) piping, piping components, and piping elements exposed to treated water in the Auxiliary Systems.
3.3.1-27	BWR Only				
3.3.1-28	Stainless steel, Piping, piping components, and piping elements; tanks exposed Treated borated water (Primary, oxygen levels controlled) >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry”	No	Consistent with NUREG-1801. The Water Chemistry (B.2.1.2) program will be used to manage cracking of stainless steel piping, piping components, and piping elements exposed to treated borated water > 140°F in the Chemical & Volume Control System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-29	Steel (with stainless steel cladding); stainless steel Piping, piping components, and piping elements exposed to Treated borated water (Primary, oxygen levels controlled)	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry”	No	Consistent with NUREG-1801. The Water Chemistry (B.2.1.2) program will be used to manage loss of material of stainless steel piping, piping components, piping elements, and tanks exposed to treated borated water in the Chemical & Volume Control System.
3.3.1-30	Concrete; cementitious material Piping, piping components, and piping elements exposed to Raw Water	Changes in material properties due to aggressive chemical attack	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Not Applicable. There are no concrete or cementitious material piping, piping components, and piping elements exposed to raw water in the Auxiliary Systems.
3.3.1-30x	Fiberglass, HDPE Piping, piping components, and piping elements exposed to Raw water (internal)	Cracking, blistering, change in color due to water absorption	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Not Applicable. There are no fiberglass or HDPE piping, piping components, and piping elements exposed to raw water in the Auxiliary Systems.
3.3.1-31	Concrete; cementitious material Piping, piping components, and piping elements exposed to Raw Water	Cracking due to settling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Not Applicable. There are no concrete or cementitious material piping, piping components, and piping elements exposed to raw water in the Auxiliary Systems.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems					
Item Number	**Component**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.3.1-32	Reinforced concrete, asbestos cement Piping, piping components, and piping elements exposed to Raw water	Cracking due to aggressive chemical attack and leaching; Changes in material properties due to aggressive chemical attack	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Not Applicable. There are no reinforced concrete or asbestos cement piping, piping components, and piping elements exposed to raw water in the Auxiliary Systems.
3.3.1-32x	Elastomer seals and components exposed to raw water	Hardening and loss of strength due to elastomer degradation; loss of material due to erosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Consistent with NUREG-1801. The Open-Cycle Cooling Water System (B.2.1.11) program will be used to manage hardening and loss of strength of elastomer piping, piping components, and piping elements exposed to raw water in the Service Water System.
3.3.1-33	Concrete; cementitious material Piping, piping components, and piping elements exposed to Raw Water	Loss of material due to abrasion, cavitation, aggressive chemical attack, and leaching	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Not Applicable. There are no concrete or cementitious material piping, piping components, and piping elements exposed to raw water in the Auxiliary Systems.
3.3.1-34	Nickel alloy, Copper alloy Piping, piping components, and piping elements exposed to Raw water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Consistent with NUREG-1801. The Open-Cycle Cooling Water System (B.2.1.11) program will be used to manage loss of material of nickel alloy heat exchanger components exposed to raw water in the Service Water System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-35	Copper alloy Piping, piping components, and piping elements exposed to Raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Consistent with NUREG-1801. The Open-Cycle Cooling Water System (B.2.1.11) program will be used to manage loss of material of copper alloy spray nozzles exposed to raw water in the Service Water System.
3.3.1-36	Copper alloy Piping, piping components, and piping elements exposed to Raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Consistent with NUREG-1801. The Open-Cycle Cooling Water System (B.2.1.11) program will be used to manage loss of material of copper alloy piping, piping components, and piping elements exposed to raw water in the Service Water System.
3.3.1-37	Steel (with coating or lining) Piping, piping components, and piping elements exposed to Raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion; lining/coating degradation	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Consistent with NUREG-1801. The Open-Cycle Cooling Water System (B.2.1.11) program will be used to manage loss of material of steel liners, liner anchors, integral attachments, piping, piping components, and piping elements exposed to raw water in the Deep Well Enclosures (Byron), Demineralized Water System, and Service Water System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-38	Copper alloy, Steel Heat exchanger components exposed to Raw water	Loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Consistent with NUREG-1801. The Open-Cycle Cooling Water System (B.2.1.11) program will be used to manage loss of material of steel and copper alloy heat exchanger components, piping, piping components, piping elements, and tanks exposed to raw water in the Circulating Water System, Non-Radioactive Drain System, Radiation Monitoring System, Sampling System, and Service Water System. The ASME Section XI, Subsection IWF (B.2.1.31) program has been substituted and will be used to manage loss of material of steel piping and component supports exposed to raw water in the Component Supports Commodity Group.
3.3.1-39	Stainless steel Piping, piping components, and piping elements exposed to Raw water	Loss of material due to pitting and crevice corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Not Applicable. AMR methodology predicts loss of material due to fouling for components exposed to raw water. Stainless steel piping, piping components, and piping elements exposed to raw water in the Auxiliary Systems are addressed in Item Number 3.3.1-40.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-40	Stainless steel Piping, piping components, and piping elements exposed to Raw water	Loss of material due to pitting and crevice corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Consistent with NUREG-1801. The Open-Cycle Cooling Water System (B.2.1.11) program will be used to manage loss of material of stainless steel piping, piping components, and piping elements exposed to raw water in the Auxiliary Feedwater System, Demineralized Water System, and Service Water System. The Structures Monitoring (B.2.1.34) program has been substituted and will be used to manage loss of material of stainless steel piping and component supports exposed to raw water in the Component Supports Commodity Group.
3.3.1-41	Stainless steel Piping, piping components, and piping elements exposed to Raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Consistent with NUREG-1801. The Open-Cycle Cooling Water System (B.2.1.11) program will be used to manage loss of material of stainless steel heat exchanger components, piping, piping components, and piping elements exposed to raw water in the Circulating Water System, Radiation Monitoring System, and Service Water System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-42	Copper alloy, Titanium, Stainless steel Heat exchanger tubes exposed to Raw water	Reduction of heat transfer due to fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Consistent with NUREG-1801. The Open-Cycle Cooling Water System (B.2.1.11) program will be used to manage reduction of heat transfer of copper alloy and stainless steel heat exchanger tubes and plates exposed to raw water in the Service Water System.
3.3.1-43	Stainless steel Piping, piping components, and piping elements exposed to Closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M21A, "Closed Treated Water Systems"	No	Consistent with NUREG-1801. The Closed Treated Water Systems (B.2.1.12) program will be used to manage cracking of stainless steel piping, piping components, and piping elements exposed to closed cycle cooling water > 140°F in the Heating Water and Heating Steam System.
3.3.1-44	Stainless steel; steel with stainless steel cladding Heat exchanger components exposed to Closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M21A, "Closed Treated Water Systems"	No	Not Applicable. There are no stainless steel or steel with stainless steel cladding heat exchanger components exposed to closed cycle cooling water > 140°F in the Auxiliary Systems.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems					
Item Number	**Component**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.3.1-45	Steel Piping, piping components, and piping elements; tanks exposed to Closed-cycle cooling water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No	Consistent with NUREG-1801. The Closed Treated Water Systems (B.2.1.12) program will be used to manage loss of material of steel piping, piping components, piping elements, tanks, and turbochargers exposed to closed cycle cooling water in the Auxiliary Feedwater System, Chilled Water System, Component Cooling System, Emergency Diesel Generator & Auxiliaries System, Heating Water and Heating Steam System, Radiation Monitoring System, Sampling System, and Service Water System.
3.3.1-46	Steel, Copper alloy Heat exchanger components, Piping, piping components, and piping elements exposed to Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No	Consistent with NUREG-1801. The Closed Treated Water Systems (B.2.1.12) program will be used to manage loss of material of steel and copper alloy heat exchanger components, piping, piping components, and piping elements exposed to closed cycle cooling water in the Auxiliary Feedwater System, Chilled Water System, Component Cooling System, Emergency Diesel Generator & Auxiliaries System, Heating Water and Heating Steam System, and Service Water System.
3.3.1-47	BWR Only				

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-48	Aluminum Piping, piping components, and piping elements exposed to Closed-cycle cooling water	Loss of material due to pitting and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No	Not Applicable. There are no aluminum alloy piping, piping components, and piping elements exposed to closed cycle cooling water in the Auxiliary Systems.
3.3.1-49	Stainless steel Piping, piping components, and piping elements exposed to Closed-cycle cooling water	Loss of material due to pitting and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No	Consistent with NUREG-1801. The Closed Treated Water Systems (B.2.1.12) program will be used to manage loss of material of stainless steel heat exchanger components, piping, piping components, piping elements, and tanks exposed to closed cycle cooling water in the Chilled Water System, Component Cooling System, Emergency Diesel Generator & Auxiliaries System, Heating Water and Heating Steam System, Radiation Monitoring System, and Service Water System.
3.3.1-50	Stainless steel, Copper Alloy, Steel Heat exchanger tubes exposed to Closed-cycle cooling water	Reduction of heat transfer due to fouling	Chapter XI.M21A, "Closed Treated Water Systems"	No	Consistent with NUREG-1801. The Closed Treated Water Systems (B.2.1.12) program will be used to manage reduction of heat transfer of stainless steel and copper alloy heat exchanger tubes and steel turbochargers exposed to closed cycle cooling water in the Chilled Water System, Component Cooling System, Emergency Diesel Generator & Auxiliaries System, and Service Water System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-51	Boraflex Spent fuel storage racks: neutron-absorbing sheets (PWR), Spent fuel storage racks: neutron-absorbing sheets (BWR) exposed to Treated borated water, Treated water	Reduction of neutron-absorbing capacity due to boraflex degradation	Chapter XI.M22, “Boraflex Monitoring”	No	Not Applicable. There are no Boraflex spent fuel storage racks or neutron-absorbing sheets exposed to treated borated water or treated water in the Auxiliary Systems.
3.3.1-52	Steel Cranes: rails and structural girders exposed to Air – indoor, uncontrolled (External)	Loss of material due to general corrosion	Chapter XI.M23, “Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems”	No	Consistent with NUREG-1801. The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13) program will be used to manage loss of material due to general corrosion of steel crane/hoist components exposed to air - indoor uncontrolled and air with borated water leakage in the Cranes and Hoists and Fuel Handling & Fuel Storage System.
3.3.1-53	Steel Cranes - rails exposed to Air – indoor, uncontrolled (External)	Loss of material due to wear	Chapter XI.M23, “Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems”	No	Consistent with NUREG-1801. The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13) program will be used to manage loss of material due to wear of steel crane/hoist components exposed to air - indoor uncontrolled and air with borated water leakage in the Cranes and Hoists and Fuel Handling & Fuel Storage System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-54	Copper alloy Piping, piping components, and piping elements exposed to Condensation	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M24, “Compressed Air Monitoring"	No	Consistent with NUREG-1801 with exceptions. The Compressed Air Monitoring (B.2.1.14) program will be used to manage loss of material of copper alloy piping, piping components, and piping elements exposed to condensation in the Compressed Air System. Exceptions apply to NUREG-1801 recommendations for Compressed Air Monitoring (B.2.1.14) program implementation.
3.3.1-55	Steel Piping, piping components, and piping elements: compressed air system exposed to Condensation (Internal)	Loss of material due to general and pitting corrosion	Chapter XI.M24, “Compressed Air Monitoring”	No	Consistent with NUREG-1801 with exceptions. The Compressed Air Monitoring (B.2.1.14) program will be used to manage loss of material of steel piping, piping components, piping elements, and tanks exposed to condensation in the Auxiliary Feedwater System and Reactor Coolant System. Exceptions apply to NUREG-1801 recommendations for Compressed Air Monitoring (B.2.1.14) program implementation.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-56	Stainless steel Piping, piping components, and piping elements exposed to Condensation (Internal)	Loss of material due to pitting and crevice corrosion	Chapter XI.M24, "Compressed Air Monitoring"	No	Consistent with NUREG-1801 with exceptions. The Compressed Air Monitoring (B.2.1.14) program will be used to manage loss of material of stainless steel piping, piping components, and piping elements exposed to condensation in the Auxiliary Feedwater System and Compressed Air System. Exceptions apply to NUREG-1801 recommendations for Compressed Air Monitoring (B.2.1.14) program implementation.
3.3.1-57	Elastomers Fire barrier penetration seals exposed to Air - indoor, uncontrolled, Air – outdoor	Increased hardness; shrinkage; loss of strength due to weathering	Chapter XI.M26, "Fire Protection"	No	Consistent with NUREG-1801. The Fire Protection (B.2.1.15) program will be used to manage hardening, loss of strength, and loss of sealing of elastomer fire barrier penetration seals exposed to air – indoor uncontrolled, air – outdoor, and air with borated water leakage in the Fire Protection System.
3.3.1-58	Steel Halon/carbon dioxide fire suppression system piping, piping components, and piping elements exposed to Air – indoor, uncontrolled (External)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M26, "Fire Protection"	No	Consistent with NUREG-1801. The Fire Protection (B.2.1.15) program will be used to manage loss of material of steel gas bottles, piping, piping components, piping elements, and tanks exposed to air - indoor uncontrolled and air with borated water leakage in the Fire Protection System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-59	Steel Fire rated doors exposed to Air - indoor, uncontrolled, Air – outdoor	Loss of material due to wear	Chapter XI.M26, "Fire Protection"	No	Consistent with NUREG-1801. The Fire Protection (B.2.1.15) program will be used to manage loss of material of steel doors exposed to air – indoor uncontrolled, air – outdoor, and air with borated water leakage in the Fire Protection System.
3.3.1-60	Reinforced concrete Structural fire barriers: walls, ceilings and floors exposed to Air - indoor, uncontrolled	Concrete cracking and spalling due to aggressive chemical attack, and reaction with aggregates	Chapter XI.M26, “Fire Protection,” and Chapter XI.S6, “Structures Monitoring”	No	Consistent with NUREG-1801. The Fire Protection (B.2.1.15) program and Structures Monitoring (B.2.1.34) program will be used to manage cracking, loss of material, loss of bond, and spalling of reinforced concrete curbs and fire barrier walls, ceilings, and floors; and grout fire barrier penetration seals exposed to air – indoor uncontrolled and air with borated water leakage in the Fire Protection System.
3.3.1-61	Reinforced concrete Structural fire barriers: walls, ceilings and floors exposed to Air – outdoor	Cracking, loss of material due to freeze-thaw, aggressive chemical attack, and reaction with aggregates	Chapter XI.M26, “Fire Protection,” and Chapter XI.S6, “Structures Monitoring”	No	Consistent with NUREG-1801. The Fire Protection (B.2.1.15) program and Structures Monitoring (B.2.1.34) program will be used to manage cracking, loss of material, loss of bond, and spalling of reinforced concrete fire barrier walls, ceilings, and floors; and grout fire barrier penetration seals exposed to air - outdoor in the Fire Protection System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-62	Reinforced concrete Structural fire barriers: walls, ceilings and floors exposed to Air - indoor, uncontrolled, Air – outdoor	Loss of material due to corrosion of embedded steel	Chapter XI.M26, "Fire Protection," and Chapter XI.S6, "Structures Monitoring"	No	Consistent with NUREG-1801. The Fire Protection (B.2.1.15) program and Structures Monitoring (B.2.1.34) program will be used to manage loss of material of reinforced concrete curbs and fire barrier walls, ceilings, and floors exposed to air – indoor uncontrolled, air – outdoor, and air with borated water leakage in the Fire Protection System.
3.3.1-63	Steel Fire Hydrants exposed to Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M27, "Fire Water System"	No	Consistent with NUREG-1801. The Fire Water System (B.2.1.16) program will be used to manage loss of material of steel fire hydrants exposed to air - outdoor in the Fire Protection System.
3.3.1-64	Steel, Copper alloy Piping, piping components, and piping elements exposed to Raw water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M27, "Fire Water System"	No	Consistent with NUREG-1801. The Fire Water System (B.2.1.16) program will be used to manage loss of material of steel and copper alloy piping, piping components, piping elements, and tanks exposed to raw water in the Fire Protection System.
3.3.1-65	Aluminum Piping, piping components, and piping elements exposed to Raw water	Loss of material due to pitting and crevice corrosion	Chapter XI.M27, "Fire Water System"	No	Not Applicable. There are no aluminum alloy piping, piping components, and piping elements exposed to raw water in the Auxiliary Systems.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-66	Stainless steel Piping, piping components, and piping elements exposed to Raw water	Loss of material due to pitting and crevice corrosion; fouling that leads to corrosion	Chapter XI.M27, "Fire Water System"	No	Consistent with NUREG-1801. The Fire Water System (B.2.1.16) program will be used to manage loss of material of stainless steel piping, piping components, and piping elements exposed to raw water in the Fire Protection System.
3.3.1-67	Steel Tanks exposed to Air – outdoor (External)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M29, "Aboveground Metallic Tanks"	No	Not Applicable. There are no steel tanks exposed to air – outdoor in the Auxiliary Systems.
3.3.1-68	Steel Piping, piping components, and piping elements exposed to Fuel oil	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M30, "Fuel Oil Chemistry", and Chapter XI.M32, "One-Time Inspection"	No	Not Applicable. There are no steel piping, piping components, and piping elements exposed to fuel oil in the Fire Protection System subject to aging management review. Steel piping, piping components, and piping elements exposed to fuel oil in other Auxiliary Systems are managed by the Fuel Oil Chemistry (B.2.1.18) program and One-Time Inspection (B.2.1.20) program and are addressed by Item Number 3.3.1-70.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-69	Copper alloy Piping, piping components, and piping elements exposed to Fuel oil	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M30, “Fuel Oil Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No	Consistent with NUREG-1801. The Fuel Oil Chemistry (B.2.1.18) program and One-Time Inspection (B.2.1.20) program will be used to manage loss of material of copper alloy heat exchanger components exposed to fuel oil in the Emergency Diesel Generator & Auxiliaries System.
3.3.1-70	Steel Piping, piping components, and piping elements; tanks exposed to Fuel oil	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M30, “Fuel Oil Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No	Consistent with NUREG-1801. The Fuel Oil Chemistry (B.2.1.18) program and One-Time Inspection (B.2.1.20) program will be used to manage loss of material of steel heat exchanger components, piping, piping components, piping elements, and tanks exposed to fuel oil in the Auxiliary Feedwater System, Emergency Diesel Generator & Auxiliaries System, Fuel Oil System, and Service Water System.
3.3.1-71	Stainless steel, Aluminum Piping, piping components, and piping elements exposed to Fuel oil	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M30, “Fuel Oil Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No	Consistent with NUREG-1801. The Fuel Oil Chemistry (B.2.1.18) program and One-Time Inspection (B.2.1.20) program will be used to manage loss of material of aluminum alloy and stainless steel piping, piping components, and piping elements exposed to fuel oil in the Emergency Diesel Generator & Auxiliaries System, Fuel Oil System, and Service Water System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-72	Gray cast iron, Copper alloy (>15% Zn or >8% Al) Piping, piping components, and piping elements, Heat exchanger components exposed to Treated water, Closed-cycle cooling water, Soil, Raw water	Loss of material due to selective leaching	Chapter XI.M33, "Selective Leaching"	No	Consistent with NUREG-1801. The Selective Leaching (B.2.1.21) program will be used to manage loss of material of copper alloy with 15% zinc or more and gray cast iron heat exchanger components, structural members, piping, piping components, and piping elements exposed to closed cycle cooling water and raw water in the Auxiliary Feedwater System, Chilled Water System, Demineralized Water System, Emergency Diesel Generator & Auxiliaries System, Essential Service Water Cooling Towers (Byron), Fire Protection System, and Service Water System.
3.3.1-73	Concrete; cementitious material Piping, piping components, and piping elements exposed to Air - outdoor	Changes in material properties due to aggressive chemical attack	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Not Applicable. There are no concrete or cementitious material piping, piping components, and piping elements exposed to air - outdoor in the Auxiliary Systems.
3.3.1-74	Concrete; cementitious material Piping, piping components, and piping elements exposed to Air - outdoor	Cracking due to settling	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Not Applicable. There are no concrete or cementitious material piping, piping components, and piping elements exposed to air - outdoor in the Auxiliary Systems.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-75	Reinforced concrete, asbestos cement Piping, piping components, and piping elements exposed to Air – outdoor	Cracking due to aggressive chemical attack and leaching; Changes in material properties due to aggressive chemical attack	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Not Applicable. There are no reinforced concrete or asbestos cement piping, piping components, and piping elements exposed to air – outdoor in the Auxiliary Systems.
3.3.1-76	Elastomers Elastomer: seals and components exposed to Air – indoor, uncontrolled (Internal/External)	Hardening and loss of strength due to elastomer degradation	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Consistent with NUREG-1801. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program will be used to manage hardening and loss of strength of elastomer ducting and components, door seals, piping, piping components, and piping elements exposed to air – indoor uncontrolled and air with borated water leakage in the Auxiliary Building Ventilation System, Containment Ventilation System, Control Area Ventilation System, and Service Water System.
3.3.1-77	Concrete; cementitious material Piping, piping components, and piping elements exposed to Air - outdoor	Loss of material due to abrasion, cavitation, aggressive chemical attack, and leaching	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Not Applicable. There are no concrete or cementitious material piping, piping components, and piping elements exposed to air – outdoor in the Auxiliary Systems.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-78	Steel Piping and components (External surfaces), Ducting and components (External surfaces), Ducting; closure bolting exposed to Air – indoor, uncontrolled (External), Air – indoor, uncontrolled (External), Air – outdoor (External), Condensation (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Consistent with NUREG-1801. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program will be used to manage loss of material of steel bolting, doors, ducting and components, gas bottles, gearboxes, heat exchanger components, piping, piping components, piping elements, tanks, and turbochargers exposed to air – indoor uncontrolled, air – outdoor, and air with borated water leakage in the Auxiliary Building Ventilation System, Chemical & Volume Control System, Chilled Water System, Circulating Water System, Combustible Gas Control System, Component Cooling System, Compressed Air System, Containment Ventilation System, Control Area Ventilation System, Demineralized Water System, Emergency Diesel Generator & Auxiliaries System, Fire Protection System, Fresh Water System, Fuel Oil System, Heating Water and Heating Steam System, Non-Radioactive Drain System, Radiation Monitoring System, Radioactive Drain System, Radwaste System, Reactor Coolant System, Sampling System, Service Water System, and Spent Fuel Cooling System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-79	Copper alloy Piping, piping components, and piping elements exposed to Condensation (External)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Not Applicable. There are no copper alloy piping, piping components, and piping elements exposed to condensation (external) in the Auxiliary Systems. Copper alloy heat exchanger components and bolting in the Auxiliary Building Ventilation System, Chilled Water System, Containment Ventilation System, Control Area Ventilation System, and Heating Water and Heating Steam System are located internal to ventilation systems and, therefore, are assigned a condensation external environment. Loss of material of these components is managed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program and is addressed by Item Number 3.3.1-89.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-80	Steel Heat exchanger components, Piping, piping components, and piping elements exposed to Air – indoor, uncontrolled (External), Air – outdoor (External)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Consistent with NUREG-1801. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program will be used to manage loss of material of steel gearboxes, heat exchanger components, piping, piping components, and piping elements exposed to air – indoor uncontrolled, air – outdoor, and air with borated water leakage in the Auxiliary Building Ventilation System, Chemical & Volume Control System, Containment Ventilation System, Control Area Ventilation System, Emergency Diesel Generator & Auxiliaries System, Fuel Oil System, and Service Water System.
3.3.1-81	Copper alloy, Aluminum Piping, piping components, and piping elements exposed to Air – outdoor (External), Air - outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Consistent with NUREG-1801. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program will be used to manage loss of material of copper alloy piping, piping components, and piping elements exposed to air – outdoor in the Fire Protection System and Service Water System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-82	Elastomers Elastomer: seals and components exposed to Air – indoor, uncontrolled (External)	Loss of material due to wear	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Consistent with NUREG-1801. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program will be used to manage loss of material of elastomer ducting and components, door seals, piping, piping components, and piping elements exposed to air – indoor uncontrolled and air with borated water leakage in the Auxiliary Building Ventilation System, Containment Ventilation System, Control Area Ventilation System, and Service Water System.
3.3.1-83	Stainless steel Diesel engine exhaust piping, piping components, and piping elements exposed to Diesel exhaust	Cracking due to stress corrosion cracking	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage cracking of stainless steel piping, piping components, and piping elements exposed to diesel exhaust in the Emergency Diesel Generator & Auxiliaries System, Fire Protection System, and Service Water System.
3.3.1-85	Elastomers Elastomer seals and components exposed to Closed-cycle cooling water	Hardening and loss of strength due to elastomer degradation	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Not Applicable. There are no elastomer seals and components exposed to closed cycle cooling water in the Auxiliary Systems.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems					
Item Number	**Component**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.3.1-86	Elastomers Elastomers, linings, Elastomer: seals and components exposed to Treated borated water, Treated water, Raw water	Hardening and loss of strength due to elastomer degradation	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Not Applicable. There are no elastomer linings, seals and components exposed to raw water, treated borated water, or treated water in the Auxiliary Systems that are subject to aging management review.
3.3.1-88	Steel; stainless steel Piping, piping components, and piping elements, Piping, piping components, and piping elements, diesel engine exhaust exposed to Raw water (potable), Diesel exhaust	Loss of material due to general (steel only), pitting, and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage loss of material of steel, stainless steel piping, piping components, piping elements, tanks, and turbochargers exposed to diesel exhaust and raw water in the Auxiliary Feedwater System, Emergency Diesel Generator & Auxiliaries System, Fire Protection System, Fresh Water System, and Service Water System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-89	Steel, Copper alloy Piping, piping components, and piping elements exposed to Moist air or condensation (Internal)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage loss of material of steel and copper alloy bolting, heat exchanger components, piping, piping components, piping elements, and tanks exposed to condensation in the Auxiliary Building Ventilation System, Chilled Water System, Compressed Air System, Containment Ventilation System, Control Area Ventilation System, Emergency Diesel Generator & Auxiliaries System, Fire Protection System, Fuel Oil System, Heating Water and Heating Steam System, Radioactive Drain System, Radwaste System, and Service Water System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-90	Steel Ducting and components (Internal surfaces) exposed to Condensation (Internal)	Loss of material due to general, pitting, crevice, and (for drip pans and drain lines) microbiologically-influenced corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage loss of material of steel ducting and components, heat exchanger components, and piping, piping components, and piping elements exposed to condensation in the Auxiliary Building Ventilation System, Combustible Gas Control System, Containment Ventilation System, Control Area Ventilation System, and Radioactive Drain System. The Fire Protection (B.2.1.15) program has been substituted and will be used to manage loss of material of steel damper housings with a fire barrier intended function exposed to condensation in the Fire Protection System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems					
Item Number	**Component**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.3.1-91	Steel Piping, piping components, and piping elements; tanks exposed to Waste Water	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage loss of material of steel heat exchanger components, piping, piping components, piping elements, and tanks exposed to waste water in the Auxiliary Building Ventilation System, Auxiliary Feedwater System, Chemical & Volume Control System, Chilled Water System, Component Cooling System, Compressed Air System, Containment Spray System, Containment Ventilation System, Control Area Ventilation System, Demineralized Water System, Emergency Diesel Generator & Auxiliaries System, Fire Protection System, Heating Water and Heating Steam System, Main Turbine and Auxiliaries System, Non-Radioactive Drain System, Radioactive Drain System, Radwaste System, Residual Heat Removal System, Safety Injection System, Sampling System, Service Water System, Spent Fuel Cooling System, and Steam Generators.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-92	Aluminum Piping, piping components, and piping elements exposed to Condensation (Internal)	Loss of material due to pitting and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage loss of material of aluminum ducting and components, piping, piping components, piping elements, and turbochargers exposed to condensation in the Auxiliary Building Ventilation System, Control Area Ventilation System, Emergency Diesel Generator & Auxiliaries System, and Radiation Monitoring System.
3.3.1-93	Copper alloy Piping, piping components, and piping elements exposed to Raw water (potable)	Loss of material due to pitting and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage loss of material of copper alloy piping, piping components, and piping elements exposed to raw water in the Fresh Water System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-94	Stainless steel Ducting and components exposed to Condensation	Loss of material due to pitting and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage loss of material of stainless steel bolting, ducting and components, heat exchanger components, piping, piping components, and piping elements exposed to condensation in the Auxiliary Building Ventilation System, Chilled Water System, Containment Ventilation System, Control Area Ventilation System, and Radioactive Drain System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-95	Copper alloy, Stainless steel, Nickel alloy, Steel Piping, piping components, and piping elements, Heat exchanger components, Piping, piping components, and piping elements; tanks exposed to Waste water, Condensation (Internal)	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage loss of material of copper alloy, stainless steel, and steel heat exchanger components, piping, piping components, piping elements, sump screens, and tanks exposed to condensation and waste water in the Auxiliary Building Ventilation System, Chemical & Volume Control System, Component Cooling System, Containment Spray System, Containment Ventilation System, Control Area Ventilation System, Demineralized Water System, Emergency Diesel Generator & Auxiliaries System, Fire Protection System, Fuel Handling & Fuel Storage System, Heating Water and Heating Steam System, Radiation Monitoring System, Radioactive Drain System, Radwaste System, Residual Heat Removal System, Safety Injection System, Sampling System, Service Water System, Spent Fuel Cooling System, and Steam Generators.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-96	Elastomers Elastomer: seals and components exposed to Air – indoor, uncontrolled (Internal)	Loss of material due to wear	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Not Applicable. There are no elastomers or elastomer seals and components exposed to air – indoor uncontrolled in the Auxiliary Systems. The internal environment of elastomer seals and components in the Auxiliary Building Ventilation System, Containment Ventilation System, and Control Area Ventilation System is considered to be condensation. Loss of material of these components is managed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems					
Item Number	**Component**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.3.1-97	Steel Piping, piping components, and piping elements, Reactor coolant pump oil collection system: tanks, Reactor coolant pump oil collection system: piping, tubing, valve bodies exposed to Lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The Lubricating Oil Analysis (B.2.1.26) program and One-Time Inspection (B.2.1.20) program will be used to manage loss of material of steel gearboxes, heat exchanger components, piping, piping components, piping elements, and tanks exposed to lubricating oil in the Chemical & Volume Control System, Emergency Diesel Generator & Auxiliaries System, Radioactive Drain System, and Service Water System. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program has been substituted and will be used to manage loss of material of steel heat exchanger components, pumps, and tanks exposed to lubricating oil in the Chemical & Volume Control System.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-98	Steel Heat exchanger components exposed to Lubricating oil	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The Lubricating Oil Analysis (B.2.1.26) program and One-Time Inspection (B.2.1.20) program will be used to manage loss of material of steel heat exchanger components exposed to lubricating oil in the Chilled Water System, Emergency Diesel Generator & Auxiliaries System, Reactor Coolant System, and Service Water System.
3.3.1-99	Copper alloy, Aluminum Piping, piping components, and piping elements exposed to Lubricating oil	Loss of material due to pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The Lubricating Oil Analysis (B.2.1.26) program and One-Time Inspection (B.2.1.20) program will be used to manage loss of material of aluminum alloy and copper alloy heat exchanger components, piping, piping components, and piping elements exposed to lubricating oil in the Chemical & Volume Control System, Emergency Diesel Generator & Auxiliaries System, and Service Water System. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program has been substituted and will be used to manage loss of material of copper alloy heat exchanger components exposed to lubricating oil in the Chemical & Volume Control System.

Table 3.3.1	**Summary of Aging Management Evaluations for the Auxiliary Systems**				
Item Number	**Component**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.3.1-100	Stainless steel Piping, piping components, and piping elements exposed to Lubricating oil	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The Lubricating Oil Analysis (B.2.1.26) program and One-Time Inspection (B.2.1.20) program will be used to manage loss of material of stainless steel heat exchanger components, piping, piping components, and piping elements exposed to lubricating oil in the Chemical & Volume Control System, Emergency Diesel Generator & Auxiliaries System, Radioactive Drain System, and Service Water System. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program has been substituted and will be used to manage loss of material of stainless steel piping, piping components, and piping elements exposed to lubricating oil in the Chemical & Volume Control System.
3.3.1-101	Aluminum Heat exchanger tubes exposed to Lubricating oil	Reduction of heat transfer due to fouling	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, "One-Time Inspection"	No	Not Applicable. There are no aluminum alloy heat exchanger tubes exposed to lubricating oil in the Auxiliary Systems.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems					
Item Number	**Component**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.3.1-102	Boral®; boron steel, and other materials (excluding Boraflex) Spent fuel storage racks: neutron-absorbing sheets (PWR), Spent fuel storage racks: neutron-absorbing sheets (BWR) exposed to Treated borated water, Treated water	Reduction of neutron-absorbing capacity; change in dimensions and loss of material due to effects of SFP environment	Chapter XI.M40, "Monitoring of Neutron-Absorbing Materials other than Boraflex"	No	Consistent with NUREG-1801. The Monitoring of Neutron-Absorbing Materials Other than Boraflex (B.2.1.27) program will be used to manage reduction of neutron-absorbing capacity, change in dimensions, and loss of material of Boral spent fuel storage racks exposed to treated borated water in the Fuel Handling & Fuel Storage System.
3.3.1-103	Reinforced concrete, asbestos cement Piping, piping components, and piping elements exposed to Soil or concrete	Cracking due to aggressive chemical attack and leaching; Changes in material properties due to aggressive chemical attack	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Not Applicable. There are no reinforced concrete or asbestos cement piping, piping components, and piping elements exposed to soil or concrete in the Auxiliary Systems.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-104	HDPE, Fiberglass Piping, piping components, and piping elements exposed to Soil or concrete	Cracking, blistering, change in color due to water absorption	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Consistent with NUREG-1801 with exceptions. The Buried and Underground Piping (B.2.1.28) program will be used to manage cracking, blistering, and change in color of polymer piping, piping components, and piping elements exposed to soil in the Main Condensate and Feedwater System. Exceptions apply to NUREG-1801 recommendations for Buried and Underground Piping (B.2.1.28) program implementation.
3.3.1-105	Concrete cylinder piping, Asbestos cement pipe Piping, piping components, and piping elements exposed to Soil or concrete	Cracking, spalling, corrosion of rebar due to exposure of rebar	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Not Applicable. There are no concrete cylinder piping or asbestos cement piping, piping components, and piping elements exposed to soil or concrete in the Auxiliary Systems.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-106	Steel (with coating or wrapping) Piping, piping components, and piping elements exposed to Soil or concrete	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Consistent with NUREG-1801 with exceptions. The Buried and Underground Piping (B.2.1.28) program will be used to manage loss of material of steel piping, piping components, and piping elements exposed to soil and concrete in the Demineralized Water System, Fire Protection System, and Service Water System. Exceptions apply to NUREG-1801 recommendations for Buried and Underground Piping (B.2.1.28) program implementation.
3.3.1-107	Stainless Steel, Nickel Alloy Piping, piping components, and piping elements exposed to Soil or concrete	Loss of material due to pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Not Applicable. There are no stainless steel or nickel alloy piping, piping components, and piping elements exposed to soil or concrete in the Auxiliary Systems.
3.3.1-108	Titanium, Super Austenitic, Aluminum, Copper Alloy, Stainless Steel, Nickel Alloy Piping, piping components, and piping elements, Bolting exposed to Soil or concrete	Loss of material due to pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Not Applicable. There are no titanium alloy, super austenitic alloy, aluminum alloy, copper alloy, stainless steel, or nickel alloy bolting, piping, piping components, and piping elements exposed to soil or concrete in the Auxiliary Systems.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-109	Steel Bolting exposed to Soil or concrete	Loss of material due to general, pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Consistent with NUREG-1801 with exceptions. The Buried and Underground Piping (B.2.1.28) program will be used to manage loss of material of steel bolting exposed to soil in the Fire Protection System and Service Water System. Exceptions apply to NUREG-1801 recommendations for Buried and Underground Piping (B.2.1.28) program implementation.
3.3.1-109x	Underground Aluminum, Copper Alloy, Stainless Steel, Nickel Alloy, Steel Piping, piping components, and piping elements	Loss of material due to general (steel only), pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Consistent with NUREG-1801 with exceptions. The Buried and Underground Piping (B.2.1.28) program will be used to manage loss of material of underground steel and stainless steel piping, piping components, and piping elements exposed to air - outdoor in the Circulating Water System, Demineralized Water System, and Service Water System. Exceptions apply to NUREG-1801 recommendations for Buried and Underground Piping (B.2.1.28) program implementation.
3.3.1-110	BWR Only				

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-111	Steel Structural steel exposed to Air – indoor, uncontrolled (External)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage loss of material of steel new fuel storage racks exposed to air with borated water leakage in the Fuel Handling & Fuel Storage System.
3.3.1-112	Steel Piping, piping components, and piping elements exposed to Concrete	None	None, provided 1) attributes of the concrete are consistent with ACI 318 or ACI 349 (low water-to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG-1557, and 2) plant OE indicates no degradation of the concrete	No, if conditions are met.	Consistent with NUREG-1801. The attributes of the concrete are consistent with ACI 318. Plant operating experience indicates no degradation of the steel piping, piping components, and piping elements as a result of exposure to the concrete environment. Plant operating experience indicates no degradation of concrete that would lead to degradation of the embedded steel piping, piping components, and piping elements (see subsection 3.5.2.2.2.1).
3.3.1-113	Aluminum Piping, piping components, and piping elements exposed to Air – dry (Internal/External), Air – indoor, uncontrolled (Internal/External), Air – indoor, controlled (External), Gas	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-114	Copper alloy Piping, piping components, and piping elements exposed to Air – indoor, uncontrolled (Internal/External), Air – dry, Gas	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.
3.3.1-115	Copper alloy (≤15% Zn and ≤8% Al) Piping, piping components, and piping elements exposed to Air with borated water leakage	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.
3.3.1-116	Galvanized steel Piping, piping components, and piping elements exposed to Air - indoor, uncontrolled	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-117	Glass Piping elements exposed to Air – indoor, uncontrolled (External), Lubricating oil, Closed-cycle cooling water, Air – outdoor, Fuel oil, Raw water, Treated water, Treated borated water, Air with borated water leakage, Condensation (Internal/External) Gas	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.
3.3.1-118	Nickel alloy Piping, piping components, and piping elements exposed to Air – indoor, uncontrolled (External)	None	None	NA - No AEM or AMP	Not Applicable. There are no nickel alloy piping, piping components, and piping elements exposed to air – indoor uncontrolled in the Auxiliary Systems
3.3.1-119	Nickel alloy, PVC, Glass Piping, piping components, and piping elements exposed to Air with borated water leakage, Air – indoor, uncontrolled, Condensation (Internal), Waste Water	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-120	Stainless steel Piping, piping components, and piping elements exposed to Air – indoor, uncontrolled (Internal/External), Air – indoor, uncontrolled (External), Air with borated water leakage, Concrete, Air – dry, Gas	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.
3.3.1-121	Steel Piping, piping components, and piping elements exposed to Air – indoor, controlled (External), Air – dry, Gas	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.
3.3.1-122	Titanium Heat exchanger components, Piping, piping components, and piping elements exposed to Air – indoor, uncontrolled or Air – outdoor	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-123	Titanium (ASTM Grades 1,2, 7, 11, or 12 that contains > 5% aluminum or more than 0.20% oxygen or any amount of tin) Heat exchanger components other than tubes, Piping, piping components, and piping elements exposed to Raw water	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.
3.3.1-124	Stainless steel, Steel (with stainless steel or nickel-alloy cladding), Spent fuel storage racks (BWR), Spent fuel storage racks (PWR), Piping, piping components, and piping elements; exposed to Treated water >60°C (>140°F), Treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32, “One-Time Inspection”	No	Not Applicable. There are no stainless steel, steel (with stainless steel or nickel-alloy cladding), spent fuel storage racks exposed to treated water > 140°F or treated borated water > 140°F in the Auxiliary Systems. Cracking of stainless steel piping, piping components, and piping elements exposed to treated borated water > 140°F in the Chemical & Volume Control System and Sampling System is managed by the Water Chemistry (B.2.1.2) program and the One-Time Inspection (B.2.1.20) program and is addressed by Item Number 3.3.1-20.

Table 3.3.1 Summary of Aging Management Evaluations for the Auxiliary Systems

Item Number	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.3.1-125	Steel (with stainless steel cladding), stainless steel Spent fuel storage racks (BWR), Spent fuel storage racks (PWR), Piping, piping components, and piping elements; exposed to Treated water, Treated borated water	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage loss of material of steel with stainless steel cladding and stainless steel bolting, crane/hoist components, fuel storage racks, heat exchanger components, penetration bellows, penetrations sleeves, piping, piping components, piping elements, and tanks exposed to treated borated water in the Chemical & Volume Control System, Fuel Handling & Fuel Storage System, Fuel Handing Building, Radiation Monitoring System, Sampling System, and Spent Fuel Cooling System.

Table 3.3.2-1
Auxiliary Building Ventilation System
Summary of Aging Management Evaluation

Table 3.3.2-1 **Auxiliary Building Ventilation System**

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.A-105	3.3.1-78	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
		Copper Alloy with less than 15% Zinc	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 3
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-261	3.3.1-15	A
		Stainless Steel Bolting	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.AP-99	3.3.1-94	C, 3
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Damper Housing	Pressure Boundary	Galvanized Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	A
Door Seal	Pressure Boundary	Elastomers	Air with Borated Water Leakage (External)	Hardening and Loss of Strength	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-102	3.3.1-76	A, 1

Table 3.3.2-1 Auxiliary Building Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Door Seal	Pressure Boundary	Elastomers	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-113	3.3.1-82	A, 1
			Condensation (Internal)	Hardening and Loss of Strength	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
Ducting and Components	Direct Flow	Aluminum Alloy	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.A3.AP-1	3.3.1-9	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.AP-142	3.3.1-92	C
		Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.A-10	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	A
		Galvanized Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-1 Auxiliary Building Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Ducting and Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.A-10	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	A
		Galvanized Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	A
Fan Housing	Pressure Boundary	Aluminum Alloy	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.A3.AP-1	3.3.1-9	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.AP-142	3.3.1-92	C
		Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.A-10	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	A
Filter Housing	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.A-10	3.3.1-78	A

Table 3.3.2-1 Auxiliary Building Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Filter Housing	Pressure Boundary	Carbon Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	A
		Elastomers	Air with Borated Water Leakage (External)	Hardening and Loss of Strength	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-102	3.3.1-76	A
				Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-113	3.3.1-82	A
			Condensation (Internal)	Hardening and Loss of Strength	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 2
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 2
		Galvanized Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	A
		Glass	Air with Borated Water Leakage (External)	None	None	VII.J.AP-96	3.3.1-117	C
			Condensation (Internal)	None	None	VII.J.AP-97	3.3.1-117	C
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.AP-99	3.3.1-94	A

Table 3.3.2-1 Auxiliary Building Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Flow Device	Pressure Boundary	Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	A
Heat Exchanger - (AFW Cubicle Coolers) Fins	Heat Transfer	Aluminum Alloy	Condensation (External)	Reduction of Heat Transfer	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 3
Heat Exchanger - (AFW Cubicle Coolers) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-41	3.3.1-80	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	C
Heat Exchanger - (AFW Cubicle Coolers) Tube Sheet	Pressure Boundary	Carbon Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	C, 3
Heat Exchanger - (AFW Cubicle Coolers) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Condensation (External)	Reduction of Heat Transfer	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 3
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 3

Table 3.3.2-1 Auxiliary Building Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (ECCS Pump [CV, SI, RH, CS, SX] Cubicle Coolers) Fins	Heat Transfer	Aluminum Alloy	Condensation (External)	Reduction of Heat Transfer	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 3
Heat Exchanger - (ECCS Pump [CV, SI, RH, CS, SX] Cubicle Coolers) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-41	3.3.1-80	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	C
Heat Exchanger - (ECCS Pump [CV, SI, RH, CS, SX] Cubicle Coolers) Tube Sheet	Pressure Boundary	Carbon Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	C, 3
Heat Exchanger - (ECCS Pump [CV, SI, RH, CS, SX] Cubicle Coolers) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Condensation (External)	Reduction of Heat Transfer	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 3
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 3
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Fins	Heat Transfer	Aluminum Alloy	Condensation (External)	Reduction of Heat Transfer	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 3

Table 3.3.2-1 Auxiliary Building Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-41	3.3.1-80	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	C
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Tube Sheet	Pressure Boundary	Carbon Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	C, 3
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Condensation (External)	Reduction of Heat Transfer	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 3
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 3
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Fins	Heat Transfer	Aluminum Alloy	Condensation (External)	Reduction of Heat Transfer	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 3
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-1 Auxiliary Building Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-41	3.3.1-80	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	C
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Tube Sheet	Pressure Boundary	Carbon Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	C, 3
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Condensation (External)	Reduction of Heat Transfer	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 3
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 3
Piping Element	Leakage Boundary	Glass	Air with Borated Water Leakage (External)	None	None	VII.J.AP-96	3.3.1-117	A
			Treated Water (Internal)	None	None	VII.J.AP-51	3.3.1-117	A
			Waste Water (Internal)	None	None	VII.J.AP-277	3.3.1-119	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-1 Auxiliary Building Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-73	3.4.1-14	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.A.SP-101	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.A.SP-101	3.4.1-16	A
		Stainless Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.AP-99	3.3.1-94	C, 3
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.E.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-88	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-1 Auxiliary Building Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	A
		Elastomers	Air with Borated Water Leakage (External)	Hardening and Loss of Strength	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-102	3.3.1-76	A
				Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-113	3.3.1-82	A
			Condensation (Internal)	Hardening and Loss of Strength	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 2
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 2
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A

Table 3.3.2-1 Auxiliary Building Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Stainless Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
	Structural Support	Carbon Steel	Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H1.A-24	3.3.1-80	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
		Stainless Steel	Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-221	3.3.1-6	A
				None	None	VII.G.AP-209	3.3.1-4	I, 4
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
Strainer Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-73	3.4.1-14	A
Tanks - (Humidifier)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-75	3.4.1-12	A

Table 3.3.2-1 Auxiliary Building Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks - (Humidifier)	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VIII.E.SP-75	3.4.1-12	A
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-73	3.4.1-14	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.A.SP-101	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.A.SP-101	3.4.1-16	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A

Table 3.3.2-1 Auxiliary Building Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A

Table 3.3.2-1 Auxiliary Building Ventilation System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The portion of the door seal exposed to an external environment will be managed by the External Surfaces Monitoring of Mechanical Components (B.2.1.23) program. The portion of the door seal exposed to an internal environment will be managed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program. The door seal is exposed to two (2) different environments.

2. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the aging effects for this component, material, and environment combination.

3. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination. The component is located within HVAC ducting and components, and the external surfaces of this component are subject to the internal HVAC environment of condensation during normal operation.

4. Based on an evaluation of the environmental conditions at BBS and a review of operating experience, cracking due to stress corrosion cracking is not an applicable aging effect for stainless steel in an Air-Outdoor environment. For more information see LRA Section 3.3.2.2.3.

Table 3.3.2-2
Chemical & Volume Control System
Summary of Aging Management Evaluation

Table 3.3.2-2 **Chemical & Volume Control System**

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Treated Borated Water (External)	Cumulative Fatigue Damage	TLAA	VII.E1.A-57	3.3.1-2	C, 1
Eductor	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Filter Element (Resin Retention)	Filter	Stainless Steel	Treated Borated Water (External)	Loss of Material	Water Chemistry (B.2.1.2)	VII.E1.A-88	3.3.1-29	A
Filter Housing	Leakage Boundary	Gray Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Filter Housing	Leakage Boundary	Gray Cast Iron	Lubricating Oil (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E1.AP-127	3.3.1-97	E, 2
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VII.E1.A-88	3.3.1-29	A
Gearbox (Speed Increaser)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.E1.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.E1.AP-127	3.3.1-97	A
Heat Exchanger - (Boron Thermal Regeneration Chiller Condenser) Shell Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-41	3.3.1-80	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Boron Thermal Regeneration Chiller Condenser) Shell Side Components	Leakage Boundary	Carbon Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	C
Heat Exchanger - (Charging Pump Bearing Oil Cooler) Shell Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.E1.AP-138	3.3.1-100	C
					One-Time Inspection (B.2.1.20)	VII.E1.AP-138	3.3.1-100	C
Heat Exchanger - (Charging Pump Bearing Oil Cooler) Tube Sheet	Pressure Boundary	Stainless Steel	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.E1.AP-138	3.3.1-100	C
					One-Time Inspection (B.2.1.20)	VII.E1.AP-138	3.3.1-100	C
Heat Exchanger - (Charging Pump Bearing Oil Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Reduction of Heat Transfer	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-78	3.2.1-51	A
					One-Time Inspection (B.2.1.20)	V.D1.EP-78	3.2.1-51	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.E1.AP-133	3.3.1-99	C
					One-Time Inspection (B.2.1.20)	VII.E1.AP-133	3.3.1-99	C

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Charging Pump Gear Oil Cooler) Shell Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.E1.AP-138	3.3.1-100	C
					One-Time Inspection (B.2.1.20)	VII.E1.AP-138	3.3.1-100	C
Heat Exchanger - (Charging Pump Gear Oil Cooler) Tube Sheet	Pressure Boundary	Stainless Steel	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.E1.AP-138	3.3.1-100	C
					One-Time Inspection (B.2.1.20)	VII.E1.AP-138	3.3.1-100	C
Heat Exchanger - (Charging Pump Gear Oil Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Reduction of Heat Transfer	Lubricating Oil Analysis (B.2.1.26)	V.D1.EP-78	3.2.1-51	A
					One-Time Inspection (B.2.1.20)	V.D1.EP-78	3.2.1-51	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.E1.AP-133	3.3.1-99	C
					One-Time Inspection (B.2.1.20)	VII.E1.AP-133	3.3.1-99	C
Heat Exchanger - (Excess Letdown) Tube Sheet	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	A
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	A
				Cumulative Fatigue Damage	TLAA	VII.E1.A-100	3.3.1-2	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Excess Letdown) Tube Sheet	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C
Heat Exchanger - (Excess Letdown) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	A
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C
Heat Exchanger - (Excess Letdown) Tubes	Heat Transfer	Stainless Steel	Treated Borated Water > 140 F (External)	Reduction of Heat Transfer	One-Time Inspection (B.2.1.20)	VII.E1.A-101	3.3.1-17	A
					Water Chemistry (B.2.1.2)	VII.E1.A-101	3.3.1-17	A
	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	A
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C
Heat Exchanger - (Letdown Chiller) Shell Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-41	3.3.1-80	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Letdown Chiller) Shell Side Components	Leakage Boundary	Carbon Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	C
Heat Exchanger - (Letdown Chiller) Tube Sheet	Pressure Boundary	Stainless Steel	Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Letdown Chiller) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Letdown Chiller) Tubes	Pressure Boundary	Stainless Steel	Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Letdown Reheat) Shell Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Letdown Reheat) Tube Sheet	Pressure Boundary	Stainless Steel	Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Letdown Reheat) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Letdown Reheat) Tubes	Pressure Boundary	Stainless Steel	Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Letdown) Tube Sheet	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (Internal)	Cracking	Closed Treated Water Systems (B.2.1.12)	VII.E1.A-69	3.3.1-3	E, 4
					One-Time Inspection (B.2.1.20)	VII.E1.A-69	3.3.1-3	E, 4
					Water Chemistry (B.2.1.2)	VII.E1.A-69	3.3.1-3	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Letdown) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water > 140 F (Internal)	Cracking	Closed Treated Water Systems (B.2.1.12)	VII.E1.A-69	3.3.1-3	E, 4
					One-Time Inspection (B.2.1.20)	VII.E1.A-69	3.3.1-3	E, 4
					Water Chemistry (B.2.1.2)	VII.E1.A-69	3.3.1-3	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C
Heat Exchanger - (Letdown) Tubes	Heat Transfer	Stainless Steel	Treated Borated Water > 140 F (Internal)	Reduction of Heat Transfer	One-Time Inspection (B.2.1.20)	VII.E1.A-101	3.3.1-17	A
					Water Chemistry (B.2.1.2)	VII.E1.A-101	3.3.1-17	A
	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (Internal)	Cracking	Closed Treated Water Systems (B.2.1.12)	VII.E1.A-69	3.3.1-3	E, 4
					One-Time Inspection (B.2.1.20)	VII.E1.A-69	3.3.1-3	E, 4
					Water Chemistry (B.2.1.2)	VII.E1.A-69	3.3.1-3	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C
Heat Exchanger - (Moderating) Shell Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Moderating) Tube Sheet	Pressure Boundary	Stainless Steel	Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Moderating) Tube Sheet	Pressure Boundary	Stainless Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Moderating) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Moderating) Tubes	Pressure Boundary	Stainless Steel	Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (PD Charging Pump Lube/Gyrol Cooler) Shell Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-41	3.3.1-80	A
			Lubricating Oil (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E1.AP-127	3.3.1-97	E, 2
Heat Exchanger - (PD Charging Pump Lube/Gyrol Cooler) Tube Sheet	Leakage Boundary	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E1.AP-133	3.3.1-99	E, 2

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (PD Charging Pump Lube/Gyrol Cooler) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E1.AP-133	3.3.1-99	E, 2
Heat Exchanger - (Recycle Distillate Cooler) Tube Sheet	Pressure Boundary	Stainless Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Recycle Distillate Cooler) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Recycle Distillate Cooler) Tubes	Pressure Boundary	Stainless Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Recycle Evaporator Condenser) Shell Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Recycle Evaporator Condenser) Tube Sheet	Pressure Boundary	Stainless Steel	Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Recycle Evaporator Condenser) Tubes	Pressure Boundary	Stainless Steel	Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
Heat Exchanger - (Recycle Evaporator Sample Cooler) Tube Side Components	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Recycle Evaporator) Shell Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
Heat Exchanger - (Recycle Evaporator) Tube Sheet	Pressure Boundary	Stainless Steel	Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
Heat Exchanger - (Recycle Evaporator) Tubes	Pressure Boundary	Stainless Steel	Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Recycle Evaporator) Tubes	Pressure Boundary	Stainless Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
Heat Exchanger - (Recycle Feed Preheater) Tube Sheet	Pressure Boundary	Stainless Steel	Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
Heat Exchanger - (Recycle Feed Preheater) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
Heat Exchanger - (Recycle Feed Preheater) Tubes	Pressure Boundary	Stainless Steel	Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
Heat Exchanger - (Recycle Vent Condenser) Shell Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Recycle Vent Condenser) Tube Sheet	Pressure Boundary	Stainless Steel	Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
Heat Exchanger - (Recycle Vent Condenser) Tubes	Pressure Boundary	Stainless Steel	Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A, 3
Heat Exchanger - (Regenerative) Shell Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	A
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	A
				Cumulative Fatigue Damage	TLAA	VII.E1.A-100	3.3.1-2	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C
Heat Exchanger - (Regenerative) Tube Sheet	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (External)	Cracking	One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	A
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	A
				Cumulative Fatigue Damage	TLAA	VII.E1.A-100	3.3.1-2	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	A
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Regenerative) Tube Sheet	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C
Heat Exchanger - (Regenerative) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	A
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	A
				Cumulative Fatigue Damage	TLAA	VII.E1.A-100	3.3.1-2	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C
Heat Exchanger - (Regenerative) Tubes	Heat Transfer	Stainless Steel	Treated Borated Water > 140 F (External)	Reduction of Heat Transfer	One-Time Inspection (B.2.1.20)	VII.E1.A-101	3.3.1-17	A
					Water Chemistry (B.2.1.2)	VII.E1.A-101	3.3.1-17	A
			Treated Borated Water > 140 F (Internal)	Reduction of Heat Transfer	One-Time Inspection (B.2.1.20)	VII.E1.A-101	3.3.1-17	A
					Water Chemistry (B.2.1.2)	VII.E1.A-101	3.3.1-17	A
	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (External)	Cracking	One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	A
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	A
				Cumulative Fatigue Damage	TLAA	VII.E1.A-100	3.3.1-2	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Regenerative) Tubes	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	A
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	A
				Cumulative Fatigue Damage	TLAA	VII.E1.A-100	3.3.1-2	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C
Heat Exchanger - (Seal Water) Tube Sheet	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (Internal)	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	VII.E1.AP-119	3.3.1-8	A
					One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	A
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C
Heat Exchanger - (Seal Water) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water > 140 F (Internal)	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	VII.E1.AP-119	3.3.1-8	A
					One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	A
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Seal Water) Tubes	Heat Transfer	Stainless Steel	Treated Borated Water > 140 F (Internal)	Reduction of Heat Transfer	One-Time Inspection (B.2.1.20)	VII.E1.A-101	3.3.1-17	A
					Water Chemistry (B.2.1.2)	VII.E1.A-101	3.3.1-17	A
	Pressure Boundary	Stainless Steel	Treated Borated Water > 140 F (Internal)	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	VII.E1.AP-119	3.3.1-8	A
					One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	A
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.E1.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-79	3.3.1-125	C
Piping Element	Leakage Boundary	Glass	Air with Borated Water Leakage (External)	None	None	VII.J.AP-96	3.3.1-117	A
			Lubricating Oil (Internal)	None	None	VII.J.AP-15	3.3.1-117	A
			Waste Water (Internal)	None	None	VII.J.AP-277	3.3.1-119	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-74	3.4.1-13	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Copper Alloy with 15% Zinc or More	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.AP-66	3.3.1-9	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Copper Alloy with 15% Zinc or More	Lubricating Oil (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E1.AP-133	3.3.1-99	E, 2
		Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Lubricating Oil (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E1.AP-133	3.3.1-99	E, 2
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Lubricating Oil (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E1.AP-138	3.3.1-100	E, 2
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	C
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-74	3.4.1-13	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.E1.AP-138	3.3.1-100	A
					One-Time Inspection (B.2.1.20)	VII.E1.AP-138	3.3.1-100	A
			Treated Borated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VII.E1.A-88	3.3.1-29	A
			Treated Borated Water > 140 F (Internal)	Cracking	Water Chemistry (B.2.1.2)	VII.E1.AP-82	3.3.1-28	A
				Cumulative Fatigue Damage	TLAA	VII.E1.A-57	3.3.1-2	A, 1
				Loss of Material	Water Chemistry (B.2.1.2)	VII.E1.A-88	3.3.1-29	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-20	3.3.1-120	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Structural Support	Stainless Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
Pump Casing (BTR Chiller)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Pump Casing (Boric Acid Transfer)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
Pump Casing (CV Auxiliary Lube Oil)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.E1.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.E1.AP-127	3.3.1-97	C
Pump Casing (CV Gear Oil)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.E1.AP-138	3.3.1-100	A
					One-Time Inspection (B.2.1.20)	VII.E1.AP-138	3.3.1-100	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Centrifugal Charging)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Cracking	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1)	VII.E1.AP-115	3.3.1-7	A
				Loss of Material	Water Chemistry (B.2.1.2)	VII.E1.A-88	3.3.1-29	A
Pump Casing (Letdown Booster)	Leakage Boundary (Byron only)	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
	Pressure Boundary (Braidwood only)	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
Pump Casing (PD Pump Aux Lube Oil)	Leakage Boundary	Gray Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E1.AP-127	3.3.1-97	E, 2
Pump Casing (PD Pump Packing Lube)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (PD Pump Packing Lube)	Leakage Boundary	Stainless Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Positive Displacement Charging)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Primary Water)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-87	3.4.1-16	A
Pump Casing (Recycle Concentrate)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
Pump Casing (Recycle Distillate)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-87	3.4.1-16	A
Pump Casing (Recycle Evaporator Feed)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Recycle Evaporator Feed)	Pressure Boundary	Stainless Steel	Treated Borated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
Pump Casing (Recycle Monitor Tank)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Valve Leakoff Drain Tank)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
Pump Casing (Zinc Injection)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-87	3.4.1-16	A
Restricting Orifice	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water > 140 F (Internal)	Cracking	Water Chemistry (B.2.1.2)	VII.E1.AP-82	3.3.1-28	A
				Loss of Material	Water Chemistry (B.2.1.2)	VII.E1.A-88	3.3.1-29	A
	Throttle	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water > 140 F (Internal)	Cracking	Water Chemistry (B.2.1.2)	VII.E1.AP-82	3.3.1-28	A
				Loss of Material	One-Time Inspection (B.2.1.20)	V.D1.E-24	3.2.1-5	E, 5
					Water Chemistry (B.2.1.2)	V.D1.E-24	3.2.1-5	E, 5

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Restricting Orifice	Throttle	Stainless Steel	Treated Borated Water > 140 F (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VII.E1.A-88	3.3.1-29	A
Strainer Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E1.AP-127	3.3.1-97	E, 2
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
Tanks (Boric Acid Batching)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C
Tanks (Boric Acid)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Boron Concentration Measurement)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Cation Bed Demin)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VII.E1.A-88	3.3.1-29	C, 6
Tanks (Charging Pump Lube Oil Reservoir)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.E1.AP-127	3.3.1-97	C
					One-Time Inspection (B.2.1.20)	VII.E1.AP-127	3.3.1-97	C
Tanks (Chemical Mixing)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-75	3.4.1-12	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-75	3.4.1-12	A
Tanks (Chiller Surge)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Chiller Surge)	Leakage Boundary	Carbon Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Tanks (Distillate Sample)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C
Tanks (Mixed Bed Demin)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VII.E1.A-88	3.3.1-29	C, 6
Tanks (PD Pump Oil Reservoir)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E1.AP-127	3.3.1-97	E, 2
Tanks (PD Pump Packing Lube Sump)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Recycle Absorption Tower)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Recycle Absorption Tower)	Pressure Boundary	Stainless Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Recycle Evaporator Condensate Demin)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C
Tanks (Recycle Evaporator Feed Demin)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C
Tanks (Recycle Holdup)	Pressure Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C
Tanks (Recycle Monitor)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Recycle Stripping Column)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Resin Fill)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-75	3.4.1-12	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-75	3.4.1-12	A
Tanks (Thermal Regeneration Demin)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Valve Leakoff Drain)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Volume Control)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VII.E1.A-88	3.3.1-29	C, 6
Tanks (Zinc Injection)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-75	3.4.1-12	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-75	3.4.1-12	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-74	3.4.1-13	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	C
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-74	3.4.1-13	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VII.E1.A-88	3.3.1-29	A
			Treated Borated Water > 140 F (Internal)	Cracking	Water Chemistry (B.2.1.2)	VII.E1.AP-82	3.3.1-28	A
				Loss of Material	Water Chemistry (B.2.1.2)	VII.E1.A-88	3.3.1-29	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-280	3.3.1-95	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-20	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The TLAA designation in the Aging Management Programs column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3.

2. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is substituted to manage the aging effect(s) applicable to this component type, material, and environment combination. The preventive measures and sampling activities provided for by the Lubricating Oil Analysis (B.2.1.26) program are not applicable for the components exposed to lubricating oil in the positive displacement pump lubricating oil subsystem since the positive displacement pump has been removed from service and, therefore, the oil quality is not maintained.

3. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination. The component is located within the heat exchanger and the external surfaces of this component are subject to the internal environment of waste water during normal operation.

4. NUREG-1801 specifies a plant-specific program to verify the effectiveness of the Water Chemistry (B.2.1.2) program in preventing cracking of the non-regenerative heat exchanger components. The One-Time Inspection (B.2.1.20) program will utilize eddy current testing to verify the absence of cracking. The Closed Treated Water Systems (B.2.1.12) program includes activities to monitor the radioactivity and temperature of the shell side water.

Table 3.3.2-2 Chemical & Volume Control System (Continued)

Plant Specific Notes: (continued)

5. NUREG-1801 specifies a plant-specific program. The Water Chemistry (B.2.1.2) program and the One-Time Inspection (B.2.1.20) program are used to manage the aging effects applicable to this component type, material and environment combination.

6. The CVC demineralizer tanks and volume control tanks are subject to constant flow in an oxygen-controlled environment during normal system operation. The design of the tanks does not allow for stagnant locations where the accumulation or concentration of contaminants could occur.

Table 3.3.2-3
Chilled Water System
Summary of Aging Management Evaluation

Table 3.3.2-3 Chilled Water System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Flow Device	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-199	3.3.1-46	A
Heat Exchanger - (Auxiliary Building Cooling Coil – Chilled Water Coil Bank) Tube Side Components	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 1
Heat Exchanger - (Auxiliary Building Cooling Coil – Chilled Water Coil Bank) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 1

Table 3.3.2-3 Chilled Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Auxiliary Building Cooling Coil – Elevator Machine Room Area Cooler) Tube Side Components	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 1
Heat Exchanger - (Auxiliary Building Cooling Coil – Elevator Machine Room Area Cooler) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 1
Heat Exchanger - (Auxiliary Building Cooling Coil – HVAC Chiller Room Area Cooler) Tube Side Components	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 1

Table 3.3.2-3 Chilled Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Auxiliary Building Cooling Coil – HVAC Chiller Room Area Cooler) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 1
Heat Exchanger - (Auxiliary Building Refrigeration Unit Evaporator) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Auxiliary Building Refrigeration Unit Evaporator) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-9	3.3.1-114	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A
Heat Exchanger - (Auxiliary Building Refrigeration Unit Oil Cooler) Shell Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-3 Chilled Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Auxiliary Building Refrigeration Unit Oil Cooler) Shell Side Components	Leakage Boundary	Carbon Steel	Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-131	3.3.1-98	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-131	3.3.1-98	A
Heat Exchanger - (Auxiliary Building Refrigeration Unit Oil Cooler) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Auxiliary Building Refrigeration Unit Pump Out Unit) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-9	3.3.1-114	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Tube Sheet	Pressure Boundary	Carbon Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-3 Chilled Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-205	3.3.1-50	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A
Heat Exchanger - (Control Room Refrigeration Unit Condenser) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-6	3.3.1-121	C
Heat Exchanger - (Control Room Refrigeration Unit Condenser) Tube Sheet	Pressure Boundary	Carbon Steel	Air/Gas - Dry (External)	None	None	VII.J.AP-6	3.3.1-121	C
Heat Exchanger - (Control Room Refrigeration Unit Condenser) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-9	3.3.1-114	C

Table 3.3.2-3 Chilled Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Control Room Refrigeration Unit Condenser) Tubes	Pressure Boundary	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-9	3.3.1-114	C
Heat Exchanger - (Control Room Refrigeration Unit Evaporator) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-6	3.3.1-121	C
Heat Exchanger - (Control Room Refrigeration Unit Evaporator) Tube Sheet	Pressure Boundary	Carbon Steel	Air/Gas - Dry (External)	None	None	VII.J.AP-6	3.3.1-121	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Control Room Refrigeration Unit Evaporator) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Control Room Refrigeration Unit Evaporator) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-9	3.3.1-114	C

Table 3.3.2-3 Chilled Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Control Room Refrigeration Unit Evaporator) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-205	3.3.1-50	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-9	3.3.1-114	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A
Heat Exchanger - (Control Room Refrigeration Unit Pump Out Unit) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-6	3.3.1-121	C
Heat Exchanger - (Control Room Refrigeration Unit Pump Out Unit) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-9	3.3.1-114	C
			Closed Cycle Cooling Water (Internal)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-205	3.3.1-50	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-9	3.3.1-114	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A

Table 3.3.2-3 Chilled Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Cooling Water Isolation Skid - Byron only) Nozzles	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Cooling Water Isolation Skid - Byron only) Plates	Leakage Boundary	Stainless Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Laboratory HVAC Chilled Water Cooling Coil) Tube Side Components	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 1
Heat Exchanger - (Laboratory HVAC Chilled Water Cooling Coil) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 1
Heat Exchanger - (Primary Containment Refrigeration Unit Evaporator) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-3 Chilled Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Primary Containment Refrigeration Unit Evaporator) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Primary Containment Refrigeration Unit Evaporator) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-9	3.3.1-114	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F3.AP-203	3.3.1-46	A
Heat Exchanger - (Primary Containment Refrigeration Unit Oil Cooler) Shell Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-131	3.3.1-98	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-131	3.3.1-98	A
Heat Exchanger - (Primary Containment Refrigeration Unit Oil Cooler) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-3 Chilled Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Primary Containment Refrigeration Unit Oil Cooler) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (RCFC Chilled Water Coils) Tube Sheet	Leakage Boundary	Stainless Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F3.AP-99	3.3.1-94	C, 1
Heat Exchanger - (RCFC Chilled Water Coils) Tube Side Components	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 1
Heat Exchanger - (RCFC Chilled Water Coils) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.F1.AP-203	3.3.1-46	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 1
Piping Element	Leakage Boundary	Glass	Air with Borated Water Leakage (External)	None	None	VII.J.AP-96	3.3.1-117	A
			Closed Cycle Cooling Water (Internal)	None	None	VII.J.AP-166	3.3.1-117	A

Table 3.3.2-3 Chilled Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.A-23	3.3.1-89	A, 1
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-9	3.3.1-114	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A

Table 3.3.2-3 Chilled Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Carbon Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.A-23	3.3.1-89	A, 1
		Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-9	3.3.1-114	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
Pump Casing (Auxiliary Building Chilled Water Pump)	Leakage Boundary	Gray Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
					Selective Leaching (B.2.1.21)	VII.C2.A-50	3.3.1-72	A
Pump Casing (Control Room Chilled Water Pump)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A

Table 3.3.2-3 Chilled Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Primary Containment Chilled Water Pump)	Leakage Boundary	Gray Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
					Selective Leaching (B.2.1.21)	VII.C2.A-50	3.3.1-72	A
Strainer Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
Tanks - (Air Separator - Control Room)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
Tanks - (Air Separator With Strainer - Containment and Auxiliary Building)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-3 Chilled Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks - (Air Separator With Strainer - Containment and Auxiliary Building)	Leakage Boundary	Carbon Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
Tanks - (Chemical Feed)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
Tanks - (Chilled Water Tank - Containment and Auxiliary Building)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
Tanks - (Control Room Chilled Water System Standpipe)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-3 Chilled Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Carbon Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.A-23	3.3.1-89	A, 1
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A

Table 3.3.2-3 Chilled Water System (Continued)

Notes	**Definition of Note**
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the aging effects applicable to this component, material, and environment combination. The component is located within HVAC housings, and the external surfaces are subject to the HVAC environment of condensation during normal operation.

Table 3.3.2-4
Circulating Water System
Summary of Aging Management Evaluation

Table 3.3.2-4 **Circulating Water System**

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting - (Byron only)	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
		Stainless Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Piping, piping components, and piping elements - (Byron only)	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air - Outdoor (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.I.AP-284	3.3.1-109x	B
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	A
Pump Casing (Circulating Water Make-up Pumps) - (Byron only)	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C

Table 3.3.2-4 Circulating Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Restricting Orifice - (Byron only)	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
Valve Body - (Byron only)	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
		Polymers	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-268	3.3.1-119	A, 2
			Raw Water (Internal)	None	None			G, 2
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	A

Table 3.3.2-4 Circulating Water System (Continued)

Notes	**Definition of Note**
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The aging effects for closure bolting in a raw water environment include loss of material. Inspection activities for bolting in a submerged environment are performed in conjunction with associated component maintenance activities.

2. The Raw Water environment is not in NUREG-1801 for this component and material. There is no aging effect for this component, material, and environment combination. Based on plant operating experience, there are no aging effects requiring management for the polymer piping in a raw water environment. This material does not experience aging effects unless exposed to elevated temperatures or radiation levels capable of attacking the specific chemical composition. The material in this water environment is not expected to experience significant aging effects due to elevated temperatures or radiation levels. The pipe material is chlorinated polyvinyl chloride (CPVC) manufactured in accordance with ASTM F1970-12, which is installed on the copper ion generator skid at Byron only. There are no chemicals injected into the Circulating Water System at the River Screen House.

Table 3.3.2-5
Component Cooling System
Summary of Aging Management Evaluation

Table 3.3.2-5 **Component Cooling System**

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Heat Exchanger - (Component Cooling) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Component Cooling) Tube Sheet	Pressure Boundary	Carbon or Low Alloy Steel with Nickel Alloy Cladding	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)			G, 1
Heat Exchanger - (Component Cooling) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (External)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-205	3.3.1-50	A
		Stainless Steel - (Braidwood Unit 2 only)	Closed Cycle Cooling Water (External)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-188	3.3.1-50	A

Table 3.3.2-5 Component Cooling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Component Cooling) Tubes	Pressure Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.E1.AP-203	3.3.1-46	A
		Stainless Steel - (Braidwood Unit 2 only)	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Containment Penetration Cooling Coils) Tubes	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Excess Letdown) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Excess Letdown) Tube Sheet	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Excess Letdown) Tubes	Heat Transfer	Stainless Steel	Closed Cycle Cooling Water (External)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-188	3.3.1-50	A
	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Letdown) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-5 Component Cooling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Letdown) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Letdown) Tube Sheet	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Letdown) Tubes	Heat Transfer	Stainless Steel	Closed Cycle Cooling Water (External)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-188	3.3.1-50	A
	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (PD Charging Pump Lube/Gyrol Cooler) Tube Sheet	Pressure Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.E1.AP-203	3.3.1-46	A
Heat Exchanger - (PD Charging Pump Lube/Gyrol Cooler) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (PD Charging Pump Lube/Gyrol Cooler) Tubes	Pressure Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.E1.AP-203	3.3.1-46	A
Heat Exchanger - (Recycle Distillate Cooler) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-5 Component Cooling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Recycle Distillate Cooler) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Recycle Distillate Cooler) Tube Sheet	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Recycle Distillate Cooler) Tubes	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Recycle Evaporator Condenser) Tube Sheet	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Recycle Evaporator Condenser) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Recycle Evaporator Condenser) Tubes	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C

Table 3.3.2-5 Component Cooling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Recycle Vent Condenser) Tube Sheet	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Recycle Vent Condenser) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Recycle Vent Condenser) Tubes	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Residual Heat Removal Pump Seal Cooler) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Residual Heat Removal Pump Seal Cooler) Tubes	Heat Transfer	Stainless Steel	Closed Cycle Cooling Water (External)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-188	3.3.1-50	A
	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C

Table 3.3.2-5 Component Cooling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Residual Heat Removal) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Residual Heat Removal) Tube Sheet	Pressure Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Residual Heat Removal) Tubes	Heat Transfer	Stainless Steel	Closed Cycle Cooling Water (External)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-188	3.3.1-50	A
	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Sample Cooler Panel Coolers) Shell Side Components	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Seal Water) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A

Table 3.3.2-5 Component Cooling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Seal Water) Tube Sheet	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Seal Water) Tubes	Heat Transfer	Stainless Steel	Closed Cycle Cooling Water (External)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-188	3.3.1-50	A
	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Spare Sample Cooler Panel Coolers) Shell Side Components	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Spare Sample Cooler Panel Coolers) Tube Sheet	Leakage Boundary	Stainless Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	C
Heat Exchanger - (Spare Sample Cooler Panel Coolers) Tubes	Leakage Boundary	Stainless Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	C
Heat Exchanger - (Spent Fuel Cooling) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-5 Component Cooling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Spent Fuel Cooling) Shell Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Spent Fuel Cooling) Tube Sheet	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Spent Fuel Cooling) Tubes	Heat Transfer	Stainless Steel	Closed Cycle Cooling Water (External)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-188	3.3.1-50	A
	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
Heat Exchanger - (Waste Gas Compressor) Tube Sheet	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
			Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	C
Heat Exchanger - (Waste Gas Compressor) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A

Table 3.3.2-5 Component Cooling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Waste Gas Compressor) Tubes	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
			Waste Water (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	C
Piping Element	Leakage Boundary	Glass	Air with Borated Water Leakage (External)	None	None	VII.J.AP-96	3.3.1-117	A
			Closed Cycle Cooling Water (Internal)	None	None	VII.J.AP-166	3.3.1-117	A
			Waste Water (Internal)	None	None	VII.J.AP-277	3.3.1-119	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-5 Component Cooling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Carbon Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
Pump Casing (Component Cooling)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
Restricting Orifice	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
	Throttle	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
Sensor Element (Radiation Detector)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
Tanks (Chemical Addition Tank)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-5 Component Cooling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Chemical Addition Tank)	Leakage Boundary	Carbon Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
Tanks (Surge Tank)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A

Table 3.3.2-5 Component Cooling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A

Table 3.3.2-5 Component Cooling System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Environment not in NUREG-1801 for this component and material. The Closed Treated Water Systems (B.2.1.12) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

Table 3.3.2-6
Compressed Air System
Summary of Aging Management Evaluation

Table 3.3.2-6 Compressed Air System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled (External) - (Byron only)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Gas Bottles (Nitrogen)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.A3.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	A
Piping, piping components, and piping elements	Leakage Boundary - (Byron only)	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.D.A-80	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-6 Compressed Air System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.D.A-80	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
		Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-8	3.3.1-114	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.AP-240	3.3.1-54	B
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.AP-81	3.3.1-56	B
	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.D.A-80	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
		Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.AP-240	3.3.1-54	B
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A

Table 3.3.2-6 Compressed Air System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Structural Support	Stainless Steel	Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.AP-81	3.3.1-56	B
Valve Body	Leakage Boundary - (Byron only)	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.D.A-80	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.D.A-80	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
		Copper Alloy with 15% Zinc or More	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.AP-66	3.3.1-9	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-8	3.3.1-114	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.AP-240	3.3.1-54	B, 1
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.AP-81	3.3.1-56	B
	Structural Support	Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.AP-240	3.3.1-54	B

Table 3.3.2-6 Compressed Air System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Structural Support	Copper Alloy with less than 15% Zinc	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.AP-81	3.3.1-56	B

Table 3.3.2-6 Compressed Air System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Loss of material due to selective leaching is not applicable to this component because the component is not subject to prolonged wetting due to ponding or pooling of water. The component is exposed to moisture controlled instrument air so aging is not expected, nevertheless, the potential for loss of material due to pitting and crevice corrosion is managed by the Compressed Air Monitoring (B.2.1.14) program.

Table 3.3.2-7
Containment Ventilation System
Summary of Aging Management Evaluation

Table 3.3.2-7 Containment Ventilation System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Outdoor (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-126	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-263	3.3.1-15	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			H, 2
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			H, 2
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Damper Housing	Pressure Boundary	Elastomers	Air with Borated Water Leakage (External)	Hardening and Loss of Strength	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F3.AP-102	3.3.1-76	A
				Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F3.AP-113	3.3.1-82	A

Table 3.3.2-7 Containment Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Damper Housing	Pressure Boundary	Elastomers	Condensation (Internal)	Hardening and Loss of Strength	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F3.AP-99	3.3.1-94	A
Ducting and Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F3.A-10	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F3.A-08	3.3.1-90	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F3.AP-99	3.3.1-94	A
Fan Housing	Pressure Boundary	Carbon Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F3.A-08	3.3.1-90	A, 2

Table 3.3.2-7 Containment Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Fan Housing	Pressure Boundary	Carbon Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F3.A-08	3.3.1-90	A
Filter Housing	Structural Support	Galvanized Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F3.A-08	3.3.1-90	A
Heat Exchanger - (RCFC Essential Service Water Coils) Shell Side Components	Pressure Boundary	Galvanized Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F3.A-08	3.3.1-90	C, 2
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F3.A-08	3.3.1-90	C
Heat Exchanger - (RCFC Essential Service Water Coils) Tube Sheet	Pressure Boundary	Carbon Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F3.A-08	3.3.1-90	C, 2
Heat Exchanger - (RCFC Essential Service Water Coils) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Condensation (External)	Reduction of Heat Transfer	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 2
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 2
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A, 2

Table 3.3.2-7 Containment Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F3.AP-99	3.3.1-94	A, 2
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
	Structural Support	Carbon Steel	Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H1.A-24	3.3.1-80	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-7 Containment Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
Valve Body	Leakage Boundary	Carbon Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A, 2
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A

Table 3.3.2-7 Containment Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Structural Support	Carbon Steel	Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H1.A-24	3.3.1-80	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A

Table 3.3.2-7 Containment Ventilation System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the aging effects for this component, material, and environment combination.

2. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination. The component is located within HVAC ducting and components, and the external surfaces of this component are subject to the internal HVAC environment of condensation during normal operation.

Table 3.3.2-8
Control Area Ventilation System
Summary of Aging Management Evaluation

Table 3.3.2-8 **Control Area Ventilation System**

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F1.A-105	3.3.1-78	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
		Copper Alloy with less than 15% Zinc	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 2
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-261	3.3.1-15	A
		Stainless Steel Bolting	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.AP-99	3.3.1-94	C, 2
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Damper Housing	Pressure Boundary	Galvanized Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-13	3.3.1-116	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.A-08	3.3.1-90	A
Door Seal	Pressure Boundary	Elastomers	Air - Indoor Uncontrolled (External)	Hardening and Loss of Strength	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F1.AP-102	3.3.1-76	A, 1
				Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F1.AP-113	3.3.1-82	A, 1

Table 3.3.2-8 Control Area Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Door Seal	Pressure Boundary	Elastomers	Condensation (Internal)	Hardening and Loss of Strength	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
Ducting and Components	Direct Flow	Aluminum Alloy	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-135	3.3.1-113	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.AP-142	3.3.1-92	C
		Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F1.A-10	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.A-08	3.3.1-90	A
		Stainless Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.AP-99	3.3.1-94	A, 2
	Pressure Boundary	Aluminum Alloy	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-135	3.3.1-113	C, 4
		Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F1.A-10	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.A-08	3.3.1-90	A

Table 3.3.2-8 Control Area Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Ducting and Components	Pressure Boundary	Galvanized Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-13	3.3.1-116	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.A-08	3.3.1-90	A
		PVC	Condensation (Internal)	None	None	VII.J.AP-269	3.3.1-119	C, 4
Electric Heaters (Housing)	Pressure Boundary	Galvanized Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-13	3.3.1-116	C
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.A-08	3.3.1-90	A
Fan Housing	Pressure Boundary	Aluminum Alloy	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-135	3.3.1-113	C
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.AP-142	3.3.1-92	C, 2
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.AP-142	3.3.1-92	C
		Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F1.A-10	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.A-08	3.3.1-90	A
Filter Housing	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F1.A-10	3.3.1-78	A

Table 3.3.2-8 Control Area Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Filter Housing	Pressure Boundary	Carbon Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.A-08	3.3.1-90	A
		Glass	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-14	3.3.1-117	C
			Condensation (Internal)	None	None	VII.J.AP-97	3.3.1-117	C
Flow Device	Pressure Boundary	Copper Alloy with less than 15% Zinc	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	A
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Fins	Heat Transfer	Aluminum Alloy	Condensation (External)	Reduction of Heat Transfer	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 2
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Shell Side Components	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F1.AP-41	3.3.1-80	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.A-08	3.3.1-90	C
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Tube Sheet	Pressure Boundary	Carbon Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.A-08	3.3.1-90	C, 2

Table 3.3.2-8 Control Area Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Control Room HVAC System Chilled Water Cooling Coil) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Condensation (External)	Reduction of Heat Transfer	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 2
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 2
Piping Element	Leakage Boundary	Glass	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-14	3.3.1-117	A
			Treated Water (Internal)	None	None	VII.J.AP-51	3.3.1-117	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-73	3.4.1-14	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Copper Alloy with less than 15% Zinc	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.A.SP-101	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.A.SP-101	3.4.1-16	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-123	3.3.1-120	A

Table 3.3.2-8 Control Area Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Stainless Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.AP-99	3.3.1-94	A, 2
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.E.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-88	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Copper Alloy with less than 15% Zinc	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	A
		Elastomers	Air - Indoor Uncontrolled (External)	Hardening and Loss of Strength	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-102	3.3.1-76	A

Table 3.3.2-8 Control Area Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Elastomers	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-113	3.3.1-82	A
			Condensation (Internal)	Hardening and Loss of Strength	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 3
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 3
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-123	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
Strainer Body	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-73	3.4.1-14	A
Tanks (Humidifier)	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-75	3.4.1-12	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-75	3.4.1-12	A
Valve Body	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-73	3.4.1-14	A

Table 3.3.2-8 Control Area Ventilation System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VIII.E.SP-73	3.4.1-14	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Copper Alloy with less than 15% Zinc	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.A.SP-101	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.A.SP-101	3.4.1-16	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-123	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A

Table 3.3.2-8 Control Area Ventilation System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The portion of the door seal exposed to an external environment will be managed by the External Surfaces Monitoring of Mechanical Components (B.2.1.23) program. The portion of the door seal exposed to an internal environment will be managed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program. The door seal is exposed to two (2) different environments.

2. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination. The component is located within HVAC ducting and components, and the external surfaces of this component are subject to the internal HVAC environment of condensation during normal operation.

3. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the aging effects for this component, material, and environment combination.

4. Flexible duct, Thermaflex M-KC, is installed between control room panels and the exhaust ductwork of the Control Area Ventilation System. The flexible duct is constructed of fiberglass with an internal surface of PVC and an external surface of aluminum foil.

Table 3.3.2-9
Cranes and Hoists
Summary of Aging Management Evaluation

Table 3.3.2-9 Cranes and Hoists

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	III.B4.TP-248	3.5.1-80	E, 1
				Loss of Preload	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	III.B4.TP-261	3.5.1-88	E, 1
					Structures Monitoring (B.2.1.34)	III.B4.TP-261	3.5.1-88	A, 2
			Air - Outdoor (External)	Loss of Material	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	III.B4.TP-274	3.5.1-82	E, 1
				Loss of Preload	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	III.B4.TP-261	3.5.1-88	E, 1
					Structures Monitoring (B.2.1.34)	III.B4.TP-261	3.5.1-88	A, 2
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A

Table 3.3.2-9 Cranes and Hoists (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	III.B4.TP-248	3.5.1-80	E, 1
				Loss of Preload	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	III.B4.TP-261	3.5.1-88	E, 1
					Structures Monitoring (B.2.1.34)	III.B4.TP-261	3.5.1-88	A, 2
Crane/Hoist (Bridge/Trolley/Girders)	Structural Support	Carbon Steel	Air - Indoor Uncontrolled (External)	Cumulative Fatigue Damage	TLAA	VII.B.A-06	3.3.1-1	A, 3
				Loss of Material	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	VII.B.A-07	3.3.1-52	A
			Air - Outdoor (External)	Cumulative Fatigue Damage	TLAA			G, 3
				Loss of Material	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)			G, 4
			Air with Borated Water Leakage (External)	Cumulative Fatigue Damage	TLAA	VII.B.A-06	3.3.1-1	A, 3
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-9 Cranes and Hoists (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Crane/Hoist (Bridge/Trolley/Girders)	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	VII.B.A-07	3.3.1-52	A
Crane/Hoist (Jib Cranes/Beams/Plates/Anchorage)	Structural Support	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	VII.B.A-07	3.3.1-52	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	VII.B.A-07	3.3.1-52	A
Crane/Hoist (Monorail and Trolley Beams/Lifting Devices/Plates)	Structural Support	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	VII.B.A-07	3.3.1-52	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	VII.B.A-07	3.3.1-52	A
Crane/Hoist (Rail System)	Structural Support	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	VII.B.A-07	3.3.1-52	A
						VII.B.A-05	3.3.1-53	A

Table 3.3.2-9 Cranes and Hoists (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Crane/Hoist (Rail System)	Structural Support	Carbon Steel	Air - Outdoor (External)	Loss of Material	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)			G, 4
								G, 4
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	VII.B.A-07	3.3.1-52	A
						VII.B.A-05	3.3.1-53	A

Table 3.3.2-9 Cranes and Hoists (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling System (B.2.1.13) program is added to supplement the Structures Monitoring (B.2.1.34) program in managing the aging effect(s) applicable to this component type, material, and environment combination. The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13) program includes visual inspections of structural bolting associated with the cranes and hoists. The Structures Monitoring (B.2.1.34) program provides for preventive measures to ensure structural bolting integrity.

2. The Structures Monitoring (B.2.1.34) program includes applicable preventive measures to ensure structural bolting integrity and supplements the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13) program.

3. The TLAA designation in the Aging Management Program column indicates cumulative fatigue damage of this component is evaluated in Section 4.7.

4. The Air - Outdoor environment is not in NUREG-1801 for this component and material. The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling System (B.2.1.13) program is used to manage the aging effects for this component, material, and environment combination.

Table 3.3.2-10
Demineralized Water System
Summary of Aging Management Evaluation

Table 3.3.2-10 Demineralized Water System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Raw Water (External) (Byron only)	Loss of Material	Bolting Integrity (B.2.1.9)			H, 1
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-264	3.3.1-15	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Flow Device - (Byron only)	Pressure Boundary	Stainless Steel	Air - Outdoor (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.I.AP-284	3.3.1-109x	B
				None	None	VII.C1.AP-209	3.3.1-4	I, 2
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-73	3.4.1-14	A

Table 3.3.2-10 Demineralized Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Copper Alloy with less than 15% Zinc - (Braidwood only)	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-101	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-101	3.4.1-16	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-272	3.3.1-95	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel (Byron only)	Air - Outdoor (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.I.AP-284	3.3.1-109x	B
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-78	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-194	3.3.1-37	A
			Soil (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.C1.AP-198	3.3.1-106	B
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A

Table 3.3.2-10 Demineralized Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
Pump Casing (Deep Well - Byron only)	Pressure Boundary	Gray Cast Iron	Raw Water (External)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-194	3.3.1-37	A
					Selective Leaching (B.2.1.21)	VII.C1.A-51	3.3.1-72	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-194	3.3.1-37	A
					Selective Leaching (B.2.1.21)	VII.C1.A-51	3.3.1-72	A
Pump Casing (Laundry Hot Water Tank - Braidwood only)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Strainer Body	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
Strainer Element - (Byron only)	Filter	Stainless Steel	Raw Water (External)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
Tanks (Laundry Hot Water Tank - Braidwood only)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-10 Demineralized Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Laundry Hot Water Tank - Braidwood only)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-73	3.4.1-14	A
		Copper Alloy with less than 15% Zinc - (Braidwood only)	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.F.SP-101	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-101	3.4.1-16	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-272	3.3.1-95	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A

Table 3.3.2-10 Demineralized Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Stainless Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel (Byron only)	Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-78	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-194	3.3.1-37	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A

Table 3.3.2-10 Demineralized Water System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The aging effects for carbon and low alloy steel closure bolting in a raw water environment include loss of material. Inspection activities for bolting in a submerged environment are performed in conjunction with associated component maintenance activities.

2. Based on an evaluation of the environmental conditions at BBS and a review of operating experience, cracking due to stress corrosion cracking is not an applicable aging effect for stainless steel in an Air - Outdoor environment. For more information see LRA Section 3.3.2.2.3.

Table 3.3.2-11
Emergency Diesel Generator & Auxiliaries System
Summary of Aging Management Evaluation

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Accumulator	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	C
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Air - Outdoor (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-126	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-263	3.3.1-15	A
		Stainless Steel Bolting - (Braidwood Unit 1 only)	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Compressor Housing (Starting Air)	Structural Support	Gray Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	C, 1
Electric Heaters	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Electric Heaters	Pressure Boundary	Carbon Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.H2.AP-202	3.3.1-45	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-127	3.3.1-97	A
Filter Housing	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H2.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-105	3.3.1-70	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-127	3.3.1-97	A
		Gray Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H2.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-105	3.3.1-70	A
		Zinc	Air - Indoor Uncontrolled (External)	None	None			F, 2
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			F, 2

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Filter Housing	Structural Support	Aluminum Alloy	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-135	3.3.1-113	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F4.AP-142	3.3.1-92	A
Heat Exchanger - (EDG Fuel Oil Cooler) Shell Side Components	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H2.AP-41	3.3.1-80	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H2.AP-105	3.3.1-70	C
					One-Time Inspection (B.2.1.20)	VII.H2.AP-105	3.3.1-70	C
Heat Exchanger - (EDG Fuel Oil Cooler) Tube Sheet	Pressure Boundary	Carbon Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
			Fuel Oil (External)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H2.AP-105	3.3.1-70	C
					One-Time Inspection (B.2.1.20)	VII.H2.AP-105	3.3.1-70	C
Heat Exchanger - (EDG Fuel Oil Cooler) Tube Side Components	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H2.AP-41	3.3.1-80	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (EDG Fuel Oil Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-205	3.3.1-50	A
			Fuel Oil (External)	Reduction of Heat Transfer	Fuel Oil Chemistry (B.2.1.18)			G, 3

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (EDG Fuel Oil Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Fuel Oil (External)	Reduction of Heat Transfer	One-Time Inspection (B.2.1.20)			G, 3
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.E1.AP-203	3.3.1-46	A
			Fuel Oil (External)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H2.AP-132	3.3.1-69	C
					One-Time Inspection (B.2.1.20)	VII.H2.AP-132	3.3.1-69	C
Heat Exchanger - (EDG Governor Oil Cooler) Shell Side Components	Pressure Boundary	Aluminum Alloy	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-135	3.3.1-113	C
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-162	3.3.1-99	C
					One-Time Inspection (B.2.1.20)	VII.H2.AP-162	3.3.1-99	C
Heat Exchanger - (EDG Governor Oil Cooler) Tube Side Components	Pressure Boundary	Copper Alloy with 15% Zinc or More	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-6	3.4.1-54	C
			Closed Cycle Cooling Water (Internal)	Cracking	Closed Treated Water Systems (B.2.1.12)			H, 9
				Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.E1.AP-203	3.3.1-46	A
					Selective Leaching (B.2.1.21)	VII.H2.AP-43	3.3.1-72	C
Heat Exchanger - (EDG Governor Oil Cooler) Tubes	Heat Transfer	Copper Alloy with 15% Zinc or More	Closed Cycle Cooling Water (Internal)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-205	3.3.1-50	A
			Lubricating Oil (External)	Reduction of Heat Transfer	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-99	3.4.1-46	A

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (EDG Governor Oil Cooler) Tubes	Heat Transfer	Copper Alloy with 15% Zinc or More	Lubricating Oil (External)	Reduction of Heat Transfer	One-Time Inspection (B.2.1.20)	VIII.G.SP-99	3.4.1-46	A
	Pressure Boundary	Copper Alloy with 15% Zinc or More	Closed Cycle Cooling Water (Internal)	Cracking	Closed Treated Water Systems (B.2.1.12)			H, 9
				Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.E1.AP-203	3.3.1-46	A
					Selective Leaching (B.2.1.21)	VII.H2.AP-43	3.3.1-72	C
			Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-133	3.3.1-99	C
					One-Time Inspection (B.2.1.20)	VII.H2.AP-133	3.3.1-99	C
Heat Exchanger - (EDG Heater/Intercooler) Fins	Heat Transfer	Aluminum Alloy	Condensation (External)	Reduction of Heat Transfer	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 4
Heat Exchanger - (EDG Heater/Intercooler) Shell Side Components	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H2.AP-41	3.3.1-80	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	C
Heat Exchanger - (EDG Heater/Intercooler) Tube Sheet	Pressure Boundary	Carbon Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	C

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (EDG Heater/Intercooler) Tube Side Components	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H2.AP-41	3.3.1-80	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (EDG Heater/Intercooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-205	3.3.1-50	A
			Condensation (Internal)	Reduction of Heat Transfer	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 4
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.E1.AP-203	3.3.1-46	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 8
Heat Exchanger - (EDG Jacket Water Upper/Lower Cooler) Shell Side Components	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H2.AP-41	3.3.1-80	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (EDG Jacket Water Upper/Lower Cooler) Tube Sheet	Pressure Boundary	Copper Alloy with 15% Zinc or More	Closed Cycle Cooling Water (External)	Cracking	Closed Treated Water Systems (B.2.1.12)			H, 9

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (EDG Jacket Water Upper/Lower Cooler) Tube Sheet	Pressure Boundary	Copper Alloy with 15% Zinc or More	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.E1.AP-203	3.3.1-46	A
					Selective Leaching (B.2.1.21)	VII.H2.AP-43	3.3.1-72	C
Heat Exchanger - (EDG Jacket Water Upper/Lower Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (External)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-205	3.3.1-50	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.E1.AP-203	3.3.1-46	A
Heat Exchanger - (EDG Lube Oil Upper/Lower Cooler) Shell Side Components	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H2.AP-41	3.3.1-80	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-131	3.3.1-98	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-131	3.3.1-98	A
Heat Exchanger - (EDG Lube Oil Upper/Lower Cooler) Tube Sheet	Pressure Boundary	Copper Alloy with 15% Zinc or More	Closed Cycle Cooling Water (Internal)	Cracking	Closed Treated Water Systems (B.2.1.12)			H, 9
				Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.E1.AP-203	3.3.1-46	A
					Selective Leaching (B.2.1.21)	VII.H2.AP-43	3.3.1-72	C
			Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-133	3.3.1-99	C

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (EDG Lube Oil Upper/Lower Cooler) Tube Sheet	Pressure Boundary	Copper Alloy with 15% Zinc or More	Lubricating Oil (External)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.H2.AP-133	3.3.1-99	C
Heat Exchanger - (EDG Lube Oil Upper/Lower Cooler) Tube Side Components	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H2.AP-41	3.3.1-80	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (EDG Lube Oil Upper/Lower Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-205	3.3.1-50	A
			Lubricating Oil (External)	Reduction of Heat Transfer	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-99	3.4.1-46	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-99	3.4.1-46	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.E1.AP-203	3.3.1-46	A
			Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-133	3.3.1-99	C
					One-Time Inspection (B.2.1.20)	VII.H2.AP-133	3.3.1-99	C
Piping Element	Pressure Boundary	Glass	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-14	3.3.1-117	A
			Closed Cycle Cooling Water (Internal)	None	None	VII.J.AP-166	3.3.1-117	A
			Condensation (Internal)	None	None	VII.J.AP-97	3.3.1-117	A
			Fuel Oil (Internal)	None	None	VII.J.AP-49	3.3.1-117	A
			Lubricating Oil (Internal)	None	None	VII.J.AP-15	3.3.1-117	A

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H1.A-24	3.3.1-80	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.H2.AP-202	3.3.1-45	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
			Diesel Exhaust (Internal)	Cumulative Fatigue Damage	TLAA			H, 5
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.AP-104	3.3.1-88	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H2.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-105	3.3.1-70	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-127	3.3.1-97	A

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Copper Alloy with 15% Zinc or More	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Closed Cycle Cooling Water (Internal)	Cracking	Closed Treated Water Systems (B.2.1.12)			H, 9
				Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.H2.AP-199	3.3.1-46	A
					Selective Leaching (B.2.1.21)	VII.H2.AP-43	3.3.1-72	A
		Copper Alloy with less than 15% Zinc	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	A
		Gray Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-127	3.3.1-97	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H2.AP-221	3.3.1-6	A
				None	None	VII.H2.AP-209	3.3.1-4	I, 6
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Stainless Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
			Diesel Exhaust (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.AP-128	3.3.1-83	A
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.AP-104	3.3.1-88	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H2.AP-136	3.3.1-71	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-136	3.3.1-71	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-138	3.3.1-100	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-138	3.3.1-100	A
	Structural Support	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
Pump Casing (Fuel Oil Engine Driven)	Pressure Boundary	Gray Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H2.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-105	3.3.1-70	A

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Jacket Water Engine Driven)	Pressure Boundary	Gray Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.H2.AP-202	3.3.1-45	A
					Selective Leaching (B.2.1.21)	VII.C2.A-50	3.3.1-72	A
Pump Casing (Jacket Water Motor Driven)	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.H2.AP-202	3.3.1-45	A
Pump Casing (Lube Oil Engine Driven)	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-127	3.3.1-97	A
Pump Casing (Lube Oil Motor Driven)	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-127	3.3.1-97	A
Restricting Orifice	Pressure Boundary	Aluminum Alloy	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-135	3.3.1-113	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F4.AP-142	3.3.1-92	A

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Restricting Orifice	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.H2.AP-202	3.3.1-45	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-127	3.3.1-97	A
		Ductile Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H2.AP-136	3.3.1-71	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-136	3.3.1-71	A
	Throttle	Aluminum Alloy	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-135	3.3.1-113	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F4.AP-142	3.3.1-92	A
		Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.H2.AP-202	3.3.1-45	A

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Restricting Orifice	Throttle	Carbon Steel	Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-127	3.3.1-97	A
		Ductile Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H2.AP-136	3.3.1-71	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-136	3.3.1-71	A
Silencer/Muffler	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-78	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
			Diesel Exhaust (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.AP-104	3.3.1-88	A
Strainer Body	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Strainer Body	Pressure Boundary	Carbon Steel	Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H2.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-105	3.3.1-70	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-127	3.3.1-97	A
Strainer Element	Filter	Carbon Steel	Fuel Oil (External)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H2.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-105	3.3.1-70	A
		Stainless Steel	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-138	3.3.1-100	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-138	3.3.1-100	A
Turbocharger Casing	Heat Transfer	Ductile Cast Iron	Closed Cycle Cooling Water (Internal)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.F4.AP-204	3.3.1-50	C
	Pressure Boundary	Aluminum Alloy	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-135	3.3.1-113	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F4.AP-142	3.3.1-92	A
		Ductile Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.H2.AP-202	3.3.1-45	A
			Diesel Exhaust (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.AP-104	3.3.1-88	A

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Copper Alloy with 15% Zinc or More	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-272	3.3.1-95	A
	Pressure Boundary	Aluminum Alloy	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-135	3.3.1-113	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F4.AP-142	3.3.1-92	A
		Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.H2.AP-202	3.3.1-45	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H2.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-105	3.3.1-70	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-127	3.3.1-97	A

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Carbon Steel	Lubricating Oil (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.H2.AP-127	3.3.1-97	A
		Copper Alloy with 15% Zinc or More	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	A, 7
		Gray Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-127	3.3.1-97	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H2.AP-136	3.3.1-71	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-136	3.3.1-71	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-138	3.3.1-100	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-138	3.3.1-100	A
	Structural Support	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Structural Support	Carbon Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
		Stainless Steel - (Braidwood Unit 1 only)	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The design and operating conditions of the starting air compressors constructed of gray cast iron exposed to an internal environment of condensation (internal) are such that they are normally dry, and not subjected to significant amounts of moisture or water pooling. Therefore, selective leaching is not considered to be an applicable aging effect and they are not included in the Selective Leaching (B.2.1.21) program. A review of plant operating experience since 2000 did not identify the occurrence of selective leaching for equipment in the scope of license renewal.

2. The component is fabricated from zinc and has no aging effects in an air-indoor (external) environment. In a condensation (internal) environment, the component is susceptible to loss of material.

3. The Fuel Oil Chemistry (B.2.1.18) and One-Time Inspection (B.2.1.20) programs are used to manage the aging effects for this component, material, and environment combination.

4. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the aging effects for this component, material, and environment combination.

5. The TLAA designation in the Aging Management Programs column indicates fatigue of this component is evaluated in Section 4.3.

Table 3.3.2-11 Emergency Diesel Generator & Auxiliaries System (Continued)

Plant Specific Notes: (continued)

6. Based on an evaluation of the environmental conditions at BBS and a review of operating experience, cracking due to stress corrosion cracking is not an applicable aging effect for stainless steel in an Air-Outdoor environment. For more information see LRA Section 3.3.2.2.3.

7. The design and operating conditions of piping, piping components and piping elements found in the starting air subsystem exposed to an internal environment of condensation (internal) are such that they are normally dry, and not subjected to significant amounts of moisture or water pooling (air dryers are installed downstream of the starting air compressors). Therefore, selective leaching is not considered to be an applicable aging effect and they are not included in the Selective Leaching (B.2.1.21) program. A review of plant operating experience since 2000 did not identify the occurrence of selective leaching for equipment in the scope of license renewal.

8. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the aging effects applicable to this component, material, and environment combination. The component is located within the emergency diesel generator combustion air ductwork and the external surfaces are subject to the environment of condensation during standby conditions.

9. The Closed Treated Water System (B.2.1.12) program is used to manage the aging effects for this component, material, and environment combination.

Table 3.3.2-12
Fire Protection System
Summary of Aging Management Evaluation

Table 3.3.2-12 Fire Protection System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Air - Outdoor (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-126	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-263	3.3.1-15	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Soil (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.I.AP-241	3.3.1-109	B
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-242	3.3.1-14	A
		Galvanized Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
		Stainless Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Raw Water (External)	Loss of Material	Bolting Integrity (B.2.1.9)			H, 1
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-264	3.3.1-15	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete Curbs	Direct Flow	Reinforced Concrete	Air - Indoor Uncontrolled (External)	Concrete Cracking and Spalling	Fire Protection (B.2.1.15)	VII.G.A-90	3.3.1-60	A
					Structures Monitoring (B.2.1.34)	VII.G.A-90	3.3.1-60	A
				Loss of Material	Fire Protection (B.2.1.15)	VII.G.A-91	3.3.1-62	A
					Structures Monitoring (B.2.1.34)	VII.G.A-91	3.3.1-62	A
			Air with Borated Water Leakage (External)	Concrete Cracking and Spalling	Fire Protection (B.2.1.15)	VII.G.A-90	3.3.1-60	A
					Structures Monitoring (B.2.1.34)	VII.G.A-90	3.3.1-60	A
				Loss of Material	Fire Protection (B.2.1.15)	VII.G.A-91	3.3.1-62	A
					Structures Monitoring (B.2.1.34)	VII.G.A-91	3.3.1-62	A
Damper Housing	Fire Barrier	Galvanized Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-13	3.3.1-116	C
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
			Condensation (Internal)	Loss of Material	Fire Protection (B.2.1.15)	VII.F1.A-08	3.3.1-90	E, 2
Doors	Fire Barrier	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
					Fire Protection (B.2.1.15)	VII.G.A-21	3.3.1-59	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-78	3.3.1-78	A
					Fire Protection (B.2.1.15)	VII.G.A-22	3.3.1-59	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Doors	Fire Barrier	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Fire Protection (B.2.1.15)	VII.G.A-21	3.3.1-59	A
Earthen water-control structures (Fuel Oil Storage Tank Berm)	Direct Flow	Soil, Rip-Rap, Sand, Gravel	Air - Outdoor (External)	Loss of Material or Loss of Form	Fire Protection (B.2.1.15)			G, 3
					Structures Monitoring (B.2.1.34)			G, 3
Fire Barriers (Insulation and Wraps)	Fire Barrier	Aluminum Alloy	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-135	3.3.1-113	C
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.AP-1	3.3.1-9	C
		Ceramic Fiber	Air - Indoor Uncontrolled (External)	None	Fire Protection (B.2.1.15)			F, 4
			Air with Borated Water Leakage (External)	None	Fire Protection (B.2.1.15)			F, 4
		Mineral Fiber	Air - Indoor Uncontrolled (External)	None	Fire Protection (B.2.1.15)			F, 5
			Air with Borated Water Leakage (External)	None	Fire Protection (B.2.1.15)			F, 5
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	C
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
Fire Barriers (Masonry Walls)	Fire Barrier	Concrete Block	Air - Indoor Uncontrolled (External)	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Fire Protection (B.2.1.15)	III.A3.TP-26	3.5.1-66	E, 6
					Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Fire Protection (B.2.1.15)	III.A3.T-12	3.5.1-70	E, 7
					Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Fire Barriers (Masonry Walls)	Fire Barrier	Concrete Block	Air - Outdoor (External)	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Fire Protection (B.2.1.15)	III.A3.TP-26	3.5.1-66	E, 6
					Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Fire Protection (B.2.1.15)	III.A3.T-12	3.5.1-70	E, 7
					Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A
				Loss of Material (Spalling, Scaling) and Cracking	Masonry Walls (B.2.1.33)	III.A5.TP-34	3.5.1-71	A
			Air with Borated Water Leakage (External)	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Fire Protection (B.2.1.15)	III.A3.TP-26	3.5.1-66	E, 6
					Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Fire Protection (B.2.1.15)	III.A3.T-12	3.5.1-70	E, 7
					Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A
Fire Barriers (Penetration Seals)	Fire Barrier	Elastomers	Air - Indoor Uncontrolled (External)	Hardening, Loss of Strength, and Loss of Sealing	Fire Protection (B.2.1.15)	VII.G.A-19	3.3.1-57	A
			Air - Outdoor (External)	Hardening, Loss of Strength, and Loss of Sealing	Fire Protection (B.2.1.15)	VII.G.A-20	3.3.1-57	A
			Air with Borated Water Leakage (External)	Hardening, Loss of Strength, and Loss of Sealing	Fire Protection (B.2.1.15)	VII.G.A-19	3.3.1-57	A
		Grout	Air - Indoor Uncontrolled (External)	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Fire Protection (B.2.1.15)	VII.G.A-90	3.3.1-60	A
					Structures Monitoring (B.2.1.34)	VII.G.A-90	3.3.1-60	A
			Air - Outdoor (External)	Cracking	Fire Protection (B.2.1.15)	VII.G.A-92	3.3.1-61	A
					Structures Monitoring (B.2.1.34)	VII.G.A-92	3.3.1-61	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Fire Barriers (Penetration Seals)	Fire Barrier	Grout	Air with Borated Water Leakage (External)	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Fire Protection (B.2.1.15)	VII.G.A-90	3.3.1-60	A
					Structures Monitoring (B.2.1.34)	VII.G.A-90	3.3.1-60	A
		Gypsum	Air - Indoor Uncontrolled (External)	Cracking, Loss of Material, and Loss of Bond	Fire Protection (B.2.1.15)			F, 8
			Air with Borated Water Leakage (External)	Cracking, Loss of Material, and Loss of Bond	Fire Protection (B.2.1.15)			F, 8
Fire Barriers (Structural Steel Fireproofing)	Fire Barrier	Gypsum	Air - Indoor Uncontrolled (External)	Cracking, Loss of Material, and Loss of Bond	Fire Protection (B.2.1.15)			F, 8
			Air with Borated Water Leakage (External)	Cracking, Loss of Material, and Loss of Bond	Fire Protection (B.2.1.15)			F, 8
		Mineral Fiber	Air - Indoor Uncontrolled (External)	None	Fire Protection (B.2.1.15)			F, 5
			Air with Borated Water Leakage (External)	None	Fire Protection (B.2.1.15)			F, 5
		Pyrocrete	Air - Indoor Uncontrolled (External)	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Fire Protection (B.2.1.15)			F, 8
			Air with Borated Water Leakage (External)	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Fire Protection (B.2.1.15)			F, 8
Fire Barriers (Walls, Ceilings, and Floors)	Fire Barrier	Gypsum	Air - Indoor Uncontrolled (External)	Cracking, Loss of Material, and Loss of Bond	Fire Protection (B.2.1.15)			F, 8
			Air with Borated Water Leakage (External)	Cracking, Loss of Material, and Loss of Bond	Fire Protection (B.2.1.15)			F, 8
		Reinforced Concrete	Air - Indoor Uncontrolled (External)	Concrete Cracking and Spalling	Fire Protection (B.2.1.15)	VII.G.A-90	3.3.1-60	A
					Structures Monitoring (B.2.1.34)	VII.G.A-90	3.3.1-60	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Fire Barriers (Walls, Ceilings, and Floors)	Fire Barrier	Reinforced Concrete	Air - Indoor Uncontrolled (External)	Loss of Material	Fire Protection (B.2.1.15)	VII.G.A-91	3.3.1-62	A
					Structures Monitoring (B.2.1.34)	VII.G.A-91	3.3.1-62	A
			Air - Outdoor (External)	Concrete Cracking and Spalling	Fire Protection (B.2.1.15)	VII.G.A-92	3.3.1-61	A
					Structures Monitoring (B.2.1.34)	VII.G.A-92	3.3.1-61	A
				Loss of Material	Fire Protection (B.2.1.15)	VII.G.A-93	3.3.1-62	A
					Structures Monitoring (B.2.1.34)	VII.G.A-93	3.3.1-62	A
			Air with Borated Water Leakage (External)	Concrete Cracking and Spalling	Fire Protection (B.2.1.15)	VII.G.A-90	3.3.1-60	A
					Structures Monitoring (B.2.1.34)	VII.G.A-90	3.3.1-60	A
				Loss of Material	Fire Protection (B.2.1.15)	VII.G.A-91	3.3.1-62	A
					Structures Monitoring (B.2.1.34)	VII.G.A-91	3.3.1-62	A
Fire Hydrant	Pressure Boundary	Ductile Cast Iron	Air - Outdoor (External)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.AP-149	3.3.1-63	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	A
			Soil (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.G.AP-198	3.3.1-106	B
Gas Bottles (Halon)	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	Fire Protection (B.2.1.15)	VII.G.AP-150	3.3.1-58	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	C
Hose Stations (Racks, Reels, and Supports)	Structural Support	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Hose Stations (Racks, Reels, and Supports)	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
Odorizer	Pressure Boundary	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-20	3.3.1-120	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
					Fire Protection (B.2.1.15)	VII.G.AP-150	3.3.1-58	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-78	3.3.1-78	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
					Fire Protection (B.2.1.15)	VII.G.AP-150	3.3.1-58	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Carbon Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.A-23	3.3.1-89	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.A-23	3.3.1-89	A
			Diesel Exhaust (Internal)	Cumulative Fatigue Damage	TLAA			H, 10
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.AP-104	3.3.1-88	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	A
			Soil (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.G.AP-198	3.3.1-106	B
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Ductile Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
					Fire Protection (B.2.1.15)	VII.G.AP-150	3.3.1-58	A
			Air - Indoor Uncontrolled (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.E-29	3.2.1-44	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-78	3.3.1-78	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Ductile Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
					Fire Protection (B.2.1.15)	VII.G.AP-150	3.3.1-58	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	A
			Soil (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.G.AP-198	3.3.1-106	B
		Galvanized Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-13	3.3.1-116	A
			Air - Indoor Uncontrolled (Internal)	None	None	VII.J.AP-13	3.3.1-116	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-78	3.3.1-78	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.G.AP-221	3.3.1-6	A
				None	None	VII.G.AP-209	3.3.1-4	I, 11
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-20	3.3.1-120	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Stainless Steel	Diesel Exhaust (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.AP-128	3.3.1-83	A
				Cumulative Fatigue Damage	TLAA			H, 10
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.AP-104	3.3.1-88	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-55	3.3.1-66	A
Pump Casing (Jockey Pump)	Pressure Boundary	Gray Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	A
					Selective Leaching (B.2.1.21)	VII.G.A-51	3.3.1-72	A
		Stainless Steel	Raw Water (External)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-55	3.3.1-66	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-55	3.3.1-66	A
Pump Casing (Motor and Diesel Driven Fire Pumps)	Pressure Boundary	Carbon Steel	Raw Water (External)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	A
		Gray Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Motor and Diesel Driven Fire Pumps)	Pressure Boundary	Gray Cast Iron	Raw Water (Internal)	Loss of Material	Selective Leaching (B.2.1.21)	VII.G.A-51	3.3.1-72	A
Restricting Orifice	Pressure Boundary	Copper Alloy with 15% Zinc or More	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	A, 12
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-55	3.3.1-66	A
	Throttle	Copper Alloy with 15% Zinc or More	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	A, 12
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-55	3.3.1-66	A
Silencer/Muffler	Pressure Boundary	Carbon Steel	Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-78	3.3.1-78	A
			Diesel Exhaust (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.AP-104	3.3.1-88	A
Spray Nozzles (Carbon Dioxide)	Spray	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Air - Indoor Uncontrolled (Internal)	None	None	VII.J.AP-17	3.3.1-120	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Spray Nozzles (Carbon Dioxide)	Spray	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
Spray Nozzles (Charcoal Filters)	Spray	Stainless Steel	Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A, 9
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
Spray Nozzles (Deluge)	Spray	Copper Alloy with 15% Zinc or More	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.AP-159	3.3.1-81	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.AP-66	3.3.1-9	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	A, 12
		Copper Alloy with less than 15% Zinc	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.AP-159	3.3.1-81	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	A
Spray Nozzles (Halon)	Spray	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Spray Nozzles (Halon)	Spray	Stainless Steel	Air - Indoor Uncontrolled (Internal)	None	None	VII.J.AP-17	3.3.1-120	A
Sprinkler Heads	Pressure Boundary	Copper Alloy with less than 15% Zinc	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.AP-197	3.3.1-64	A
	Spray	Copper Alloy with less than 15% Zinc	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.AP-197	3.3.1-64	A
Strainer Body	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	A
		Gray Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	A
					Selective Leaching (B.2.1.21)	VII.G.A-51	3.3.1-72	A
Strainer Element	Filter	Carbon Steel	Raw Water (External)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	A
		Stainless Steel	Raw Water (External)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-55	3.3.1-66	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (10 Ton Carbon Dioxide)	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
					Fire Protection (B.2.1.15)	VII.G.AP-150	3.3.1-58	C
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	C
Tanks (2 Ton Carbon Dioxide)	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
					Fire Protection (B.2.1.15)	VII.G.AP-150	3.3.1-58	C
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	C
Tanks (Foam Concentrate Storage)	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	C
Tanks (Retard Chamber)	Pressure Boundary	Ductile Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.A-23	3.3.1-89	C
Valve Body	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
					Fire Protection (B.2.1.15)	VII.G.AP-150	3.3.1-58	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
					Fire Protection (B.2.1.15)	VII.G.AP-150	3.3.1-58	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	A
			Soil (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.G.AP-198	3.3.1-106	B
		Copper Alloy with less than 15% Zinc	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-8	3.3.1-114	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.AP-197	3.3.1-64	A
		Ductile Cast Iron	Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	A
			Soil (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.G.AP-198	3.3.1-106	B
		Gray Cast Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-78	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-33	3.3.1-64	A
					Selective Leaching (B.2.1.21)	VII.G.A-51	3.3.1-72	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A

Table 3.3.2-12 Fire Protection System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Stainless Steel	Raw Water (Internal)	Loss of Material	Fire Water System (B.2.1.16)	VII.G.A-55	3.3.1-66	A

Table 3.3.2-12 Fire Protection System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The aging effects for stainless steel closure bolting in a raw water environment include loss of material. Inspection activities for bolting in a submerged environment are performed in conjunction with associated component maintenance activities.

2. The Fire Protection (B.2.1.15) program is added to supplement the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program in managing the aging effect(s) applicable to this component type, material, and environment combination. The damper housings for dampers with a fire barrier intended function are evaluated with the Fire Protection System and are inspected in accordance with Fire Protection (B.2.1.15) program requirements. Fire barrier damper housings located within the in scope boundary of the various ventilation systems also have a pressure boundary intended function and are inspected in accordance with the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program. The pressure boundary intended function is evaluated with the various ventilation systems.

3. The Fire Protection (B.2.1.15) program and Structures Monitoring (B.2.1.34) program will be used to manage the aging effect(s) applicable to this component type, material, and environment combination.

Table 3.3.2-12 **Fire Protection System** **(Continued)**

Plant Specific Notes: (continued)

4. Based on plant operating experience, there are no aging effects requiring management for ceramic fiber insulation and fire wrap in an Air-Indoor or Air with Borated Water Leakage environment. This material does not experience aging effects unless exposed to temperatures, radiation, or chemical capable of attacking the specific chemical composition. The material in this non-aggressive air environment is not expected to experience significant aging effects. Nonetheless, the Fire Protection (B.2.1.15) program is credited for ensuring the absence of any aging effects.

5. Based on plant operating experience, there are no aging effects requiring management for mineral fiber insulation in an Air-Indoor or Air with Borated Water Leakage environment. This material does not experience aging effects unless exposed to temperatures, radiation, or chemical capable of attacking the specific chemical composition. The material in this non-aggressive air environment is not expected to experience significant aging effects. Nonetheless, the Fire Protection (B.2.1.15) program is credited for ensuring the absence of any aging effects.

6. The Fire Protection (B.2.1.15) program is added to supplement the Structures Monitoring (B.2.1.34) program in managing the aging effects applicable to this component type, material, and environment combination.

7. The Fire Protection (B.2.1.15) program is added to supplement the Masonry Walls (B.2.1.33) program in managing the aging effects applicable to this component type, material, and environment combination.

8. The Fire Protection (B.2.1.15) program will be used to manage the cracking, loss of bond, and loss of material aging effects applicable to this material and environment combination.

9. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the aging effects applicable to this component, material, and environment combination. The component is located within HVAC housings, and the external surfaces are subject to the HVAC environment of condensation during normal operation.

10. The TLAA designation in the Aging Management Program column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3.

11. Based on an evaluation of the environmental conditions at BBS and a review of operating experience, cracking due to stress corrosion cracking is not an applicable aging effect for stainless steel in an Air-Outdoor environment. For more information see LRA Section 3.3.2.2.3.

12. Loss of material due to selective leaching is not applicable to this component because the orientation of the component does not allow for prolonged wetting due to ponding or pooling of water. The component is exposed to moist air and is subject to periodic wetting and, therefore, the potential for loss of material due to pitting and crevice corrosion is managed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program.

Table 3.3.2-13
Fresh Water System
Summary of Aging Management Evaluation

Table 3.3.2-13 Fresh Water System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Raw Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-271	3.3.1-93	A
Tanks (Hot Water Tank - Auxiliary Building)	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-270	3.3.1-88	C
Valve Body	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-144	3.3.1-114	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Raw Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-271	3.3.1-93	A

Table 3.3.2-13 Fresh Water System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

None.

Table 3.3.2-14
Fuel Handling & Fuel Storage System
Summary of Aging Management Evaluation

Table 3.3.2-14 Fuel Handling & Fuel Storage System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	III.B4.TP-248	3.5.1-80	E, 1
				Loss of Preload	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	III.B4.TP-261	3.5.1-88	E, 1
					Structures Monitoring (B.2.1.34)	III.B4.TP-261	3.5.1-88	A, 1
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Preload	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	III.B4.TP-261	3.5.1-88	E, 1
					Structures Monitoring (B.2.1.34)	III.B4.TP-261	3.5.1-88	A, 1
			Treated Borated Water (External)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A2.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A2.AP-79	3.3.1-125	C

Table 3.3.2-14 Fuel Handling & Fuel Storage System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Treated Borated Water (External)	Loss of Preload	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	III.B4.TP-261	3.5.1-88	E, 1
					Structures Monitoring (B.2.1.34)	III.B4.TP-261	3.5.1-88	A, 1
Crane/Hoist (New Fuel Elevator)	Structural Support	Stainless Steel	Treated Borated Water (External)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A2.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A2.AP-79	3.3.1-125	C
Crane/Hoist (Rail System for Refueling Machine & Spent Fuel Bridge Crane)	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	VII.B.A-07	3.3.1-52	A
						VII.B.A-05	3.3.1-53	A
Crane/Hoist (Refueling Machine Mast)	Structural Support	Stainless Steel	Treated Borated Water (External)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A2.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A2.AP-79	3.3.1-125	C
Crane/Hoist (Refueling Machine and Spent Fuel Bridge Crane structural support members	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Cumulative Fatigue Damage	TLAA	VII.B.A-06	3.3.1-1	A, 2
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-14 Fuel Handling & Fuel Storage System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Crane/Hoist (Refueling Machine and Spent Fuel Bridge Crane structural support members	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13)	VII.B.A-07	3.3.1-52	A
Fuel Storage Racks (Fuel Rod Storage Baskets)	Structural Support	Stainless Steel	Treated Borated Water (External)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A2.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A2.AP-79	3.3.1-125	C
Fuel Storage Racks (New Fuel Storage Racks)	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					Structures Monitoring (B.2.1.34)	VII.A1.A-94	3.3.1-111	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
Fuel Storage Racks (Spent Fuel Storage Racks)	Absorb Neutrons	Boral	Treated Borated Water (External)	Reduction of Neutron Absorbing Capacity; Change in Dimensions and Loss of Material	Monitoring of Neutron-Absorbing Materials Other than Boraflex (B.2.1.27)	VII.A2.AP-235	3.3.1-102	A
	Structural Support	Stainless Steel	Treated Borated Water (External)	Cumulative Fatigue Damage	TLAA	VII.E1.A-57	3.3.1-2	C, 3
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.A2.A-99	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A2.A-99	3.3.1-125	A
Piping, piping components, and piping elements (Fuel Transfer Tube)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A

Table 3.3.2-14 Fuel Handling & Fuel Storage System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements (Fuel Transfer Tube)	Pressure Boundary	Stainless Steel	Treated Borated Water (External)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A2.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A2.AP-79	3.3.1-125	A
Valve Body	Pressure Boundary	Stainless Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
			Treated Borated Water (External)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A2.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A2.AP-79	3.3.1-125	A

Table 3.3.2-14 Fuel Handling & Fuel Storage System (Continued)

Notes	**Definition of Note**
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling System (B.2.1.13) program is added to supplement the Structures Monitoring (B.2.1.34) program in managing the aging effect(s) applicable to this component type, material, and environment combination. The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13) program includes visual inspections of structural bolting associated with the cranes and hoists. The Structures Monitoring (B.2.1.34) program provides for preventive measures to ensure structural bolting integrity.

2. The TLAA designation in the Aging Management Programs column indicates that Cumulative Fatigue Damage for this component is evaluated in Section 4.7.

3. The TLAA designation in the Aging Management Programs column indicates that Cumulative Fatigue Damage for this component is evaluated in Section 4.3.

Table 3.3.2-15
Fuel Oil System
Summary of Aging Management Evaluation

Table 3.3.2-15 Fuel Oil System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-136	3.3.1-71	A

Table 3.3.2-15 Fuel Oil System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Stainless Steel	Fuel Oil (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.H1.AP-136	3.3.1-71	A
	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H1.A-24	3.3.1-80	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VIII.B1.SP-60	3.4.1-37	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-136	3.3.1-71	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-136	3.3.1-71	A
	Structural Support	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-15 Fuel Oil System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
Pump Casing (Fuel Oil Transfer Pumps)	Pressure Boundary	Gray Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
Strainer Body	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-136	3.3.1-71	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-136	3.3.1-71	A
Tanks (Auxiliary Feedwater Day Tanks)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A

Table 3.3.2-15 Fuel Oil System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Diesel Generator Day Tanks)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
Tanks (Diesel Generator Fuel Oil Storage Tanks)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
Tanks (ESW Diesel Pump Storage Tank - Byron only)	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
Tanks (Fire Protection Fuel Oil Storage Tank)	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A

Table 3.3.2-15 Fuel Oil System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-136	3.3.1-71	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-136	3.3.1-71	A
	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A

Table 3.3.2-15 Fuel Oil System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Stainless Steel	Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-136	3.3.1-71	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-136	3.3.1-71	A

Table 3.3.2-15 Fuel Oil System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

None.

Table 3.3.2-16
Heating Water and Heating Steam System
Summary of Aging Management Evaluation

Table 3.3.2-16 **Heating Water and Heating Steam System**

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Flow Device	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water > 140 F (Internal)	Cracking	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-186	3.3.1-43	A
				Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
Heat Exchanger - (Auxiliary Building Hot Water Heating Coil Bank) Tube Side Components	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-199	3.3.1-46	C
Heat Exchanger - (Auxiliary Building Hot Water Heating Coil Bank) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-199	3.3.1-46	C
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 1

Table 3.3.2-16 Heating Water and Heating Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Feed Preheater) Shell Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	C
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Laboratory Heating Coil) Tube Side Components	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-199	3.3.1-46	C
Heat Exchanger - (Laboratory Heating Coil) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-199	3.3.1-46	C
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 1
Heat Exchanger - (Laboratory Preheat Coil) Tube Side Components	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	C

Table 3.3.2-16 Heating Water and Heating Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Laboratory Preheat Coil) Tube Side Components	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-199	3.3.1-46	C
Heat Exchanger - (Laboratory Preheat Coil) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-199	3.3.1-46	C
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 1
Heat Exchanger - (Normal Containment Purge Hot Water Heating Coil Bank) Tube Side Components	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-199	3.3.1-46	C
Heat Exchanger - (Normal Containment Purge Hot Water Heating Coil Bank) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-199	3.3.1-46	C
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.G.AP-143	3.3.1-89	C, 1
Heat Exchanger - (Recycle Evaporator) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-16 Heating Water and Heating Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Recycle Evaporator) Tube Side Components	Leakage Boundary	Carbon Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	C
Heat Exchanger - (Recycle Feed Preheater) Shell Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	C
Heat Exchanger - (Type 1 thru Type 6 Unit Heaters) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-199	3.3.1-46	C
Heat Exchanger - (Vent Condenser) Shell Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	C
Piping Element	Leakage Boundary	Glass	Air with Borated Water Leakage (External)	None	None	VII.J.AP-96	3.3.1-117	A
			Waste Water (Internal)	None	None	VII.J.AP-277	3.3.1-119	A

Table 3.3.2-16 Heading Water and Heating Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Cumulative Fatigue Damage	TLAA	VIII.B1.S-08	3.4.1-1	A, 2
				Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.D1.S-16	3.4.1-5	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water > 140 F (Internal)	Cracking	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-186	3.3.1-43	A
				Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Auxiliary Building Vent System Heating Coil Bank Hot Water Recirculation Pumps 0A, 0B, 0C, and 0D)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-16 Heating Water and Heating Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Auxiliary Building Vent System Heating Coil Bank Hot Water Recirculation Pumps 0A, 0B, 0C, and 0D)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
Pump Casing (Condensate Return Tank Pump)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Pump Casing (Laboratory HVAC System Preheat Coil Hot Water Recirculation)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A

Table 3.3.2-16 Heating Water and Heating Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Normal Containment Purge Heating Coil Hot Water Recirculation)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
Restricting Orifice	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Strainer Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Tanks (Condensate Return Tank)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-16 Heating Water and Heating Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Condensate Return Tank)	Leakage Boundary	Carbon Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water > 140 F (Internal)	Cracking	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-186	3.3.1-43	A
				Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.3.2-16 Heading Water and Heating Steam System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination. The component is located within HVAC ducting and components, and the external surfaces of this component are subject to the internal HVAC environment of condensation during normal operation.

2. The TLAA designation in the Aging Management Program column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3.

Table 3.3.2-17
Non-Radioactive Drain System
Summary of Aging Management Evaluation

Table 3.3.2-17 Non-Radioactive Drain System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Pump Casing (Auxiliary Building Waste Oil Collection Tank Pump)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-17 Non-Radioactive Drain System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Auxiliary Building Waste Oil Collection Tank Pump)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Pump Casing (Diesel Fuel Oil Storage Tank Sump Pump)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Pump Casing (River Screen House Sump Pump - Byron only)	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Restricting Orifice	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-17 Non-Radioactive Drain System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Restricting Orifice	Leakage Boundary	Carbon Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Tanks (1000 Gallon Auxiliary Building Waste Oil Collection Tank)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Valve Body	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A

Table 3.3.2-17 Non-Radioactive Drain System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

None.

Table 3.3.2-18
Radiation Monitoring System
Summary of Aging Management Evaluation

Table 3.3.2-18 Radiation Monitoring System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Filter Housing	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
	Structural Support	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
Flow Device	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C

Table 3.3.2-18 Radiation Monitoring System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Flow Device	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-73	3.4.1-14	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Aluminum Alloy	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.AP-1	3.3.1-9	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F1.AP-142	3.3.1-92	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
Piping Element	Pressure Boundary	Glass	Air with Borated Water Leakage (External)	None	None	VII.J.AP-96	3.3.1-117	A
			Condensation (Internal)	None	None	VII.J.AP-97	3.3.1-117	A
Piping, piping components, and piping elements	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A

Table 3.3.2-18 Radiation Monitoring System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Stainless Steel	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-20	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
	Structural Support	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-20	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
Pump Casing (Auxiliary Building Sump Radiation Monitoring Sample Pumps - Byron only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A

Table 3.3.2-18 Radiation Monitoring System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Auxiliary Building Sump Radiation Monitoring Sample Pumps - Byron only)	Leakage Boundary	Stainless Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Auxiliary Building Vent Stack Radiation Monitor Bypass Pumps)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
Pump Casing (Auxiliary Building Vent Stack Radiation Monitoring Sample Pumps)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
Pump Casing (Blowdown Afterfilter Radiation Monitoring Sample Pumps)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.3.2-18 Radiation Monitoring System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Component Cooling Outlet Radiation Monitoring Sample Pumps)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
Pump Casing (Control Area Ventilation Radiation Monitoring Sample Pumps)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
Pump Casing (Essential Service Water Radiation Monitoring Sample Pumps)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	A
Pump Casing (Radwaste Evaporator Condensate Radiation Monitoring Sample Pumps)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.3.2-18 Radiation Monitoring System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Strainer Body	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Valve Body	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.3.2-18 Radiation Monitoring System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-20	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
	Structural Support	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-20	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A

Table 3.3.2-18 Radiation Monitoring System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

None.

Table 3.3.2-19
Radioactive Drain System
Summary of Aging Management Evaluation

Table 3.3.2-19 Radioactive Drain System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Filter Housing	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Piping Element	Leakage Boundary	Glass	Air with Borated Water Leakage (External)	None	None	VII.J.AP-96	3.3.1-117	A
			Waste Water (Internal)	None	None	VII.J.AP-277	3.3.1-119	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.A-08	3.3.1-90	C, 2

Table 3.3.2-19 Radioactive Drain System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.F2.AP-99	3.3.1-94	C, 2
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
			Waste Water > 140 F (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.G.AP-117	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.G.AP-117	3.3.1-97	A

Table 3.3.2-19 Radioactive Drain System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Carbon Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.G.AP-138	3.3.1-100	A
					One-Time Inspection (B.2.1.20)	VII.G.AP-138	3.3.1-100	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
			Waste Water > 140 F (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	A

Table 3.3.2-19 Radioactive Drain System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Structural Support	Carbon Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
Pump Casing (Auxiliary Building Borated Equipment Drain Tank Pump)	Leakage Boundary	Ductile Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Pump Casing (Auxiliary Building Equipment Drain Tank Pumps)	Leakage Boundary	Ductile Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A

Table 3.3.2-19 Radioactive Drain System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Auxiliary Building Floor Drain Tank Pump)	Leakage Boundary	Ductile Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Pump Casing (Blowdown Sample Collection and Chromated Drain Tank Pumps)	Leakage Boundary	Ductile Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Pump Casing (Chemical Drain Tank Pump)	Leakage Boundary	Ductile Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A

Table 3.3.2-19 Radioactive Drain System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Laundry Drain Tank Pump)	Leakage Boundary	Ductile Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Pump Casing (Laundry Waste Storage Tank Pump)	Leakage Boundary	Ductile Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Pump Casing (Reactor Coolant Drain Pumps)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
			Waste Water > 140 F (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1

Table 3.3.2-19 Radioactive Drain System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Reactor Coolant Drain Pumps)	Leakage Boundary	Stainless Steel	Waste Water > 140 F (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Restricting Orifice	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
			Waste Water > 140 F (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Strainer Body	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (2000 Gallon Laundry Waste Storage Tanks)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A

Table 3.3.2-19 Radioactive Drain System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (4000 Gallon Laundry Drain Tanks)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Tanks (6000 Gallon Chemical Drain Tanks)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water > 140 F (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (8,000 Gallon Auxiliary Building Equipment Drain Tanks)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water > 140 F (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.3.2-19 Radioactive Drain System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (8,000 Gallon Auxiliary Building Floor Drain Tanks)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Auxiliary Building Borated Equipment Drain Tanks)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Blowdown Sample Collection and Chromated Drain Tanks)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water > 140 F (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Containment Lube Oil Leakage Reservoirs)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-19 Radioactive Drain System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Containment Lube Oil Leakage Reservoirs)	Pressure Boundary	Carbon Steel	Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.G.AP-116	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.G.AP-116	3.3.1-97	A
Tanks (Reactor Coolant Drain Tanks)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water > 140 F (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.3.2-19 Radioactive Drain System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Stainless Steel	Waste Water > 140 F (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.G.AP-117	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.G.AP-117	3.3.1-97	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.3.2-19 Radioactive Drain System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Stainless Steel	Waste Water > 140 F (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 1
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A

Table 3.3.2-19 Radioactive Drain System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The aging effects for stainless steel components in a waste water > 140 °F environment includes cracking. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage the applicable aging effects for this component, material, and environment combination.

2. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination. The component is located within HVAC ducting and components, and the external surfaces of this component are subject to the internal HVAC environment of condensation during normal operation.

Table 3.3.2-20
Radwaste System
Summary of Aging Management Evaluation

Table 3.3.2-20 Radwaste System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Compressor Housing (Waste Gas Compressor)	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-272	3.3.1-95	A
		Ductile Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Electric Heaters (Dilution Water Electric Heaters)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Filter Housing	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Structural Support - (Byron only)	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	A
Flow Device - (Byron only)	Structural Support	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-20	3.3.1-120	A
Heat Exchanger - (Feed Preheater) Tube Side Components	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Overheads Condenser) Shell Side Components	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Radwaste Evaporator Distillate After Cooler) Nozzles	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Radwaste Evaporator Distillate After Cooler) Plates	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Radwaste Evaporator Distillate After Cooler) Tie Bars	Mechanical Closure	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	C
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	C
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	C
Heat Exchanger - (Radwaste Evaporator Heating Element) Shell Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Radwaste Evaporator Heating Element) Shell Side Components	Leakage Boundary	Carbon Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	C
Heat Exchanger - (Radwaste Evaporator Heating Element) Tube Side Components	Leakage Boundary	Carbon or Low Alloy Steel with Titanium Cladding	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	None	None			G, 1
Heat Exchanger - (Radwaste Evaporator Surface Condenser) Shell Side Components	Leakage Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Radwaste Evaporator) Shell Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Radwaste Evaporator) Shell Side Components	Leakage Boundary	Carbon Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	C
Heat Exchanger - (Radwaste Evaporator) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	C
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-275	3.3.1-95	A
Heat Exchanger - (Waste Gas Compressor) Shell Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	C
Piping Element	Leakage Boundary	Glass	Air with Borated Water Leakage (External)	None	None	VII.J.AP-96	3.3.1-117	A
			Waste Water (Internal)	None	None	VII.J.AP-277	3.3.1-119	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-87	3.4.1-16	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-20	3.3.1-120	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
Pump Casing (Acid Metering Pump - Braidwood only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Caustic Metering Pump)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Chem/Regen Waste Drain Tank Pump)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Chem/Regen Waste Drain Tank Pump)	Leakage Boundary	Stainless Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Concentrate Piston Pump - Byron only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Concentrate Transfer Pump – Byron only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Decant Pumps - Byron only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Decanting Tank Piston Pump - Byron only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (High Level Spent Resin Pump - Braidwood only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Low Level Spent Resin Pump - Braidwood only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Radwaste Concentrates Booster Pump - Braidwood only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Radwaste Evaporator Concentrate Pump)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Radwaste Evaporator Condensate Pump)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Pump Casing (Radwaste Evaporator Distillate Pump)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Pump Casing (Radwaste Evaporator Feed Pump)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Radwaste Evaporator Recycle Pump)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Radwaste Evaporator Recycle Pump)	Leakage Boundary	Stainless Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Radwaste Evaporator Seal Water Tank Pump - Byron only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Radwaste Monitoring Pump)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Regeneration Waste Drain Tank Pump)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Spent Resin Flushing Pump)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Spent Resin Pump - Byron only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Sulfuric Acid Metering Pump)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Restricting Orifice	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Strainer Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (10,000 Gallon Chem/Regen Waste Drain Tank)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (20,000 Gallon Radwaste Monitor Tank)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Blowdown Mixed Bed Demineralizer)	Leakage Boundary	Glass	Air with Borated Water Leakage (External)	None	None	VII.J.AP-96	3.3.1-117	C
			Treated Water (Internal)	None	None	VII.J.AP-51	3.3.1-117	C
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-87	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.G.SP-87	3.4.1-16	C
Tanks (Caustic Day Tank)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Concentrate Holding Tank - Byron only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Decanting Tank - Byron only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Decanting Tank Level Control Chamber - Byron only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Drum Processing Unit - Byron only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Gas Decay Tank)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Gas Decay Tank)	Pressure Boundary	Carbon Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	C
Tanks (High Level Spent Resin Storage Tank - Braidwood only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Low Level Spent Resin Storage Tank - Braidwood only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Radwaste Evaporator Concentrate Receiver)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Radwaste Evaporator Seal Water Tank)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Radwaste Evaporator Vapor Body Tank)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Radwaste Mixed Bed Demineralizers)	Leakage Boundary	Glass	Air with Borated Water Leakage (External)	None	None	VII.J.AP-96	3.3.1-117	C
			Treated Water (Internal)	None	None	VII.J.AP-51	3.3.1-117	C
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-87	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.G.SP-87	3.4.1-16	C
Tanks (Regeneration Waste Drain Tank)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Spent Resin Storage Tank - Byron only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Sulfuric Acid Day Tank)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Sulfuric Acid Day Tank)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Tanks (Waste Gas Compressor Separator)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Ductile Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Gray Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
					Selective Leaching (B.2.1.21)			G, 2
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-87	3.4.1-16	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-20 Radwaste System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air/Gas - Dry (Internal)	None	None	VII.J.AP-4	3.3.1-121	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A

Table 3.3.2-20 Radwaste System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The component material is titanium cladding in waste water environment. This environment is not in NUREG-1801 for this component and material. Selection of the no aging effects is based on other NUREG-1801 items for titanium in similar environments, such as VII.C1.AP-152.

2. The component material is gray cast iron in waste water environment. This environment is not in NUREG-1801 for this component and material. Selection of the Selective Leaching (B.2.1.21) program is based on other NUREG-1801 items for gray cast iron in similar environments, such as VII.H2.A-51.

Table 3.3.2-21
Sampling System
Summary of Aging Management Evaluation

Table 3.3.2-21 Sampling System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Heat Exchanger - (Blowdown Sample Cooling Skid Evaporator - Braidwood only) Tube Side Components	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VIII.G.S-25	3.4.1-26	A
Heat Exchanger - (Blowdown Sample Cooling Skid Evaporator - Braidwood only) Tubes	Leakage Boundary	Stainless Steel	Air/Gas - Dry (External)	None	None	VII.J.AP-22	3.3.1-120	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VIII.G.S-25	3.4.1-26	A

Table 3.3.2-21 Sampling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Blowdown Sample Cooling Skid Primary Cooler) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VIII.G.S-23	3.4.1-25	A
Heat Exchanger - (Cooling Water Isolation Skid - Byron only) Nozzles	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VIII.G.S-25	3.4.1-26	A
Heat Exchanger - (Cooling Water Isolation Skid - Byron only) Plates	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VIII.G.S-25	3.4.1-26	A
Heat Exchanger - (Cooling Water Isolation Skid - Byron only) Tie Bars	Mechanical Closure	Stainless Steel	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	C
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	C
Heat Exchanger - (SGBD Sample Cooler) Nozzles	Leakage Boundary	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	C
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.F.SP-85	3.4.1-11	A

Table 3.3.2-21 Sampling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (SGBD Sample Cooler) Nozzles	Leakage Boundary	Stainless Steel	Treated Water > 140 F (Internal)	Cracking	Water Chemistry (B.2.1.2)	VIII.F.SP-85	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-80	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-80	3.4.1-16	A
Heat Exchanger - (SGBD Sample Cooler) Plates	Leakage Boundary	Stainless Steel	Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.F.SP-85	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-85	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-80	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-80	3.4.1-16	A
Heat Exchanger - (SGBD Sample Cooler) Tie Bars	Mechanical Closure	Stainless Steel	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	C
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	C
Heat Exchanger - (Sample Cooler Panel Coolers) Tube Side Components	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.F.SP-85	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-85	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-80	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-80	3.4.1-16	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-21 Sampling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal) - (Byron only)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VIII.G.SP-39	3.4.1-26	A
			Treated Borated Water (Internal)	Cumulative Fatigue Damage	TLAA	VII.E1.A-57	3.3.1-2	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	C
				Cumulative Fatigue Damage	TLAA	VII.E1.A-57	3.3.1-2	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
			Treated Water (Internal)	Cumulative Fatigue Damage	TLAA	VII.E1.A-57	3.3.1-2	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A

Table 3.3.2-21 Sampling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.E.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-88	3.4.1-11	A
				Cumulative Fatigue Damage	TLAA	VII.E1.A-57	3.3.1-2	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
			Waste Water > 140 F (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 2
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
Pump Casing (Accumulator Tank Transfer Pump)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A

Table 3.3.2-21 Sampling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Accumulator Tank Transfer Pump)	Leakage Boundary	Stainless Steel	Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (HRSS Waste Drain Tank Pump)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Waste Water > 140 F (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 2
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Pump Casing (Positive Displacement Sample Pump)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.E.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-88	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
Pump Casing (Primary Cooler Pump)	Leakage Boundary	Ductile Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A

Table 3.3.2-21 Sampling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Secondary Cooler Pump)	Leakage Boundary	Ductile Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
Sensor Element (Post-Accident Hydrogen Monitor Panel)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A
Tanks (Accumulator Tank)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C
Tanks (Blowdown Sample Cooling Skid Surge Tank)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
Tanks (HRSS Waste Drain Tank)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C

Table 3.3.2-21 Sampling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (HRSS Waste Drain Tank)	Leakage Boundary	Stainless Steel	Waste Water > 140 F (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 2
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
Tanks (Pulsation Dampener)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.E.SP-88	3.4.1-11	C
					Water Chemistry (B.2.1.2)	VIII.E.SP-88	3.4.1-11	C
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	C
Tanks (Sample Reboiler - Braidwood only)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
Valve Body	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal) - (Byron only)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
		Copper Alloy with 15% Zinc or More	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.AP-66	3.3.1-9	A
			Closed Cycle Cooling Water (Internal)	Cracking	Closed Treated Water Systems (B.2.1.12)			H, 3
				Loss of Material	Closed Treated Water Systems (B.2.1.12)	VIII.F.SP-8	3.4.1-27	A

Table 3.3.2-21 Sampling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Copper Alloy with 15% Zinc or More	Closed Cycle Cooling Water (Internal)	Loss of Material	Selective Leaching (B.2.1.21)	VIII.F.SP-29	3.4.1-33	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VIII.G.SP-39	3.4.1-26	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
			Treated Borated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VII.E1.AP-118	3.3.1-20	C
					Water Chemistry (B.2.1.2)	VII.E1.AP-118	3.3.1-20	C
				Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.E.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-88	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A

Table 3.3.2-21 Sampling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Stainless Steel	Waste Water > 140 F (Internal)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 2
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-273	3.3.1-95	A

Table 3.3.2-21 Sampling System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The TLAA designation in the Aging Management Programs column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3.

2. The aging effects for stainless steel components in a waste water > 140 °F environment includes cracking. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage the applicable aging effects for this component, material, and environment combination.

3. The Closed Treated Water System (B.2.1.12) program is used to manage the aging effects for this component, material, and environment combination.

Table 3.3.2-22
Service Water System
Summary of Aging Management Evaluation

Table 3.3.2-22 Service Water System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Air - Outdoor (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-126	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-263	3.3.1-15	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Soil (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.I.AP-241	3.3.1-109	B
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-242	3.3.1-14	A
		Stainless Steel Bolting	Air - Indoor Uncontrolled (External) - (Byron only)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
			Raw Water (External) - (Byron only)	Loss of Material	Bolting Integrity (B.2.1.9)			H, 1
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-264	3.3.1-15	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Filter Housing (Essential Service Water Makeup Fuel Oil - Byron only)	Pressure Boundary	Aluminum Alloy	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-135	3.3.1-113	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-129	3.3.1-71	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-129	3.3.1-71	A
		Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
Flow Device	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-196	3.3.1-36	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Gearbox (SX Cooling Tower - Byron only)	Pressure Boundary	Gray Cast Iron	Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H1.A-24	3.3.1-80	C
					Selective Leaching (B.2.1.21)			H, 2
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.C1.AP-127	3.3.1-97	C
					One-Time Inspection (B.2.1.20)	VII.C1.AP-127	3.3.1-97	C
Heat Exchanger - (AFW Motor-Driven Pump Lube Oil Cooler) Tube Sheet	Pressure Boundary	Stainless Steel	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (AFW Motor-Driven Pump Lube Oil Cooler) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (AFW Motor-Driven Pump Lube Oil Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-72	3.3.1-42	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Auxiliary Building HVAC Refrigeration Unit Condenser) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Auxiliary Building HVAC Refrigeration Unit Condenser) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
			Waste Water (Internal) - (Byron only)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	C
Heat Exchanger - (Auxiliary Building HVAC Refrigeration Unit Condenser) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-9	3.3.1-114	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
			Waste Water (Internal) - (Byron only)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-272	3.3.1-95	C
Heat Exchanger - (Blowdown Sample Cooling Skid Condenser - Braidwood only) Tube Side Components	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Blowdown Sample Cooling Skid Condenser - Braidwood only) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-8	3.3.1-114	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Blowdown Sample Cooling Skid Primary Cooler) Shell Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (Boron Thermal Regeneration Chiller Condenser) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (Charging Pump Bearing Oil Cooler) Tube Sheet	Pressure Boundary	Stainless Steel	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Charging Pump Bearing Oil Cooler) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (Charging Pump Bearing Oil Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-72	3.3.1-42	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Charging Pump Gear Oil Cooler) Tube Sheet	Pressure Boundary	Stainless Steel	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (Charging Pump Gear Oil Cooler) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (Charging Pump Gear Oil Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-72	3.3.1-42	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Chilled Water Primary Containment Refrigeration Unit Condenser) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (Chilled Water Primary Containment Refrigeration Unit Condenser) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-9	3.3.1-114	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Component Cooling) Tube Sheet	Pressure Boundary	Carbon or Low Alloy Steel with Nickel Alloy Cladding	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-206	3.3.1-34	C
Heat Exchanger - (Component Cooling) Tube Side Components	Pressure Boundary	Carbon or Low Alloy Steel with Copper Alloy (<15% Zinc) Cladding	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Component Cooling) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-72	3.3.1-42	A
		Stainless Steel - (Braidwood Unit 2 only)	Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-187	3.3.1-42	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
		Stainless Steel - (Braidwood Unit 2 only)	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (Computer Room AC Condenser Coil) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (Computer Room AC Condenser Coil) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-8	3.3.1-114	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Control Room Refrigeration Unit Condenser) Tube Sheet	Pressure Boundary	Carbon Steel	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Control Room Refrigeration Unit Condenser) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (Control Room Refrigeration Unit Condenser) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-72	3.3.1-42	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Diesel-Driven SX Makeup Pump Engine Lube Oil - Byron only) Nozzles	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-131	3.3.1-98	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-131	3.3.1-98	A
Heat Exchanger - (Diesel-Driven SX Makeup Pump Engine Lube Oil - Byron only) Plates	Heat Transfer	Stainless Steel	Closed Cycle Cooling Water (Internal)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-188	3.3.1-50	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Diesel-Driven SX Makeup Pump Engine Lube Oil - Byron only) Plates	Heat Transfer	Stainless Steel	Lubricating Oil (External)	Reduction of Heat Transfer	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-102	3.4.1-46	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-102	3.4.1-46	A
	Pressure Boundary	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	C
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.C1.AP-138	3.3.1-100	C
					One-Time Inspection (B.2.1.20)	VII.C1.AP-138	3.3.1-100	C
Heat Exchanger - (Diesel-Driven SX Makeup Pump Engine Lube Oil - Byron only) Tie Bars	Mechanical Closure	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	C
Heat Exchanger - (Diesel-Driven SX Makeup Pump Jacket Water - Byron only) Shell Side Components	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
Heat Exchanger - (Diesel-Driven SX Makeup Pump Jacket Water - Byron only) Tube Sheet	Pressure Boundary	Carbon Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Diesel-Driven SX Makeup Pump Jacket Water - Byron only) Tube Sheet	Pressure Boundary	Carbon Steel	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (Diesel-Driven SX Makeup Pump Jacket Water - Byron only) Tube Side Components	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (Diesel-Driven SX Makeup Pump Jacket Water - Byron only) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (External)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-205	3.3.1-50	A
			Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-72	3.3.1-42	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.H2.AP-199	3.3.1-46	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Diesel-Driven SX Makeup Pump Right Angle Gear Box Lube Oil - Byron only) Shell Side Components	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-131	3.3.1-98	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Diesel-Driven SX Makeup Pump Right Angle Gear Box Lube Oil - Byron only) Shell Side Components	Pressure Boundary	Carbon Steel	Lubricating Oil (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.H2.AP-131	3.3.1-98	A
Heat Exchanger - (Diesel-Driven SX Makeup Pump Right Angle Gear Box Lube Oil - Byron only) Tube Sheet	Pressure Boundary	Carbon Steel	Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-131	3.3.1-98	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-131	3.3.1-98	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (Diesel-Driven SX Makeup Pump Right Angle Gear Box Lube Oil - Byron only) Tube Side Components	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (Diesel-Driven SX Makeup Pump Right Angle Gear Box Lube Oil - Byron only) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Reduction of Heat Transfer	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-99	3.4.1-46	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-99	3.4.1-46	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Diesel-Driven SX Makeup Pump Right Angle Gear Box Lube Oil - Byron only) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-72	3.3.1-42	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.C1.AP-133	3.3.1-99	C
					One-Time Inspection (B.2.1.20)	VII.C1.AP-133	3.3.1-99	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (EDG Jacket Water Upper/Lower Cooler) Tube Sheet	Pressure Boundary	Copper Alloy with 15% Zinc or More	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
					Selective Leaching (B.2.1.21)	VII.C1.A-66	3.3.1-72	A
Heat Exchanger - (EDG Jacket Water Upper/Lower Cooler) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (EDG Jacket Water Upper/Lower Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-72	3.3.1-42	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (EDG Jacket Water Upper/Lower Cooler) Tubes	Pressure Boundary	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Essential Service Water Pump Oil Cooler) Shell Side Components	Pressure Boundary	Carbon Steel - (Braidwood only)	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.H2.AP-131	3.3.1-98	A
					One-Time Inspection (B.2.1.20)	VII.H2.AP-131	3.3.1-98	A
		Stainless Steel - (Byron only)	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.C1.AP-138	3.3.1-100	C
					One-Time Inspection (B.2.1.20)	VII.C1.AP-138	3.3.1-100	C
Heat Exchanger - (Essential Service Water Pump Oil Cooler) Tube Sheet	Pressure Boundary	Stainless Steel	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.C1.AP-138	3.3.1-100	C
					One-Time Inspection (B.2.1.20)	VII.C1.AP-138	3.3.1-100	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Essential Service Water Pump Oil Cooler) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (Essential Service Water Pump Oil Cooler) Tubes	Heat Transfer	Stainless Steel	Lubricating Oil (External)	Reduction of Heat Transfer	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-102	3.4.1-46	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-102	3.4.1-46	A
			Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-187	3.3.1-42	A
	Pressure Boundary	Stainless Steel	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.C1.AP-138	3.3.1-100	C
					One-Time Inspection (B.2.1.20)	VII.C1.AP-138	3.3.1-100	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (Mask Cleaning Room Condenser Unit - Braidwood only) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Mask Cleaning Room Condenser Unit - Braidwood only) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-8	3.3.1-114	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Overheads Condenser) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Tube Sheet	Pressure Boundary	Carbon Steel	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-72	3.3.1-42	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (PD Charging Pump Cubicle Cooler) Tubes	Pressure Boundary	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (RCFC Essential Service Water Coils) Tube Sheet	Pressure Boundary	Stainless Steel	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (RCFC Essential Service Water Coils) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (RCFC Essential Service Water Coils) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-72	3.3.1-42	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Radwaste & RSD Control Room HVAC Condenser) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Radwaste & RSD Control Room HVAC Condenser) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (Radwaste & RSD Control Room HVAC Condenser) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-8	3.3.1-114	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Radwaste & RSD Control Room HVAC Condensing Unit) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
		Gray Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
					Selective Leaching (B.2.1.21)	VII.C1.A-51	3.3.1-72	C

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Radwaste & RSD Control Room HVAC Condensing Unit) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-8	3.3.1-114	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Radwaste Evaporator Distillate After Cooler) Nozzles	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (Radwaste Evaporator Distillate After Cooler) Plates	Leakage Boundary	Stainless Steel	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (Radwaste Evaporator Surface Condenser) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Recycle Evaporator Sample Cooler) Shell Side Components	Leakage Boundary	Carbon or Low Alloy Steel with Stainless Steel Cladding	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (SGBD Sample Cooler) Nozzles	Leakage Boundary	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (SGBD Sample Cooler) Plates	Leakage Boundary	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (SI Pump Bearing Oil Cooler) Tube Sheet	Pressure Boundary	Stainless Steel	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (SI Pump Bearing Oil Cooler) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-55	3.3.1-41	C
Heat Exchanger - (SI Pump Bearing Oil Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-72	3.3.1-42	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (SI Pump Bearing Oil Cooler) Tubes	Pressure Boundary	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Security Control Room Condenser Unit) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (Security Control Room Condenser Unit) Tubes	Leakage Boundary	Copper Alloy with less than 15% Zinc	Air/Gas - Dry (External)	None	None	VII.J.AP-8	3.3.1-114	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Tube Sheet	Pressure Boundary	Carbon Steel	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Spent Fuel Pit Pump Cubicle Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-72	3.3.1-42	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Heat Exchanger - (Steam Generator Blowdown Condenser) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - (Vent Condenser) Tube Side Components	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - ([CV, SI, RH, CS, SX] Pump Cubicle Cooler) Tube Sheet	Pressure Boundary	Carbon Steel	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - ([CV, SI, RH, CS, SX] Pump Cubicle Cooler) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	A
Heat Exchanger - ([CV, SI, RH, CS, SX] Pump Cubicle Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-72	3.3.1-42	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-179	3.3.1-38	A
Piping Element	Pressure Boundary	Glass	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-14	3.3.1-117	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-96	3.3.1-117	A
			Closed Cycle Cooling Water (Internal) - (Byron only)	None	None	VII.J.AP-166	3.3.1-117	A
			Lubricating Oil (Internal)	None	None	VII.J.AP-15	3.3.1-117	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air - Outdoor (External) - (Byron only)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.I.AP-284	3.3.1-109x	B
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Copper Alloy with 15% Zinc or More	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.AP-66	3.3.1-9	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-196	3.3.1-36	A
					Selective Leaching (B.2.1.21)	VII.C1.A-47	3.3.1-72	A
		Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-196	3.3.1-36	A
		Elastomers - (Braidwood only)	Air with Borated Water Leakage (External)	Hardening and Loss of Strength	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-102	3.3.1-76	A
				Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.F2.AP-113	3.3.1-82	A
			Raw Water (Internal)	Hardening and Loss of Strength	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-75	3.3.1-32x	A
				Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-76	3.3.1-32x	A
		Polymers	Air with Borated Water Leakage (External)	None	None	VII.J.AP-268	3.3.1-119	A, 3
			Raw Water (Internal)	None	None			G, 3

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air - Outdoor (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.I.AP-284	3.3.1-109x	B
			Air - Outdoor (External) - (Byron only)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H1.A-24	3.3.1-80	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal) - (Byron only)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
			Concrete (External)	None	None	VII.J.AP-282	3.3.1-112	A, 4
			Concrete (External) - (Byron only)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.C1.AP-198	3.3.1-106	B, 5
			Condensation (Internal) - (Byron only)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.A-23	3.3.1-89	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Carbon Steel	Diesel Exhaust (Internal) - (Byron only)	Cumulative Fatigue Damage	TLAA			H, 6
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.AP-104	3.3.1-88	A
			Fuel Oil (Internal) - (Byron only)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.C1.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.C1.AP-127	3.3.1-97	A
			Raw Water (External)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-194	3.3.1-37	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
			Soil (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.C1.AP-198	3.3.1-106	B
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Air - Outdoor (External) - (Byron only)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.I.AP-284	3.3.1-109x	B
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.C1.AP-221	3.3.1-6	A
				None	None	VII.C1.AP-209	3.3.1-4	I, 7
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (Internal) - (Byron only)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
			Diesel Exhaust (Internal) - (Byron only)	Cracking	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.AP-128	3.3.1-83	A
				Cumulative Fatigue Damage	TLAA			H, 6
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.AP-104	3.3.1-88	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.C1.AP-138	3.3.1-100	A
					One-Time Inspection (B.2.1.20)	VII.C1.AP-138	3.3.1-100	A
			Raw Water (External) - (Byron only)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
		Titanium Alloy - (Braidwood only)	Air - Outdoor (External)	None	None	VII.J.AP-160	3.3.1-122	A
			Raw Water (Internal)	None	None	VII.C1.AP-161	3.3.1-123	A
	Structural Support - (Byron only)	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Corrosion Monitoring Sample Return - Braidwood only)	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
Pump Casing (Essential Service Water Lube Oil)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.C1.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.C1.AP-127	3.3.1-97	A
Pump Casing (Essential Service Water Makeup - Byron only)	Pressure Boundary	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Raw Water (External)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
Pump Casing (Essential Service Water Makeup Fuel Oil - Byron only)	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (Essential Service Water Makeup Fuel Oil - Byron only)	Pressure Boundary	Carbon Steel	Fuel Oil (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
Pump Casing (Essential Service Water)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
Pump Casing (Inline Booster - Byron only)	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
Restricting Orifice	Pressure Boundary	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
	Throttle	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
Silencer/Muffler - (Byron only)	Pressure Boundary	Carbon Steel	Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H1.A-24	3.3.1-80	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Silencer/Muffler - (Byron only)	Pressure Boundary	Carbon Steel	Diesel Exhaust (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.AP-104	3.3.1-88	A
Spray Nozzles (SX Cooling Tower - Byron only)	Spray	Copper Alloy with less than 15% Zinc	Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.AP-159	3.3.1-81	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.H2.AP-193	3.3.1-35	A
Strainer Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
Strainer Element	Filter	Stainless Steel	Raw Water (External)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
Tanks (Corrosion Monitoring Sample Return - Braidwood only)	Leakage Boundary	Carbon Steel with Polymer Lining	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Corrosion Monitoring Sample Return - Braidwood only)	Leakage Boundary	Carbon Steel with Polymer Lining	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
Tanks (Diesel-Driven SX Makeup Pump Expansion - Byron only)	Pressure Boundary	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
Tanks (Essential Service Water Lube Oil Reservoir)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.C1.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.C1.AP-127	3.3.1-97	A
Tanks (Essential Service Water Make-Up Fuel Oil - Byron only)	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
Valve Body	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Copper Alloy with 15% Zinc or More	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.AP-66	3.3.1-9	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-196	3.3.1-36	A
					Selective Leaching (B.2.1.21)	VII.C1.A-47	3.3.1-72	A
		Copper Alloy with less than 15% Zinc	Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-196	3.3.1-36	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Carbon Steel	Air - Outdoor (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.I.AP-284	3.3.1-109x	B
			Air - Outdoor (External) - (Byron only)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.H1.A-24	3.3.1-80	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Closed Cycle Cooling Water (Internal) - (Byron only)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
			Fuel Oil (Internal) - (Byron only)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.C1.AP-127	3.3.1-97	A
					One-Time Inspection (B.2.1.20)	VII.C1.AP-127	3.3.1-97	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
		Copper Alloy with less than 15% Zinc	Air - Outdoor (External) - (Byron only)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.AP-159	3.3.1-81	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-11	3.3.1-115	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.C1.AP-133	3.3.1-99	A
					One-Time Inspection (B.2.1.20)	VII.C1.AP-133	3.3.1-99	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Gray Cast Iron - (Byron only)	Air - Outdoor (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.I.AP-284	3.3.1-109x	B
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
					Selective Leaching (B.2.1.21)	VII.C1.A-51	3.3.1-72	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A
			Air - Outdoor (External) - (Byron only)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VII.I.AP-284	3.3.1-109x	B
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.C1.AP-221	3.3.1-6	A
				None	None	VII.C1.AP-209	3.3.1-4	I, 7
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Closed Cycle Cooling Water (Internal) - (Byron only)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.A-52	3.3.1-49	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VII.C1.AP-138	3.3.1-100	A
					One-Time Inspection (B.2.1.20)	VII.C1.AP-138	3.3.1-100	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
	Structural Support - (Byron only)	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.AP-183	3.3.1-38	C
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VII.J.AP-17	3.3.1-120	A

Table 3.3.2-22 Service Water System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Structural Support - (Byron only)	Stainless Steel	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A

Table 3.3.2-22 Service Water System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The aging effects for stainless steel closure bolting in a raw water environment include loss of material. Inspection activities for bolting in a submerged environment are performed in conjunction with associated component maintenance activities.

2. This component is susceptible to selective leaching due to prolonged wetting caused by the misting effect of the essential service water cooling tower as the fan pulls the vapor up across the gear reducer.

3. Based on plant operating experience, there are no aging effects requiring management for the polymer piping in a raw water environment. This material does not experience aging effects unless exposed to elevated temperatures or radiation levels capable of attacking the specific chemical composition. The material in this water environment is not expected to experience significant aging effects due to elevated temperatures or radiation levels. The first pipe material is Bristol Pipe PVC 1120, which is installed on the corrosion monitoring skid at Braidwood Only. The primary chemical at this point in the system is sodium hypochlorite, which is maintained at a concentration of less than 1 ppm free available chlorine. The second pipe material is Kynar PVDF (polyvinylidene fluoride) for the chemical feed piping at both Byron and Braidwood sites. The primary chemical in this system is also sodium hypochlorite, which has a concentration of approximately 15%.

Table 3.3.2-22 Service Water System (Continued)

Plant Specific Notes: (continued)

4. The Service Water system contains buried piping that is embedded in the reinforced concrete foundation of the Turbine Building Complex. The reinforced concrete foundation, which is founded on the underlying bedrock at the site, provides protection to the below-grade piping. This area, including any potential ground water exposure, is considered oxygen deficient and not conducive to active corrosion. Therefore, no aging affects are assumed for the carbon steel piping embedded in the reinforced concrete foundation of the Turbine Building Complex.

5. Byron Station contains carbon steel make-up Service Water piping embedded in a below-grade reinforced concrete box section between the River Screen House and Essential Service Water Cooling Tower. Due to the potential for cracking of the reinforced concrete section that could result in the embedded piping being exposed to rain and groundwater intrusion, loss of material of the carbon steel piping is conservatively assumed applicable. The Buried and Underground Piping (B.2.1.28) program is credited for managing the effects of aging for this buried piping.

6. The TLAA designation in the Aging Management Program column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3.

7. Based on an evaluation of the environmental conditions at BBS and a review of operating experience, cracking due to stress corrosion cracking is not an applicable aging effect for stainless steel in an Air-Outdoor environment. For more information see LRA Section 3.3.2.2.3.

Table 3.3.2-23
Spent Fuel Cooling System
Summary of Aging Management Evaluation

Table 3.3.2-23 Spent Fuel Cooling System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.I.A-102	3.3.1-9	A
					Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
		Stainless Steel Bolting	Air with Borated Water Leakage (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.I.AP-125	3.3.1-12	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	A
Filter Housing	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
Heat Exchanger - (Spent Fuel Cooling) Tube Sheet	Pressure Boundary	Stainless Steel	Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C
Heat Exchanger - (Spent Fuel Cooling) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C

Table 3.3.2-23 Spent Fuel Cooling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Spent Fuel Cooling) Tubes	Heat Transfer	Stainless Steel	Treated Borated Water (Internal)	Reduction of Heat Transfer	One-Time Inspection (B.2.1.20)	VII.A3.A-101	3.3.1-17	A
					Water Chemistry (B.2.1.2)	VII.A3.A-101	3.3.1-17	A
	Pressure Boundary	Stainless Steel	Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C
Piping Element	Leakage Boundary	Glass	Air with Borated Water Leakage (External)	None	None	VII.J.AP-96	3.3.1-117	A
			Waste Water (Internal)	None	None	VII.J.AP-277	3.3.1-119	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.A3.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-278	3.3.1-95	A
	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (External)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A

Table 3.3.2-23 Spent Fuel Cooling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Stainless Steel	Treated Borated Water (External)	Loss of Material	Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
Pump Casing (Purification Pump A)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
Pump Casing (Purification Pump B)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
Pump Casing (Skimmer Pump)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
Pump Casing (Spent Fuel Pit Pump)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
Strainer Element (Spent Fuel Pit Strainer)	Filter	Stainless Steel	Treated Borated Water (External)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A

Table 3.3.2-23 Spent Fuel Cooling System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Strainer Element (Spent Fuel Pit Strainer)	Filter	Stainless Steel	Treated Borated Water (External)	Loss of Material	Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
Tanks (Spent Fuel Pit Demineralizer)	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	C
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.A3.A-79	3.3.1-9	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VII.I.A-77	3.3.1-78	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A
	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Treated Borated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	A
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	A

Table 3.3.2-23 Spent Fuel Cooling System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

None.

3.4 AGING MANAGEMENT OF STEAM AND POWER CONVERSION SYSTEM

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

3.4.1 INTRODUCTION

This section provides the results of the aging management review for those components identified in Section 2.3.4, Steam and Power Conversion System, as being subject to aging management review. The systems, or portions of systems, which are addressed in this section are described in the indicated sections.

- Auxiliary Feedwater System (2.3.4.1)
- Condensate and Feedwater Auxiliaries System (2.3.4.2)
- Main Condensate and Feedwater System (2.3.4.3)
- Main Steam System (2.3.4.4)
- Main Turbine and Auxiliaries System (2.3.4.5)

3.4.2 RESULTS

The following tables summarize the results of the aging management review for Steam and Power Conversion System.

Table 3.4.2-1 Auxiliary Feedwater System - Summary of Aging Management Evaluation

Table 3.4.2-2 Condensate and Feedwater Auxiliaries System - Summary of Aging Management Evaluation

Table 3.4.2-3 Main Condensate and Feedwater System - Summary of Aging Management Evaluation

Table 3.4.2-4 Main Steam System - Summary of Aging Management Evaluation

Table 3.4.2-5 Main Turbine and Auxiliaries System - Summary of Aging Management Evaluation

3.4.2.1 Materials, Environments, Aging Effects Requiring Management And Aging Management Programs

3.4.2.1.1 Auxiliary Feedwater System

Materials

The materials of construction for the Auxiliary Feedwater System components are:

- Aluminum Alloy
- Carbon Steel

- Carbon and Low Alloy Steel Bolting
- Copper Alloy with less than 15% Zinc
- Ductile Cast Iron
- Glass
- Gray Cast Iron
- Stainless Steel

Environments

The Auxiliary Feedwater System components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Air with Borated Water Leakage
- Closed Cycle Cooling Water
- Condensation
- Diesel Exhaust
- Fuel Oil
- Lubricating Oil
- Raw Water
- Treated Water
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Auxiliary Feedwater System components require management:

- Cumulative Fatigue Damage
- Loss of Material
- Loss of Preload
- Reduction of Heat Transfer

Aging Management Programs

The following aging management programs manage the aging effects for the Auxiliary Feedwater System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Closed Treated Water Systems (B.2.1.12)

- Compressed Air Monitoring (B.2.1.14)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Fuel Oil Chemistry (B.2.1.18)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- Lubricating Oil Analysis (B.2.1.26)
- One-Time Inspection (B.2.1.20)
- Open-Cycle Cooling Water System (B.2.1.11)
- Selective Leaching (B.2.1.21)
- TLAA
- Water Chemistry (B.2.1.2)

3.4.2.1.2 Condensate and Feedwater Auxiliaries System

Materials

The materials of construction for the Condensate and Feedwater Auxiliaries System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Copper Alloy with less than 15% Zinc - (Byron only)
- Glass
- Stainless Steel
- Stainless Steel Bolting - (Byron only)

Environments

The Condensate and Feedwater Auxiliaries System components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Treated Water

Aging Effect Requiring Management

The following aging effects associated with the Condensate and Feedwater Auxiliaries System components require management:

- Loss of Material
- Loss of Preload
- Wall Thinning

Aging Management Programs

The following aging management programs manage the aging effects for the Condensate and Feedwater Auxiliaries System components:

- Bolting Integrity (B.2.1.9)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Flow-Accelerated Corrosion (B.2.1.8)
- One-Time Inspection (B.2.1.20)
- Water Chemistry (B.2.1.2)

3.4.2.1.3 Main Condensate and Feedwater System

Materials

The materials of construction for the Main Condensate and Feedwater System components are:

- Aluminum Alloy
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Polymers - (Braidwood Unit 2 only)
- Stainless Steel
- Stainless Steel Bolting

Environments

The Main Condensate and Feedwater System components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Air with Borated Water Leakage
- Lubricating Oil - (Braidwood only)
- Soil
- Treated Water
- Treated Water > 140°F
- Waste Water - (Byron only)

Aging Effect Requiring Management

The following aging effects associated with the Main Condensate and Feedwater System components require management:

- Cracking

- Cracking, Blistering, Change in Color
- Cumulative Fatigue Damage
- Loss of Material
- Loss of Preload
- Wall Thinning

Aging Management Programs

The following aging management programs manage the aging effects for the Main Condensate and Feedwater System components:

- Aboveground Metallic Tanks (B.2.1.17)
- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- Buried and Underground Piping (B.2.1.28)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Flow-Accelerated Corrosion (B.2.1.8)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- One-Time Inspection (B.2.1.20)
- TLAA
- Water Chemistry (B.2.1.2)

3.4.2.1.4 Main Steam System

Materials

The materials of construction for the Main Steam System components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Nickel Alloy - (Byron Unit 2 and Braidwood Unit 2 only)
- Stainless Steel

Environments

The Main Steam System components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Air with Borated Water Leakage
- Condensation

- Steam
- Treated Water
- Treated Water > 140°F

Aging Effect Requiring Management

The following aging effects associated with the Main Steam System components require management:

- Cracking
- Cumulative Fatigue Damage
- Loss of Material
- Loss of Preload
- Wall Thinning

Aging Management Programs

The following aging management programs manage the aging effects for the Main Steam System components:

- Bolting Integrity (B.2.1.9)
- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Flow-Accelerated Corrosion (B.2.1.8)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- One-Time Inspection (B.2.1.20)
- TLAA
- Water Chemistry (B.2.1.2)

3.4.2.1.5 Main Turbine and Auxiliaries System

Materials

The materials of construction for the Main Turbine and Auxiliaries System components are:

- Aluminum Alloy
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Carbon or Low Alloy Steel with Stainless Steel Cladding
- Stainless Steel

Environments

The Main Turbine and Auxiliaries System components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Lubricating Oil
- Steam
- Treated Water
- Treated Water > 140°F
- Waste Water

Aging Effect Requiring Management

The following aging effects associated with the Main Turbine and Auxiliaries System components require management:

- Cracking
- Cumulative Fatigue Damage
- Loss of Material
- Loss of Preload
- Wall Thinning

Aging Management Programs

The following aging management programs manage the aging effects for the Main Turbine and Auxiliaries System components:

- Bolting Integrity (B.2.1.9)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Flow-Accelerated Corrosion (B.2.1.8)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- Lubricating Oil Analysis (B.2.1.26)
- One-Time Inspection (B.2.1.20)
- TLAA
- Water Chemistry (B.2.1.2)

3.4.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

NUREG-1801 provides the basis for identifying those programs that warrant further evaluation by the reviewer in the license renewal application. For the Steam and Power Conversion System, those programs are addressed in the following subsections.

3.4.2.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The reviewer reviews the evaluation of this TLAA separately following the guidance in Section 4.3 of this SRP-LR.

Cumulative fatigue damage is an aging effect assessed by a fatigue time-limited aging analysis (TLAA). The fatigue TLAA is required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of the fatigue TLAA for the Auxiliary Feedwater System, Heating Water and Heating Steam System, Main Steam System, and Main Turbine and Auxiliaries System is discussed in Section 4.3, “Metal Fatigue”. In addition, the evaluation of the fatigue TLAA for the Main Condensate and Feedwater System is discussed in Section 4.3, “Metal Fatigue” and Section 4.7, “Other Plant-Specific Time-Limited Aging Analysis.”

3.4.2.2.2 Cracking due to Stress Corrosion Cracking (SCC)

Cracking due to stress corrosion cracking could occur for stainless steel piping, piping components, piping elements, and tanks exposed to outdoor air. The possibility of cracking also extends to components exposed to air which has recently been introduced into buildings, i.e., components near intake vents. Cracking is only known to occur in environments containing sufficient halides (primarily chlorides) and in which condensation or deliquescence is possible. Condensation or deliquescence should generally be assumed to be possible. Applicable outdoor air environments (and associated indoor air environments) include, but are not limited to, those within approximately 5 miles of a saltwater coastline, those within 1/2 mile of a highway which is treated with salt in the wintertime, those areas in which the soil contains more than trace chlorides, those plants having cooling towers where the water is treated with chlorine or chlorine compounds, and those areas subject to chloride contamination from other agricultural or industrial sources. This item is applicable for the environments described above.

GALL AMP XI.M36, “External Surfaces Monitoring,” is an acceptable method to manage the aging effect. The applicant may demonstrate that this item is not applicable by describing the outdoor air environment present at the plant and demonstrating that external chloride stress corrosion cracking is not expected. The GALL Report recommends further evaluation to determine whether an adequate aging management program is used to manage this aging effect based on the environmental conditions *applicable to the plant and ASME Code Section XI requirements applicable to the components.*

The only stainless steel components exposed to outdoor air in the Steam and Power Conversion system are associated with the condensate storage tank. These components include instrumentation at Byron and Braidwood Stations and drain valves located on the side of each condensate storage tank at Braidwood Station only. These components are evaluated with the Main Condensate and Feedwater System. The drain valves at Braidwood Station are fully insulated, and, therefore, protected from potential halide contamination from environmental sources. Stress corrosion cracking of these components is not expected to occur. The condensate storage tanks are fabricated from aluminum alloy. There are no stainless steel tanks exposed to an outdoor air environment in the scope of license renewal at Byron and Braidwood Stations (BBS).

The thermal insulation for the condensate storage tank drain valves is enclosed in waterproof jacketing and is not in contact with the stainless steel valves. Therefore, halide contamination of the stainless steel valves due to leaching of contaminants from the insulation is not credible.

A large buildup of halide contamination increases the probability of cracking due to stress corrosion cracking which has the potential to lead to loss of component intended function. As explained below, significant halide contamination of stainless steel piping, piping components, and piping elements exposed to outdoor air or exposed to air which has recently been introduced into buildings is not expected at BBS. Additionally, an elevated temperature increases the likelihood of cracking. Experimental studies and industry operating experience in chloride-containing (coastal) environments have shown that stainless steel exposed to an outdoor air environment can crack at temperatures as low as 104°F to 120°F, depending on humidity, component surface temperature, and contaminant concentration and composition. The highest temperatures recorded at BBS over the ten year period between June 1, 2001 and June 1, 2012 were 94.4°F at Byron Station and 98.2°F at Braidwood Station. A review of historical temperature data since construction for areas surrounding BBS indicates that temperatures rarely exceed 100°F. UFSAR Section 2.3.2.1.2 identifies long-term average temperatures of approximately 50°F for BBS. Therefore, stress corrosion cracking of stainless steel piping, piping components, and piping elements exposed to outdoor air or exposed to air which has recently been introduced into buildings is not expected to occur at BBS.

Halide surface contamination is significant in areas where there are greater concentrations of halides such as near the seacoast where salt spray is prevalent or near industrial facilities. Byron and Braidwood Stations are not located near the seacoast. They are located inland, in central Illinois. Both Byron and Braidwood are located in areas where industrial halide concentrations are low, since they are located in rural areas with no heavy industry nearby.

Byron and Braidwood Stations are not located within one half mile of a highway treated with salt in the wintertime. Major highways in the vicinity of Byron Station include interstate I-90 northeast of the site approximately 11 miles away, interstate I-39 east of the site approximately 11 miles away, and interstate I-88 south of the site approximately

14 miles away. The only major highway in the vicinity of Braidwood Station is interstate I-55 northwest of the site approximately three quarters of a mile away.

The cooling towers at Byron Station are treated with sodium hypochlorite. However, chloride contamination of stainless steel components located outdoors is not expected since the prevailing wind direction is west to east and is directed away from the site. Braidwood Station does not have cooling towers.

Halide contamination of stainless steel components from soil containing more than trace chlorides or from agricultural sources is not expected. However, should halide contamination occur, any potential buildup of halide contamination would be gradual and such contamination would be periodically washed away by rainfall or snow. Cracking due to cumulative build up of halides on stainless steel components located outdoors at BBS has not been experienced and is not expected. The smooth surfaces of the stainless steel components aid the removal of potential halide contamination. Therefore, the concentration of contaminants necessary to initiate stress corrosion cracking of stainless steel is not expected.

Based on the collective environmental conditions, as described above, and confirmed by a review of operating experience, cracking due to stress corrosion cracking of stainless steel components exposed to outdoor air is not expected to occur. Therefore, aging management activities for cracking due to stress corrosion cracking for stainless steel components exposed to outdoor air are not required for the period of extended operation.

3.4.2.2.3 Loss of Material due to Pitting and Crevice Corrosion

Loss of material due to pitting and crevice corrosion could occur for stainless steel piping, piping components, piping elements, and tanks exposed to outdoor air. The possibility of pitting and crevice corrosion also extends to components exposed to air which has recently been introduced into buildings, i.e., components near intake vents. Pitting and crevice corrosion is only known to occur in environments containing sufficient halides (primarily chlorides) and in which condensation or deliquescence is possible. Condensation or deliquescence should generally be assumed to be possible. Applicable outdoor air environments (and associated indoor air environments) include, but are not limited to, those within approximately 5 miles of a saltwater coastline, those within 1/2 mile of a highway which is treated with salt in the wintertime, those areas in which the soil contains more than trace chlorides, those plants having cooling towers where the water is treated with chlorine or chlorine compounds, and those areas subject to chloride contamination from other agricultural or industrial sources. This item is applicable for the environments described above.

GALL AMP XI.M36, "External Surfaces Monitoring," is an acceptable method to manage the aging effect. The applicant may demonstrate that this item is not applicable by describing the outdoor air environment present at the plant and demonstrating that external pitting or crevice corrosion is not expected. The GALL Report recommends further evaluation to determine whether an adequate aging management program is used to manage this aging effect based on the environmental conditions applicable to the *plant and ASME Code Section XI requirements Quality Assurance for Aging Management of Nonsafety-Related Components.*

BBS will implement the External Surfaces Monitoring of Mechanical Components (B.2.1.23) program to manage the loss of material in stainless steel piping, piping components, and piping elements exposed to an outdoor air environment in the Main Condensate and Feedwater System. There are no stainless steels tanks exposed to an outdoor air environment in the scope of license renewal at BBS. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program provides for management of aging effects through periodic visual inspection of external surfaces for evidence of loss of material. Visual inspection activities will be performed by qualified personnel in accordance with site controlled procedures and processes. Any visible evidence of loss of material will be evaluated for acceptability of continued service. Deficiencies will be documented in accordance with the 10 CFR Part 50, Appendix B Corrective Action Program. The External Surfaces Monitoring of Mechanical Components program is described in Appendix B.

3.4.2.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

QA provisions applicable to License Renewal are discussed in Section B.1.3.

3.4.2.3 Time-Limited Aging Analyses

The time-limited aging analyses identified below are associated with the Steam and Power Conversion System components:

- Section 4.3, Metal Fatigue
- Section 4.7, Other Plant Specific Time-Limited Aging Analyses

3.4.3 CONCLUSION

The Steam and Power Conversion System piping, fittings, and components that are subject to aging management review have been identified in accordance with the requirements of 10 CFR 54.4. The aging management programs selected to manage aging effects for the Steam and Power Conversion System components are identified in the summaries in Section 3.4.2.1 above.

A description of these aging management programs is provided in Appendix B, along with the demonstration that the identified aging effects will be managed for the period of extended operation.

Therefore, based on the conclusions provided in Appendix B, the effects of aging associated with the Steam and Power Conversion System components will be adequately managed so that there is reasonable assurance that the intended functions are maintained consistent with the current licensing basis during the period of extended operation.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.4.1-1	Steel Piping, piping components, and piping elements exposed to Steam or Treated water	Cumulative fatigue damage due to fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA	Cumulative fatigue damage is an aging effect assessed by a fatigue TLAA. Further evaluation is documented in subsection subsection 3.4.2.2.1.
3.4.1-2	Stainless steel Piping, piping components, and piping elements; tanks exposed to Air – outdoor	Cracking due to stress corrosion cracking	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated	Based on the evaluation of the environmental conditions at BBS and a review of operating experience, cracking is not an applicable aging effect for the stainless steel bolting, piping, piping components, and piping elements exposed to air - outdoor. See subsection 3.4.2.2.2.
3.4.1-3	Stainless steel Piping, piping components, and piping elements; tanks exposed to Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes, environmental conditions need to be evaluated	Consistent with NUREG-1801. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program will be used to manage loss of material of stainless steel piping, piping components, and piping elements exposed to air - outdoor. See subsection 3.4.2.2.3.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-4	Steel External surfaces, Bolting exposed to Air with borated water leakage	Loss of material due to boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	No	Consistent with NUREG-1801. The Boric Acid Corrosion (B.2.1.4) program will be used to manage loss of material of steel bolting, gearboxes, heat exchanger components, piping, piping components, piping elements, and tanks exposed to air with borated water leakage in the Auxiliary Feedwater System, Main Condensate and Feedwater System, Main Steam System, and Steam Generators.
3.4.1-5	Steel Piping, piping components, and piping elements exposed to Steam, Treated water	Wall thinning due to flow-accelerated corrosion	Chapter XI.M17, “Flow-Accelerated Corrosion”	No	Consistent with NUREG-1801. The Flow-Accelerated Corrosion (B.2.1.8) program will be used to manage wall thinning of steel heat exchanger components, piping, piping components, and piping elements exposed to steam and treated water in the Condensate and Feedwater Auxiliaries System, Heating Water and Heating Steam System, Main Condensate and Feedwater System, Main Steam System, Main Turbine and Auxiliaries System, and Steam Generators.
3.4.1-6	Steel, Stainless Steel Bolting exposed to Soil	Loss of preload	Chapter XI.M18, "Bolting Integrity "	No	Consistent with NUREG-1801. The Bolting Integrity (B.2.1.9) program will be used to manage loss of preload of stainless steel bolting exposed to soil in the Main Condensate and Feedwater System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.4.1-7	High-strength steel Closure bolting exposed to Air with steam or water leakage	Cracking due to cyclic loading, stress corrosion cracking	Chapter XI.M18, "Bolting Integrity"	No	Not Applicable. There is no high strength steel bolting exposed to air with steam or water leakage in the Steam and Power Conversion System.
3.4.1-8	Steel; stainless steel Bolting, Closure bolting exposed to Air – outdoor (External), Air – indoor, uncontrolled (External)	Loss of material due to general (steel only), pitting, and crevice corrosion	Chapter XI.M18, "Bolting Integrity"	No	Consistent with NUREG-1801. The Bolting Integrity (B.2.1.9) program will be used to manage loss of material of steel and stainless steel bolting exposed to air-indoor uncontrolled, air- outdoor, and air with borated water leakage in the Auxiliary Feedwater System, Condensate and Feedwater Auxiliaries System, Main Condensate and Feedwater System, Main Steam System, Main Turbine and Auxiliaries System, and Steam Generators.
3.4.1-9	Steel Closure bolting exposed to Air with steam or water leakage	Loss of material due to general corrosion	Chapter XI.M18, "Bolting Integrity"	No	Not Applicable. There is no steel closure bolting exposed to air with steam or water leakage in the Steam and Power Conversion System. AMR methodology conservatively assumes wetting due to leakage for all bolting in an air – indoor environment. Steel closure bolting exposed to air – indoor is addressed by Item Number 3.4.1-8.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-10	Copper alloy, Nickel alloy, Steel; stainless steel, Steel; stainless steel Bolting, Closure bolting exposed to Any environment, Air – outdoor (External), Air – indoor, uncontrolled (External)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	No	Consistent with NUREG-1801. The Bolting Integrity (B.2.1.9) program will be used to manage loss of preload of steel and stainless steel bolting exposed to air-indoor uncontrolled, air-outdoor, and air with borated water leakage in the Auxiliary Feedwater System, Condensate and Feedwater Auxiliaries System, Main Condensate and Feedwater System, Main Steam System, Main Turbine and Auxiliaries System, and Steam Generators.
3.4.1-11	Stainless steel Piping, piping components, and piping elements, Tanks, Heat exchanger components exposed to Steam, Treated water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage cracking of stainless steel heat exchanger components, piping, piping components, piping elements, and tanks exposed to steam and treated water > 140°F in the Auxiliary Building Ventilation System, Control Area Ventilation System, Main Condensate and Feedwater System, Main Steam System, Main Turbine and Auxiliaries System, Sampling System, and Steam Generators.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.4.1-12	Steel; stainless steel Tanks exposed to Treated water	Loss of material due to general (steel only), pitting, and crevice corrosion	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage loss of material of steel and stainless steel tanks exposed to treated water in the Auxiliary Building Ventilation System, Chemical & Volume Control System, Condensate and Feedwater Auxiliaries System, and Control Area Ventilation System.
3.4.1-13	Steel Piping, piping components, and piping elements exposed to Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage loss of material of steel nozzle thermal sleeves, piping, piping components, piping elements, and tanks exposed to treated water in the Auxiliary Feedwater System, Chemical & Volume Control System, Main Condensate and Feedwater System, Main Steam System, and Steam Generators.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-14	Steel Piping, piping components, and piping elements, PWR heat exchanger components exposed to Steam, Treated water	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage loss of material of steel heat exchanger components, piping, piping components, and piping elements exposed to steam and treated water in the Auxiliary Building Ventilation System, Condensate and Feedwater Auxiliaries System, Control Area Ventilation System, Demineralized Water System, Main Steam System, Main Turbine and Auxiliaries System, Radiation Monitoring System, and Steam Generators.
3.4.1-15	Steel Heat exchanger components exposed to Treated water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage loss of material of steel heat exchanger components exposed to treated water in the Main Condensate and Feedwater System and Main Turbine and Auxiliaries System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-16	Copper alloy, Stainless steel, Nickel alloy, Aluminum Piping, piping components, and piping elements, Heat exchanger components and tubes, PWR heat exchanger components exposed to Treated water, Steam	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The One-Time Inspection (B.2.1.20) program and Water Chemistry (B.2.1.2) program will be used to manage loss of material of aluminum alloy, copper alloy, nickel alloy, and stainless steel heat exchanger components, nozzle thermal sleeves, piping, piping components, piping elements; steam generator manway covers, handhole covers, nozzles, safe ends, and welds; and tanks exposed to steam and treated water in the Auxiliary Building Ventilation System, Auxiliary Feedwater System, Chemical & Volume Control System, Condensate and Feedwater Auxiliaries System, Control Area Ventilation System, Demineralized Water System, Main Condensate and Feedwater System, Main Steam System, Main Turbine and Auxiliaries System, Radiation Monitoring System, Radwaste System, Sampling System, and Steam Generators.
3.4.1-17	Copper alloy Heat exchanger tubes exposed to Treated water	Reduction of heat transfer due to fouling	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No	Not Applicable. There are no copper alloy heat exchanger tubes exposed to treated water in the Steam and Power Conversion System.
3.4.1-18	Copper alloy, Stainless steel Heat exchanger tubes exposed to Treated water	Reduction of heat transfer due to fouling	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32, "One-Time Inspection"	No	Not Applicable. There are no copper alloy or stainless steel heat exchanger tubes exposed to treated water in the Steam and Power Conversion System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-19	Stainless steel, Steel Heat exchanger components exposed to Raw water	Loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Consistent with NUREG-1801. The Open-Cycle Cooling Water System (B.2.1.11) program will be used to manage loss of material of steel and stainless steel heat exchanger components, piping, piping components, and piping elements exposed to raw water in the Auxiliary Feedwater System.
3.4.1-20	Copper alloy, Stainless steel Piping, piping components, and piping elements exposed to Raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Consistent with NUREG-1801. The Open-Cycle Cooling Water System (B.2.1.11) program will be used to manage loss of material of copper alloy heat exchanger components exposed to raw water in the Auxiliary Feedwater System.
3.4.1-21	Stainless steel Heat exchanger components exposed to Raw water	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Consistent with NUREG-1801. The Open-Cycle Cooling Water System (B.2.1.11) program will be used to manage loss of material of stainless steel heat exchanger components exposed to raw water in the Auxiliary Feedwater System.
3.4.1-22	Stainless steel, Copper alloy, Steel Heat exchanger tubes, Heat exchanger components exposed to Raw water	Reduction of heat transfer due to fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	No	Consistent with NUREG-1801. The Open-Cycle Cooling Water System (B.2.1.11) program will be used to manage reduction of heat transfer of copper alloy heat exchanger tubes exposed to raw water in the Auxiliary Feedwater System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.4.1-23	Stainless steel Piping, piping components, and piping elements exposed to Closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	Chapter XI.M21A, "Closed Treated Water Systems"	No	Not Applicable. There are no stainless steel piping, piping components, and piping elements exposed to closed cycle cooling water >140 F in the Steam and Power Conversion System.
3.4.1-24	Steel Heat exchanger components exposed to Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No	Not Applicable. This component, material, environment and aging effect combination is addressed by Item Number 3.4.1-25.
3.4.1-25	Steel Heat exchanger components exposed to Closed-cycle cooling water	Loss of material due to general, pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No	Consistent with NUREG-1801. The Closed Treated Water Systems (B.2.1.12) program will be used to manage loss of material of steel heat exchanger components exposed to closed cycle cooling water in the Sampling System.
3.4.1-26	Stainless steel Heat exchanger components, Piping, piping components, and piping elements exposed to Closed-cycle cooling water	Loss of material due to pitting and crevice corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No	Consistent with NUREG-1801. The Closed Treated Water Systems (B.2.1.12) program will be used to manage loss of material of stainless steel heat exchanger components, piping, piping components, and piping elements exposed to closed cycle cooling water in the Auxiliary Feedwater System and Sampling System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-27	Copper alloy Piping, piping components, and piping elements exposed to Closed-cycle cooling water	Loss of material due to pitting, crevice, and galvanic corrosion	Chapter XI.M21A, "Closed Treated Water Systems"	No	Consistent with NUREG-1801. The Closed Treated Water Systems (B.2.1.12) program will be used to manage loss of material of copper alloy heat exchanger components, piping, piping components and piping elements exposed to closed cycle cooling water in the Auxiliary Feedwater System and Sampling System.
3.4.1-28	Steel, Stainless steel, Copper alloy Heat exchanger components and tubes, Heat exchanger tubes exposed to Closed-cycle cooling water	Reduction of heat transfer due to fouling	Chapter XI.M21A, "Closed Treated Water Systems"	No	Consistent with NUREG-1801. The Closed Treated Water Systems (B.2.1.12) program will be used to manage reduction of heat transfer of copper alloy and stainless steel heat exchanger plates and tubes exposed to closed cycle cooling water in the Auxiliary Feedwater System.
3.4.1-29	Steel Tanks exposed to Air – outdoor (External)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M29, “Aboveground Metallic Tanks”	No	Not Applicable. There are no steel tanks exposed to air-outdoor in the Steam and Power Conversion System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-30	Steel, Stainless Steel, Aluminum Tanks exposed to Soil or Concrete, Air – outdoor (External)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M29, "Aboveground Metallic Tanks"	No	Consistent with NUREG-1801 with exceptions. The Aboveground Metallic Tanks (B.2.1.17) program will be used to manage loss of material of aluminum alloy tanks exposed to air-outdoor in the Main Condensate and Feedwater System. Exceptions apply to the NUREG-1801 recommendations for the Aboveground Metallic Tanks (B.2.1.17) program implementation.
3.4.1-31	Stainless steel, Aluminum Tanks exposed to Soil or Concrete	Loss of material due to pitting, and crevice corrosion	Chapter XI.M29, "Aboveground Metallic Tanks"	No	Consistent with NUREG-1801 with exceptions. The Aboveground Metallic Tanks (B.2.1.17) program will be used to manage loss of material of aluminum alloy tanks exposed to soil in the Main Condensate and Feedwater System. Exceptions apply to the NUREG-1801 recommendations for the Aboveground Metallic Tank (B.2.1.17) program implementation.
3.4.1-32	Gray cast iron Piping, piping components, and piping elements exposed to Soil	Loss of material due to selective leaching	Chapter XI.M33, "Selective Leaching"	No	Not Applicable. There are no gray cast iron piping, piping components, and piping elements exposed to soil in the Steam and Power Conversion System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-33	Gray cast iron, Copper alloy (>15% Zn or >8% Al) Piping, piping components, and piping elements exposed to Treated water, Raw water, Closed-cycle cooling water	Loss of material due to selective leaching	Chapter XI.M33, “Selective Leaching”	No	Consistent with NUREG-1801. The Selective Leaching (B.2.1.21) program will be used to manage loss of material of copper alloy with 15% zinc or more for piping, piping components, and piping elements exposed to closed cycle cooling water in the Sampling System.
3.4.1-34	Steel External surfaces exposed to Air – indoor, uncontrolled (External), Air – outdoor (External), Condensation (External)	Loss of material due to general corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Consistent with NUREG-1801. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program will be used to manage loss of material of steel gearboxes, heat exchanger components, piping, piping components, piping elements, and tanks exposed to air-indoor uncontrolled, air-outdoor, and air with borated water leakage in the Auxiliary Feedwater System, Condensate and Feedwater Auxiliaries System, Main Condensate and Feedwater System, Main Steam System, Main Turbine and Auxiliaries System, and Steam Generators.
3.4.1-35	Aluminum Piping, piping components, and piping elements exposed to Air - outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	Consistent with NUREG-1801. The External Surfaces Monitoring of Mechanical Components (B.2.1.23) program will be used to manage loss of material of aluminum alloy piping, piping components, and piping elements exposed to air - outdoor in the Main Condensate and Feedwater System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-36	Steel Piping, piping components, and piping elements exposed to Air – outdoor (Internal)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Not Applicable. There are no steel piping, piping components, and piping elements exposed to air-outdoor in the Steam and Power Conversion System.
3.4.1-37	Steel Piping, piping components, and piping elements exposed to Condensation (Internal)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage loss of material of steel piping, piping components, and piping elements exposed to condensation in the Auxiliary Feedwater System, Combustible Gas Control System, Fuel Oil System, and Main Steam System.
3.4.1-38	Steel Piping, piping components, and piping elements exposed to Raw water	Loss of material due to general, pitting, crevice, galvanic, and microbiologically-influenced corrosion; fouling that leads to corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage loss of material of steel piping, piping components, and piping elements exposed to raw water in the Auxiliary Feedwater System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.4.1-39	Stainless steel Piping, piping components, and piping elements exposed to Condensation (Internal)	Loss of material due to pitting and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program will be used to manage loss of material of stainless steel heat exchanger components exposed to condensation in the Auxiliary Feedwater System.
3.4.1-40	Steel Piping, piping components, and piping elements exposed to Lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No	Consistent with NUREG-1801. The Lubricating Oil Analysis (B.2.1.26) program and One-Time Inspection (B.2.1.20) program will be used to manage loss of material of steel gearboxes, heat exchanger components, piping, piping components, piping elements, and tanks exposed to lubricating oil in the Auxiliary Feedwater System.
3.4.1-41	Steel Heat exchanger components exposed to Lubricating oil	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, “One-Time Inspection”	No	Consistent with NUREG-1801. The Lubricating Oil Analysis (B.2.1.26) program and One-Time Inspection (B.2.1.20) program will be used to manage loss of material of steel heat exchanger components exposed to lubricating oil in the Auxiliary Feedwater System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-42	Aluminum Piping, piping components, and piping elements exposed to Lubricating oil	Loss of material due to pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The Lubricating Oil Analysis (B.2.1.26) program and One-Time Inspection (B.2.1.20) program will be used to manage loss of material of aluminum alloy piping, piping components, and piping elements exposed to lubricating oil in the Auxiliary Feedwater System and Main Turbine and Auxiliaries System. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program has been substituted and will be used to manage loss of material of aluminum alloy heater wells exposed to lubricating oil.
3.4.1-43	Copper alloy Piping, piping components, and piping elements exposed to Lubricating oil	Loss of material due to pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The Lubricating Oil Analysis (B.2.1.26) program and One-Time Inspection (B.2.1.20) program will be used to manage loss of material of copper heat exchanger components exposed to lubricating oil in the Auxiliary Feedwater System.
3.4.1-44	Stainless steel Piping, piping components, and piping elements, Heat exchanger components exposed to Lubricating oil	Loss of material due to pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The Lubricating Oil Analysis (B.2.1.26) program and One-Time Inspection (B.2.1.20) program will be used to manage loss of material of stainless steel heat exchanger components, piping, piping components, and piping elements exposed to lubricating oil in the Auxiliary Feedwater System and Main Turbine and Auxiliaries System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-45	Aluminum Heat exchanger components and tubes exposed to Lubricating oil	Reduction of heat transfer due to fouling	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, "One-Time Inspection"	No	Not Applicable. There are no aluminum heat exchanger components and tubes exposed to lubricating oil in the Steam and Power Conversion System.
3.4.1-46	Stainless steel, Steel, Copper alloy Heat exchanger tubes exposed to Lubricating oil	Reduction of heat transfer due to fouling	Chapter XI.M39, "Lubricating Oil Analysis," and Chapter XI.M32, "One-Time Inspection"	No	Consistent with NUREG-1801. The Lubricating Oil Analysis (B.2.1.26) program and One-Time Inspection (B.2.1.20) program will be used to manage reduction of heat transfer of copper alloy and stainless steel heat exchanger plates and tubes exposed to lubricating oil in the Auxiliary Feedwater System, Emergency Diesel Generator & Auxiliaries System, and Service Water System.
3.4.1-47	Steel (with coating or wrapping) Piping, piping components, and piping elements; tanks exposed to Soil or Concrete	Loss of material due to general, pitting, crevice, and microbiologically-influenced corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Consistent with NUREG-1801 with exceptions. The Buried and Underground Piping (B.2.1.28) program will be used to manage loss of material of steel piping, piping components, and piping elements exposed to concrete or soil in the Main Condensate and Feedwater System and Service Water System. Exceptions apply to the NUREG-1801 recommendations for the Buried and Underground Piping (B.2.1.28) program implementation.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-48	Stainless Steel Bolting exposed to Soil	Loss of material due to pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Consistent with NUREG-1801 with exceptions. The Buried and Underground Piping (B.2.1.28) program will be used to manage loss of material of stainless steel bolting exposed to soil in the Main Condensate and Feedwater System. Exceptions apply to the NUREG-1801 recommendations for the Buried and Underground Piping (B.2.1.28) program implementation.
3.4.1-49	Stainless steel Piping, piping components, and piping elements exposed to Soil or Concrete	Loss of material due to pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Consistent with NUREG-1801 with exceptions. The Buried and Underground Piping (B.2.1.28) program will be used to manage loss of material of the stainless steel piping, piping components, and piping elements exposed to soil in the Main Condensate and Feedwater System. Exceptions apply to the NUREG-1801 recommendations for the Buried and Underground Piping (B.2.1.28) program implementation.
3.4.1-50	Steel Bolting exposed to Soil	Loss of material due to general, pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Not Applicable. There is no steel bolting exposed to soil in the Steam and Power Conversion System.
3.4.1-50x	Underground Stainless Steel and Steel Piping, piping components, and piping elements	Loss of material due to general (steel only), pitting and crevice corrosion	Chapter XI.M41, "Buried and Underground Piping and Tanks"	No	Not Applicable. There are no steel or stainless steel piping, piping components, and piping elements exposed to an underground environment in the Steam and Power Conversion System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.4.1-51	Steel Piping, piping components, and piping elements exposed to Concrete	None	None, provided 1) attributes of the concrete are consistent with ACI 318 or ACI 349 (low water-to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG-1557, and 2) plant OE indicates no degradation of the concrete	No, if conditions are met.	Not Applicable. There is no steel piping, piping components, and piping elements exposed to concrete in the Steam and Power Conversion System.
3.4.1-52	Aluminum Piping, piping components, and piping elements exposed to Gas, Air – indoor, uncontrolled (Internal/External)	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.
3.4.1-53	Copper alloy (≤15% Zn and ≤8% Al) Piping, piping components, and piping elements exposed to Air with borated water leakage	None	None	NA - No AEM or AMP	Not Applicable. There are no copper alloy piping, piping components, and piping elements exposed to air with borated water leakage in the Steam and Power Conversion System.
3.4.1-54	Copper alloy Piping, piping components, and piping elements exposed to Gas, Air – indoor, uncontrolled (External)	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-55	Glass Piping elements exposed to Lubricating oil, Air – outdoor, Condensation (Internal/External), Raw water, Treated water, Air with borated water leakage, Gas, Closed-cycle cooling water, Air – indoor, uncontrolled (External)	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.
3.4.1-56	Nickel alloy Piping, piping components, and piping elements exposed to Air – indoor, uncontrolled (External)	None	None	NA - No AEM or AMP	Not Applicable. There are no nickel alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled in the Steam and Power Conversion System.
3.4.1-57	Nickel alloy, PVC Piping, piping components, and piping elements exposed to Air with borated water leakage, Air – indoor, uncontrolled, Condensation (Internal)	None	None	NA - No AEM or AMP	Not Applicable. There are no nickel alloy or PVC piping, piping components, and piping elements exposed to air with borated water leakage, air – indoor uncontrolled, or condensation in the Steam and Power Conversion System.

Table 3.4.1 Summary of Aging Management Evaluations for the Steam and Power Conversion System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.4.1-58	Stainless steel Piping, piping components, and piping elements exposed to Air – indoor, uncontrolled (External), Concrete, Gas, Air – indoor, uncontrolled (Internal)	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.
3.4.1-59	Steel Piping, piping components, and piping elements exposed to Air – indoor controlled (External), Gas	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.

Table 3.4.2-1
Auxiliary Feedwater System
Summary of Aging Management Evaluation

Table 3.4.2-1 Auxiliary Feedwater System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Accumulator	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.A-26	3.3.1-55	D
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Outdoor (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VIII.H.SP-82	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VIII.H.SP-151	3.4.1-10	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-40	3.4.1-4	A
					Bolting Integrity (B.2.1.9)	VIII.H.SP-84	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VIII.H.SP-83	3.4.1-10	A
Electric Heaters	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.H2.AP-202	3.3.1-45	A
Filter Housing	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Filter Housing	Pressure Boundary	Carbon Steel	Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VIII.G.SP-60	3.4.1-37	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-91	3.4.1-40	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-91	3.4.1-40	A
		Ductile Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-91	3.4.1-40	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-91	3.4.1-40	A
Gearbox (Speed Increaser)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-91	3.4.1-40	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-91	3.4.1-40	A
Heat Exchanger - (AFW Cubicle Coolers) Tube Sheet	Pressure Boundary	Carbon Steel	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-146	3.4.1-19	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (AFW Cubicle Coolers) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-146	3.4.1-19	A
Heat Exchanger - (AFW Cubicle Coolers) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-56	3.4.1-22	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-31	3.4.1-20	C
Heat Exchanger - (AFW Diesel Engine Lube Oil Coolers) Nozzles	Pressure Boundary	Gray Cast Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
					Selective Leaching (B.2.1.21)	VII.C2.A-50	3.3.1-72	C
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-76	3.4.1-41	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-76	3.4.1-41	A
Heat Exchanger - (AFW Diesel Engine Lube Oil Coolers) Plates	Heat Transfer	Stainless Steel	Closed Cycle Cooling Water (Internal)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VIII.G.SP-41	3.4.1-28	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (AFW Diesel Engine Lube Oil Coolers) Plates	Heat Transfer	Stainless Steel	Lubricating Oil (Internal)	Reduction of Heat Transfer	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-102	3.4.1-46	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-102	3.4.1-46	A
	Pressure Boundary	Stainless Steel	Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VIII.G.S-25	3.4.1-26	A
			Condensation (External)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VIII.B1.SP-110	3.4.1-39	C, 1
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-79	3.4.1-44	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-79	3.4.1-44	A
Heat Exchanger - (AFW Diesel Engine Lube Oil Coolers) Tie Bars	Mechanical Closure	Carbon Steel	Condensation (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VII.D.AP-121	3.3.1-12	C
				Loss of Preload	Bolting Integrity (B.2.1.9)	VII.I.AP-124	3.3.1-15	C
Heat Exchanger - (AFW Diesel-Driven Pump Lube Oil Cooler) Shell Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VIII.I.SP-12	3.4.1-58	C
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-79	3.4.1-44	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-79	3.4.1-44	A
Heat Exchanger - (AFW Diesel-Driven Pump Lube Oil Cooler) Tube Sheet	Pressure Boundary	Stainless Steel	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-79	3.4.1-44	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (AFW Diesel-Driven Pump Lube Oil Cooler) Tube Sheet	Pressure Boundary	Stainless Steel	Lubricating Oil (External)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-79	3.4.1-44	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.F.SP-117	3.4.1-21	A
Heat Exchanger - (AFW Diesel-Driven Pump Lube Oil Cooler) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VIII.I.SP-12	3.4.1-58	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.F.SP-117	3.4.1-21	A
Heat Exchanger - (AFW Diesel-Driven Pump Lube Oil Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Reduction of Heat Transfer	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-99	3.4.1-46	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-99	3.4.1-46	A
			Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-56	3.4.1-22	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-92	3.4.1-43	C
					One-Time Inspection (B.2.1.20)	VIII.G.SP-92	3.4.1-43	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-31	3.4.1-20	C
Heat Exchanger - (AFW Gearbox / Speed Increaser Lube Oil Cooler) Shell Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VIII.I.SP-12	3.4.1-58	C

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (AFW Gearbox / Speed Increaser Lube Oil Cooler) Shell Side Components	Pressure Boundary	Stainless Steel	Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-79	3.4.1-44	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-79	3.4.1-44	A
Heat Exchanger - (AFW Gearbox / Speed Increaser Lube Oil Cooler) Tube Sheet	Pressure Boundary	Stainless Steel	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-79	3.4.1-44	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-79	3.4.1-44	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.F.SP-117	3.4.1-21	A
Heat Exchanger - (AFW Gearbox / Speed Increaser Lube Oil Cooler) Tube Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VIII.I.SP-12	3.4.1-58	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.F.SP-117	3.4.1-21	A
Heat Exchanger - (AFW Gearbox / Speed Increaser Lube Oil Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Reduction of Heat Transfer	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-99	3.4.1-46	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-99	3.4.1-46	A
			Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-56	3.4.1-22	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (AFW Gearbox / Speed Increaser Lube Oil Cooler) Tubes	Pressure Boundary	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-92	3.4.1-43	C
					One-Time Inspection (B.2.1.20)	VIII.G.SP-92	3.4.1-43	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-31	3.4.1-20	C
Heat Exchanger - (AFW Jacket Water Cooler) Shell Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VIII.I.SP-12	3.4.1-58	C
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VIII.G.S-25	3.4.1-26	A
Heat Exchanger - (AFW Jacket Water Cooler) Tube Sheet	Pressure Boundary	Carbon Steel	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-189	3.3.1-46	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-146	3.4.1-19	A
Heat Exchanger - (AFW Jacket Water Cooler) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-146	3.4.1-19	A
Heat Exchanger - (AFW Jacket Water Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (External)	Reduction of Heat Transfer	Closed Treated Water Systems (B.2.1.12)	VIII.E.SP-57	3.4.1-28	A
			Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-56	3.4.1-22	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Closed Cycle Cooling Water (External)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VIII.G.SP-8	3.4.1-27	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (AFW Jacket Water Cooler) Tubes	Pressure Boundary	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-31	3.4.1-20	C
Heat Exchanger - (AFW Motor-Driven Pump Lube Oil Cooler) Shell Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VIII.I.SP-12	3.4.1-58	C
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-79	3.4.1-44	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-79	3.4.1-44	A
Heat Exchanger - (AFW Motor-Driven Pump Lube Oil Cooler) Tube Sheet	Pressure Boundary	Stainless Steel	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-79	3.4.1-44	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-79	3.4.1-44	A
Heat Exchanger - (AFW Motor-Driven Pump Lube Oil Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Reduction of Heat Transfer	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-99	3.4.1-46	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-99	3.4.1-46	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-92	3.4.1-43	C
					One-Time Inspection (B.2.1.20)	VIII.G.SP-92	3.4.1-43	C
Heat Exchanger - (AFW Right Angle Gear Oil Cooler) Shell Side Components	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VIII.I.SP-12	3.4.1-58	C

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (AFW Right Angle Gear Oil Cooler) Shell Side Components	Pressure Boundary	Stainless Steel	Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-79	3.4.1-44	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-79	3.4.1-44	A
Heat Exchanger - (AFW Right Angle Gear Oil Cooler) Tube Sheet	Pressure Boundary	Carbon Steel	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-91	3.4.1-40	C
					One-Time Inspection (B.2.1.20)	VIII.G.SP-91	3.4.1-40	C
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-146	3.4.1-19	A
Heat Exchanger - (AFW Right Angle Gear Oil Cooler) Tube Side Components	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-146	3.4.1-19	A
Heat Exchanger - (AFW Right Angle Gear Oil Cooler) Tubes	Heat Transfer	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Reduction of Heat Transfer	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-99	3.4.1-46	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-99	3.4.1-46	A
			Raw Water (Internal)	Reduction of Heat Transfer	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-56	3.4.1-22	A
	Pressure Boundary	Copper Alloy with less than 15% Zinc	Lubricating Oil (External)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-92	3.4.1-43	C
					One-Time Inspection (B.2.1.20)	VIII.G.SP-92	3.4.1-43	C

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (AFW Right Angle Gear Oil Cooler) Tubes	Pressure Boundary	Copper Alloy with less than 15% Zinc	Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VIII.G.SP-31	3.4.1-20	C
Piping Element	Leakage Boundary	Glass	Air with Borated Water Leakage (External)	None	None	VIII.I.SP-67	3.4.1-55	A
			Waste Water (Internal)	None	None	VII.J.AP-277	3.3.1-119	A
	Pressure Boundary	Glass	Air with Borated Water Leakage (External)	None	None	VIII.I.SP-67	3.4.1-55	A
			Closed Cycle Cooling Water (Internal)	None	None	VIII.I.SP-70	3.4.1-55	A
			Lubricating Oil (Internal)	None	None	VIII.I.SP-10	3.4.1-55	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Air - Indoor Uncontrolled (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.E-29	3.2.1-44	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-41	3.4.1-34	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.H2.AP-202	3.3.1-45	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.A-26	3.3.1-55	B
			Diesel Exhaust (Internal)	Cumulative Fatigue Damage	TLAA			H, 2
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.H2.AP-104	3.3.1-88	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-91	3.4.1-40	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-91	3.4.1-40	A
			Raw Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VIII.G.SP-136	3.4.1-38	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-74	3.4.1-13	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.AP-81	3.3.1-56	B

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Stainless Steel	Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-95	3.4.1-44	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-95	3.4.1-44	A
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-87	3.4.1-16	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.A-26	3.3.1-55	B
Pump Casing (AFW Diesel Engine Gearbox / Speed Increaser Auxiliary Lube Oil Pump)	Pressure Boundary	Aluminum Alloy	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.AP-1	3.3.1-9	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-114	3.4.1-42	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-114	3.4.1-42	A
Pump Casing (AFW Diesel Engine Gearbox / Speed Increaser Shaft-Driven Lube Oil Pump)	Pressure Boundary	Aluminum Alloy	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VII.E1.AP-1	3.3.1-9	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (AFW Diesel Engine Gearbox / Speed Increaser Shaft-Driven Lube Oil Pump)	Pressure Boundary	Aluminum Alloy	Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-114	3.4.1-42	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-114	3.4.1-42	A
Pump Casing (AFW Diesel Engine Shaft-Driven Essential Service Water Booster Pump)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Raw Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VIII.G.SP-146	3.4.1-19	C
Pump Casing (AFW Diesel Engine Shaft-Driven Fuel Oil Pump)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A
					One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (AFW Diesel Engine Shaft-Driven Jacket Water Pump)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.C2.AP-202	3.3.1-45	A
Pump Casing (AFW Diesel Engine Shaft-Driven Lube Oil Pump)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-91	3.4.1-40	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-91	3.4.1-40	A
Pump Casing (AFW Diesel-Driven Pump Auxiliary Lube Oil Pump)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-91	3.4.1-40	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-91	3.4.1-40	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (AFW Diesel-Driven Pump Shaft-Driven Lube Oil Pump)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-91	3.4.1-40	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-91	3.4.1-40	A
Pump Casing (AFW Diesel-Driven Pump)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-74	3.4.1-13	A
Pump Casing (AFW Motor-Driven Pump Auxiliary Lube Oil Pump)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-91	3.4.1-40	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-91	3.4.1-40	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Pump Casing (AFW Motor-Driven Pump Shaft-Driven Lube Oil Pump)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-91	3.4.1-40	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-91	3.4.1-40	A
Pump Casing (AFW Motor-Driven Pump)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-74	3.4.1-13	A
Restricting Orifice	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-87	3.4.1-16	A
	Throttle	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-87	3.4.1-16	A
Tanks (AFW Diesel Engine Jacket Water Head Tank)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (AFW Diesel Engine Jacket Water Head Tank)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.H2.AP-202	3.3.1-45	A
Tanks (Lube Oil Reservoirs)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-91	3.4.1-40	C
					One-Time Inspection (B.2.1.20)	VIII.G.SP-91	3.4.1-40	C
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water Systems (B.2.1.12)	VII.H2.AP-202	3.3.1-45	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.A-26	3.3.1-55	B
			Fuel Oil (Internal)	Loss of Material	Fuel Oil Chemistry (B.2.1.18)	VII.H1.AP-105	3.3.1-70	A

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Carbon Steel	Fuel Oil (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VII.H1.AP-105	3.3.1-70	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-91	3.4.1-40	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-91	3.4.1-40	A
			Raw Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VIII.G.SP-136	3.4.1-38	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.G.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.G.SP-74	3.4.1-13	A
		Stainless Steel	Air with Borated Water Leakage (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.AP-81	3.3.1-56	B
			Raw Water (Internal)	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C1.A-54	3.3.1-40	A
	Structural Support - (Braidwood Unit 2 only)	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Condensation (Internal)	Loss of Material	Compressed Air Monitoring (B.2.1.14)	VII.D.A-26	3.3.1-55	B

Table 3.4.2-1 Auxiliary Feedwater System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the aging effects applicable to this component, material, and environment combination. The heat exchanger plates are within an enclosed housing, and the external surface of the plates is subject to condensation during normal operation.

2. The TLAA designation in the Aging Management Programs column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3.

Table 3.4.2-2
Condensate and Feedwater Auxiliaries System
Summary of Aging Management Evaluation

Table 3.4.2-2 **Condensate and Feedwater Auxiliaries System**

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VIII.H.SP-84	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VIII.H.SP-83	3.4.1-10	A
		Stainless Steel Bolting - (Byron only)	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VIII.H.SP-84	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VIII.H.SP-83	3.4.1-10	A
Flow Device - (Byron only)	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-73	3.4.1-14	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
Piping Element	Leakage Boundary	Glass	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-9	3.4.1-55	A
			Treated Water (Internal)	None	None	VIII.I.SP-35	3.4.1-55	A
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-73	3.4.1-14	A

Table 3.4.2-2 Condensate and Feedwater Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VIII.E.SP-73	3.4.1-14	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.E.S-16	3.4.1-5	A
		Copper Alloy with less than 15% Zinc - (Byron only)	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-6	3.4.1-54	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.A.SP-101	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.A.SP-101	3.4.1-16	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
Restricting Orifice - (Byron only)	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-73	3.4.1-14	A
Strainer Body - (Byron only)	Leakage Boundary	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A
Tanks (Hydrazine and ETA Day Tanks - Byron only)	Leakage Boundary	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	C
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-75	3.4.1-12	A

Table 3.4.2-2 Condensate and Feedwater Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tanks (Hydrazine and ETA Day Tanks - Byron only)	Leakage Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VIII.E.SP-75	3.4.1-12	A
Tanks (MSR Shell and Reheater Drain Tanks)	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-75	3.4.1-12	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-75	3.4.1-12	A
Valve Body	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-73	3.4.1-14	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-87	3.4.1-16	A

Table 3.4.2-2 Condensate and Feedwater Auxiliaries System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

None.

Table 3.4.2-3
Main Condensate and Feedwater System
Summary of Aging Management Evaluation

Table 3.4.2-3 **Main Condensate and Feedwater System**

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VIII.H.SP-84	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VIII.H.SP-83	3.4.1-10	A
			Air - Outdoor (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VIII.H.SP-82	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VIII.H.SP-151	3.4.1-10	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-40	3.4.1-4	A
					Bolting Integrity (B.2.1.9)	VIII.H.SP-84	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VIII.H.SP-83	3.4.1-10	A
		Stainless Steel Bolting	Air - Outdoor (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VIII.H.SP-82	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VIII.H.SP-151	3.4.1-10	A
				None	None	VIII.D1.SP-118	3.4.1-2	I, 1
			Soil (External) - (Braidwood Unit 2 only)	Cracking	Buried and Underground Piping (B.2.1.28)			H, 2
				Loss of Material	Buried and Underground Piping (B.2.1.28)	VIII.H.SP-143	3.4.1-48	B
				Loss of Preload	Bolting Integrity (B.2.1.9)	VIII.H.SP-144	3.4.1-6	A
Heat Exchanger - (Gland Steam Condenser) Tube Side Components	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-77	3.4.1-15	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-77	3.4.1-15	A

Table 3.4.2-3 Main Condensate and Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Main Steam Sample Cooler - Byron only) Shell Side Components	Leakage Boundary	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	C
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-80	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-80	3.4.1-16	A
Heater Well	Pressure Boundary	Aluminum Alloy	Lubricating Oil (Internal) - (Braidwood only)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VIII.G.SP-114	3.4.1-42	E, 7
			Treated Water (External)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-90	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-90	3.4.1-16	A
			Waste Water (Internal) - (Byron only)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			G, 6
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Cumulative Fatigue Damage	TLAA	VIII.D1.S-11	3.4.1-1	A, 4
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-74	3.4.1-13	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.D1.S-16	3.4.1-5	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-87	3.4.1-16	A

Table 3.4.2-3 Main Condensate and Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Stainless Steel	Treated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VIII.D1.SP-87	3.4.1-16	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.D1.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-88	3.4.1-11	A
				Cumulative Fatigue Damage	TLAA	VII.E3.A-62	3.3.1-2	A, 4
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-87	3.4.1-16	A
	Pressure Boundary	Aluminum Alloy	Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.SP-147	3.4.1-35	A
			Treated Water (External)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-90	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-90	3.4.1-16	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-90	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-90	3.4.1-16	A
		Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-41	3.4.1-34	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Soil (External)	Loss of Material	Buried and Underground Piping (B.2.1.28)	VIII.E.SP-145	3.4.1-47	B

Table 3.4.2-3 Main Condensate and Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Carbon Steel	Treated Water (Internal)	Cumulative Fatigue Damage	TLAA	VIII.D1.S-11	3.4.1-1	A, 4
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-74	3.4.1-13	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.D1.S-16	3.4.1-5	A
		Polymers - (Braidwood Unit 2 only)	Soil (External)	Cracking, Blistering, Change in Color	Buried and Underground Piping (B.2.1.28)	VII.C1.AP-175	3.3.1-104	B
			Treated Water (Internal)	None	None			G, 5
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.D1.SP-127	3.4.1-3	A
				None	None	VIII.D1.SP-118	3.4.1-2	I, 1
			Soil (External) - (Braidwood Unit 2 only)	Cracking	Buried and Underground Piping (B.2.1.28)			H, 2
				Loss of Material	Buried and Underground Piping (B.2.1.28)	VIII.E.SP-94	3.4.1-49	B
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-87	3.4.1-16	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.D1.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-88	3.4.1-11	A
				Cumulative Fatigue Damage	TLAA	VII.E3.A-62	3.3.1-2	A, 4
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-87	3.4.1-16	A

Table 3.4.2-3 Main Condensate and Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Stainless Steel	Treated Water > 140 F (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VIII.D1.SP-87	3.4.1-16	A
Tanks (Condensate Storage Tanks)	Pressure Boundary	Aluminum Alloy	Air - Outdoor (External)	Loss of Material	Aboveground Metallic Tanks (B.2.1.17)	VIII.E.SP-140	3.4.1-30	B
			Soil (External)	Loss of Material	Aboveground Metallic Tanks (B.2.1.17)	VIII.E.SP-139	3.4.1-31	B
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-90	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.D1.SP-90	3.4.1-16	C
Valve Body	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-74	3.4.1-13	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.D1.S-16	3.4.1-5	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-87	3.4.1-16	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.D1.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-88	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-87	3.4.1-16	A

Table 3.4.2-3 Main Condensate and Feedwater System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-41	3.4.1-34	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-74	3.4.1-13	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.D1.S-16	3.4.1-5	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.D1.SP-127	3.4.1-3	A
				None	None	VIII.D1.SP-118	3.4.1-2	I, 1
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-87	3.4.1-16	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.D1.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-88	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.D1.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.D1.SP-87	3.4.1-16	A

Table 3.4.2-3 Main Condensate and Feedwater System (Continued)

Notes	**Definition of Note**
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on an evaluation of the environmental conditions at BBS and a review of operating experience, cracking due to stress corrosion cracking is not an applicable aging effect for stainless steel in an Air–Outdoor environment. For more information see LRA Section 3.4.2.2.2.

2. The aging effects for stainless steel components in a soil (external) environment includes cracking. The Buried and Underground Piping (B.2.1.28) program will be used to manage the applicable aging effects for this component, material, and environment combination.

3. The Water Chemistry (B.2.1.2) program and One-Time Inspection (B.2.1.22) program are used to manage the aging effect(s) applicable to this component type, material, and environment combination.

4. The TLAA designation in the Aging Management Programs column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3 and Section 4.7.

5. Component material is HDPE (High Density Polyethylene) which corresponds to the NUREG-1801 material of Polymers. High Density Polyethylene has no aging effects in the Treated Water environment.

Table 3.4.2-3 Main Condensate and Feedwater System (Continued)

Plant Specific Notes: (continued)

6. Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is substituted to manage the aging effect(s) applicable to this component type, material, and environment combination. The preventive measures and sampling activities provided for by the Lubricating Oil Analysis (B.2.1.26) program are not applicable for the components exposed to the heat conduction oil found in the condensate storage tank heater assemblies at Braidwood.

7. The Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program includes performance of appropriate aging detection activities for the component, material, and environment combination found in the heater well.

Table 3.4.2-4
Main Steam System
Summary of Aging Management Evaluation

Table 3.4.2-4 Main Steam System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VIII.H.SP-84	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VIII.H.SP-83	3.4.1-10	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-40	3.4.1-4	A
					Bolting Integrity (B.2.1.9)	VIII.H.SP-84	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VIII.H.SP-83	3.4.1-10	A
Condensing Chamber	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-74	3.4.1-13	A
Flow Device	Throttle	Nickel Alloy - (Byron Unit 2 and Braidwood Unit 2 only)	Steam (External)	Cracking	One-Time Inspection (B.2.1.20)	IV.D2.R-36	3.1.1-78	C
					Water Chemistry (B.2.1.2)	IV.D2.R-36	3.1.1-78	C
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-157	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-157	3.4.1-16	C
			Steam (Internal)	Cracking	One-Time Inspection (B.2.1.20)	IV.D2.R-36	3.1.1-78	C

Table 3.4.2-4 Main Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Flow Device	Throttle	Nickel Alloy - (Byron Unit 2 and Braidwood Unit 2 only)	Steam (Internal)	Cracking	Water Chemistry (B.2.1.2)	IV.D2.R-36	3.1.1-78	C
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-157	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-157	3.4.1-16	C
		Stainless Steel - (Byron Unit 1 and Braidwood Unit 1 only)	Steam (External)	Cracking	One-Time Inspection (B.2.1.20)	VIII.B1.SP-98	3.4.1-11	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-98	3.4.1-11	C
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-155	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-155	3.4.1-16	C
			Steam (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.B1.SP-98	3.4.1-11	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-98	3.4.1-11	C
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-155	3.4.1-16	C
					Water Chemistry (B.2.1.2)	VIII.B1.SP-155	3.4.1-16	C
Heat Exchanger - (Main Steam Sample Cooler - Byron only) Tube Side Components	Leakage Boundary	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	C
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.F.SP-85	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.F.SP-85	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-80	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-80	3.4.1-16	A

Table 3.4.2-4 Main Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Direct Flow	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-41	3.4.1-34	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VIII.B1.SP-60	3.4.1-37	A
	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Steam (Internal)	Cumulative Fatigue Damage	TLAA	VIII.B1.S-08	3.4.1-1	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-71	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-71	3.4.1-14	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.B1.S-15	3.4.1-5	A
			Treated Water (Internal)	Cumulative Fatigue Damage	TLAA	VIII.B1.S-08	3.4.1-1	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-74	3.4.1-13	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A

Table 3.4.2-4 Main Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Stainless Steel	Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Steam (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.B1.SP-98	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-98	3.4.1-11	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-155	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-155	3.4.1-16	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.B1.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-88	3.4.1-11	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-87	3.4.1-16	A
	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Steam (Internal)	Cumulative Fatigue Damage	TLAA	VIII.B1.S-08	3.4.1-1	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-71	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-71	3.4.1-14	A

Table 3.4.2-4 Main Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Pressure Boundary	Carbon Steel	Steam (Internal)	Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.B1.S-15	3.4.1-5	A
			Treated Water (Internal)	Cumulative Fatigue Damage	TLAA	VIII.B1.S-08	3.4.1-1	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-74	3.4.1-13	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Steam (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.B1.SP-98	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-98	3.4.1-11	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-155	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-155	3.4.1-16	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.B1.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-88	3.4.1-11	A
				Cumulative Fatigue Damage	TLAA	IV.C2.R-18	3.1.1-5	A, 1
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-87	3.4.1-16	A
Valve Body	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A

Table 3.4.2-4 Main Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Steam (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-71	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-71	3.4.1-14	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.B1.S-15	3.4.1-5	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-74	3.4.1-13	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Steam (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.B1.SP-98	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-98	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-155	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-155	3.4.1-16	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.B1.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-88	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-87	3.4.1-16	A
	Pressure Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A

Table 3.4.2-4 Main Steam System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B.2.1.4)	VIII.H.S-30	3.4.1-4	A
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Steam (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-71	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-71	3.4.1-14	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.B1.S-15	3.4.1-5	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-74	3.4.1-13	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-74	3.4.1-13	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Air with Borated Water Leakage (External)	None	None	VII.J.AP-18	3.3.1-120	A
			Steam (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.B1.SP-98	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-98	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-155	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-155	3.4.1-16	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.B1.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-88	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.B1.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.B1.SP-87	3.4.1-16	A

Table 3.4.2-4 Main Steam System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The TLAA designation in the Aging Management Programs column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3.

Table 3.4.2-5
Main Turbine and Auxiliaries System
Summary of Aging Management Evaluation

Table 3.4.2-5 **Main Turbine and Auxiliaries System**

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting	Mechanical Closure	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled (External)	Loss of Material	Bolting Integrity (B.2.1.9)	VIII.H.SP-84	3.4.1-8	A
				Loss of Preload	Bolting Integrity (B.2.1.9)	VIII.H.SP-83	3.4.1-10	A
Flow Device	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)			H, 1
					One-Time Inspection (B.2.1.20)	VIII.C.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.C.SP-73	3.4.1-14	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.C.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.C.SP-88	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.C.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.C.SP-87	3.4.1-16	A
Heat Exchanger - (Gland Steam Condenser) Shell Side Components	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A

Table 3.4.2-5 Main Turbine and Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger - (Gland Steam Condenser) Shell Side Components	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-77	3.4.1-15	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-77	3.4.1-15	A
Heat Exchanger - (Moisture Separator Reheater) Shell Side Components	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-77	3.4.1-15	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-77	3.4.1-15	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.E.S-16	3.4.1-5	C
Heat Exchanger - (Moisture Separator Reheater) Tube Side Components	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Steam (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.C.SP-71	3.4.1-14	C
					Water Chemistry (B.2.1.2)	VIII.C.SP-71	3.4.1-14	C
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.E.SP-77	3.4.1-15	A
					Water Chemistry (B.2.1.2)	VIII.E.SP-77	3.4.1-15	A
Piping, piping components, and piping elements	Leakage Boundary	Aluminum Alloy	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-93	3.4.1-52	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-114	3.4.1-42	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-114	3.4.1-42	A

Table 3.4.2-5 Main Turbine and Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Steam (Internal)	Cumulative Fatigue Damage	TLAA	VIII.B1.S-08	3.4.1-1	A, 2
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.C.SP-71	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.C.SP-71	3.4.1-14	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.A.S-15	3.4.1-5	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.C.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.C.SP-73	3.4.1-14	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.E.S-16	3.4.1-5	A
			Waste Water (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	VII.E5.AP-281	3.3.1-91	A
		Carbon or Low Alloy Steel with Stainless Steel Cladding	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Steam (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.C.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.C.SP-88	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.C.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.C.SP-87	3.4.1-16	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.C.SP-88	3.4.1-11	A

Table 3.4.2-5 Main Turbine and Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Piping, piping components, and piping elements	Leakage Boundary	Stainless Steel	Treated Water > 140 F (Internal)	Cracking	Water Chemistry (B.2.1.2)	VIII.C.SP-88	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.C.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.C.SP-87	3.4.1-16	A
	Pressure Relief	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.A.SP-95	3.4.1-44	A
					One-Time Inspection (B.2.1.20)	VIII.A.SP-95	3.4.1-44	A
Restricting Orifice	Leakage Boundary	Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.C.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.C.SP-87	3.4.1-16	A
	Pressure Boundary	Aluminum Alloy	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-93	3.4.1-52	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-114	3.4.1-42	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-114	3.4.1-42	A
		Stainless Steel - (Braidwood only)	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.A.SP-95	3.4.1-44	A
					One-Time Inspection (B.2.1.20)	VIII.A.SP-95	3.4.1-44	A
	Throttle	Aluminum Alloy	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-93	3.4.1-52	A

Table 3.4.2-5 Main Turbine and Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Restricting Orifice	Throttle	Aluminum Alloy	Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.G.SP-114	3.4.1-42	A
					One-Time Inspection (B.2.1.20)	VIII.G.SP-114	3.4.1-42	A
		Stainless Steel - (Braidwood only)	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.A.SP-95	3.4.1-44	A
					One-Time Inspection (B.2.1.20)	VIII.A.SP-95	3.4.1-44	A
Rupture Disks	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.C.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.C.SP-73	3.4.1-14	A
Strainer Body	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.C.SP-73	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.C.SP-73	3.4.1-14	A
Valve Body	Leakage Boundary	Carbon Steel	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	VIII.H.S-29	3.4.1-34	A
			Steam (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.C.SP-71	3.4.1-14	A
					Water Chemistry (B.2.1.2)	VIII.C.SP-71	3.4.1-14	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.A.S-15	3.4.1-5	A
			Treated Water (Internal)	Loss of Material	One-Time Inspection (B.2.1.20)	VIII.C.SP-73	3.4.1-14	A

Table 3.4.2-5 Main Turbine and Auxiliaries System (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Valve Body	Leakage Boundary	Carbon Steel	Treated Water (Internal)	Loss of Material	Water Chemistry (B.2.1.2)	VIII.C.SP-73	3.4.1-14	A
				Wall Thinning	Flow-Accelerated Corrosion (B.2.1.8)	VIII.E.S-16	3.4.1-5	A
		Stainless Steel	Air - Indoor Uncontrolled (External)	None	None	VIII.I.SP-12	3.4.1-58	A
			Lubricating Oil (Internal)	Loss of Material	Lubricating Oil Analysis (B.2.1.26)	VIII.A.SP-95	3.4.1-44	A
					One-Time Inspection (B.2.1.20)	VIII.A.SP-95	3.4.1-44	A
			Treated Water > 140 F (Internal)	Cracking	One-Time Inspection (B.2.1.20)	VIII.C.SP-88	3.4.1-11	A
					Water Chemistry (B.2.1.2)	VIII.C.SP-88	3.4.1-11	A
				Loss of Material	One-Time Inspection (B.2.1.20)	VIII.C.SP-87	3.4.1-16	A
					Water Chemistry (B.2.1.2)	VIII.C.SP-87	3.4.1-16	A

Table 3.4.2-5 Main Turbine and Auxiliaries System (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The aging effects for carbon steel in a treated water environment include loss of material due to erosion. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program is used to manage the identified aging effect applicable to carbon steel components in a treated water environment.

2. The TLAA designation in the Aging Management Programs column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3

3.5 AGING MANAGEMENT OF CONTAINMENTS, STRUCTURES, AND COMPONENT SUPPORTS

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

3.5.1 INTRODUCTION

This section provides the results of the aging management review for those components identified in Section 2.4, Scoping and Screening Results: Structures, as being subject to aging management review. The systems, or portions of systems, which are addressed in this section are described in the indicated sections.

- Auxiliary Building (2.4.1)
- Circulating Water Pump House (Byron) (2.4.2)
- Component Supports Commodity Group (2.4.3)
- Containment Structure (2.4.4)
- Deep Well Enclosures (Byron) (2.4.5)
- Essential Service Cooling Pond (Braidwood) (2.4.6)
- Essential Service Water Cooling Towers (Byron) (2.4.7)
- Fuel Handling Building (2.4.8)
- Lake Screen Structures (Braidwood) (2.4.9)
- Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms (2.4.10)
- Natural Draft Cooling Towers (Byron) (2.4.11)
- RWST Foundation and Tunnel (2.4.12)
- Radwaste and Service Building Complex (2.4.13)
- River Screen House (Byron) (2.4.14)
- Structural Commodity Group (2.4.15)
- Switchyard Structures (2.4.16)
- Turbine Building Complex (2.4.17)
- Yard Structures (2.4.18)

3.5.2 RESULTS

The following tables summarize the results of the aging management review for Structures and Component Supports.

Table 3.5.2-1 Auxiliary Building - Summary of Aging Management Evaluation

Table 3.5.2-2 Circulating Water Pump House (Byron) - Summary of Aging Management Evaluation

Table 3.5.2-3 Component Supports Commodity Group - Summary of Aging Management Evaluation

Table 3.5.2-4 Containment Structure - Summary of Aging Management Evaluation

Table 3.5.2-5 Deep Well Enclosures (Byron) - Summary of Aging Management Evaluation

Table 3.5.2-6 Essential Service Cooling Pond (Braidwood) - Summary of Aging Management Evaluation

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) - Summary of Aging Management Evaluation

Table 3.5.2-8 Fuel Handling Building - Summary of Aging Management Evaluation

Table 3.5.2-9 Lake Screen Structures (Braidwood) - Summary of Aging Management Evaluation

Table 3.5.2-10 Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms - Summary of Aging Management Evaluation

Table 3.5.2-11 Natural Draft Cooling Towers (Byron) - Summary of Aging Management Evaluation

Table 3.5.2-12 RWST Foundation and Tunnel - Summary of Aging Management Evaluation

Table 3.5.2-13 Radwaste and Service Building Complex - Summary of Aging Management Evaluation

Table 3.5.2-14 River Screen House (Byron) - Summary of Aging Management Evaluation

Table 3.5.2-15 Structural Commodity Group - Summary of Aging Management Evaluation

Table 3.5.2-16 Switchyard Structures - Summary of Aging Management Evaluation

Table 3.5.2-17 Turbine Building Complex- Summary of Aging Management Evaluation

Table 3.5.2-18 Yard Structures - Summary of Aging Management Evaluation

3.5.2.1 Materials, Environments, Aging Effects Requiring Management And Aging Management Programs

3.5.2.1.1 Auxiliary Building

Materials

The materials of construction for the Auxiliary Building components are:

- Aluminum
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Concrete Block
- Galvanized Steel
- Galvanized Steel Bolting
- Reinforced concrete
- Stainless Steel
- Stainless Steel Bolting

Environments

The Auxiliary Building components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Air with Borated Water Leakage
- Concrete
- Groundwater/Soil
- Waste Water
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the Auxiliary Building components require management:

- Cracking
- Cracking and Distortion
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Cumulative Fatigue Damage
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength

- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Auxiliary Building components:

- Boric Acid Corrosion (B.2.1.4)
- External Surfaces Monitoring of Mechanical Components (B.2.1.23)
- Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)
- Masonry Walls (B.2.1.33)
- Structures Monitoring (B.2.1.34)
- TLAA

3.5.2.1.2 Circulating Water Pump House (Byron)

Materials

The materials of construction for the Circulating Water Pump House (Byron) components are:

- Aluminum
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Concrete Block
- Galvanized Steel
- Galvanized Steel Bolting
- Reinforced concrete
- Stainless Steel

Environments

The Circulating Water Pump House (Byron) components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Groundwater/Soil

- Raw Water
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the Circulating Water Pump House (Byron) components require management:

- Cracking
- Cracking and Distortion
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength
- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Circulating Water Pump House (Byron) components:

- Masonry Walls (B.2.1.33)
- Structures Monitoring (B.2.1.34)

3.5.2.1.3 Component Supports Commodity Group

Materials

The materials of construction for the Component Supports Commodity Group components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Elastomer
- Galvanized Steel
- Galvanized Steel Bolting
- Graphitic Tool Steel
- Grout
- High Strength Low Alloy Steel Bolting with Yield Strength of 150 ksi or Greater
- Lubrite
- Reinforced concrete

- Stainless Steel
- Stainless Steel Bolting

Environments

The Component Supports Commodity Group components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Air with Borated Water Leakage
- Raw Water
- Treated Borated Water

Aging Effect Requiring Management

The following aging effects associated with the Component Supports Commodity Group components require management:

- Cracking
- Cumulative Fatigue Damage
- Loss of Material
- Loss of Mechanical Function
- Loss of Preload
- Reduction in Concrete Anchor Capacity
- Reduction or Loss of Isolation Function

Aging Management Programs

The following aging management programs manage the aging effects for the Component Supports Commodity Group components:

- ASME Section XI, Subsection IWF (B.2.1.31)
- Boric Acid Corrosion (B.2.1.4)
- Structures Monitoring (B.2.1.34)
- TLAA
- Water Chemistry (B.2.1.2)

3.5.2.1.4 Containment Structure

Materials

The materials of construction for the Containment Structure components are:

- Carbon Steel

- Carbon and Low Alloy Steel Bolting
- Coatings
- Concrete Block
- Elastomer
- Galvanized Steel
- Galvanized Steel Bolting
- Lubrite
- Reinforced concrete
- Silicone
- Stainless Steel
- Stainless Steel Bolting

Environments

The Containment Structure components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Air with Borated Water Leakage
- Condensation
- Groundwater/Soil
- Treated Borated Water
- Waste Water
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the Containment Structure components require management:

- Cracking
- Cracking and Distortion
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Cumulative Fatigue Damage
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength
- Loss of Coating Integrity
- Loss of Leaktightness

- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Mechanical Function
- Loss of Preload
- Loss of Prestress
- Loss of Sealing

Aging Management Programs

The following aging management programs manage the aging effects for the Containment Structure components:

- 10 CFR Part 50, Appendix J (B.2.1.32)
- ASME Section XI, Subsection IWE (B.2.1.29)
- ASME Section XI, Subsection IWL (B.2.1.30)
- Boric Acid Corrosion (B.2.1.4)
- Masonry Walls (B.2.1.33)
- Protective Coating Monitoring and Maintenance Program (B.2.1.36)
- Structures Monitoring (B.2.1.34)
- TLAA
- Water Chemistry (B.2.1.2)

3.5.2.1.5 Deep Well Enclosures (Byron)

Materials

The materials of construction for the Deep Well Enclosures (Byron) components are:

- Carbon Steel
- Galvanized Steel
- Galvanized Steel Bolting
- Grout
- Reinforced concrete

Environments

The Deep Well Enclosures (Byron) components are exposed to the following environments:

- Air - Outdoor
- Concrete
- Groundwater/Soil

- Raw Water
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the Deep Well Enclosures (Byron) components require management:

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength
- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Deep Well Enclosures (Byron) components:

- Open-Cycle Cooling Water System (B.2.1.11)
- Structures Monitoring (B.2.1.34)

3.5.2.1.6 Essential Service Cooling Pond (Braidwood)

Materials

The materials of construction for the Essential Service Cooling Pond (Braidwood) components are:

- Soil, Rip-Rap, Sand, Gravel

Environments

The Essential Service Cooling Pond (Braidwood) components are exposed to the following environments:

- Air - Outdoor
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the Essential Service Cooling Pond (Braidwood) components require management:

- Loss of Material or Loss of Form

Aging Management Programs

The following aging management programs manage the aging effects for the Essential Service Cooling Pond (Braidwood) components:

- RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)

3.5.2.1.7 Essential Service Water Cooling Towers (Byron)

Materials

The materials of construction for the Essential Service Water Cooling Towers (Byron) components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Ceramic Tile
- Fiberglass
- Galvanized Steel
- Galvanized Steel Bolting
- Gray Cast Iron
- PVC
- Reinforced concrete
- Stainless Steel
- Stainless Steel Bolting

Environments

The Essential Service Water Cooling Towers (Byron) components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Groundwater/Soil
- Raw Water
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the Essential Service Water Cooling Towers (Byron) components require management:

- Change in Material Properties
- Cracking and Distortion

- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength
- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Preload
- Reduction of Heat Transfer

Aging Management Programs

The following aging management programs manage the aging effects for the Essential Service Water Cooling Towers (Byron) components:

- RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)
- Selective Leaching (B.2.1.21)
- Structures Monitoring (B.2.1.34)

3.5.2.1.8 Fuel Handling Building

Materials

The materials of construction for the Fuel Handling Building components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Concrete Block
- Elastomer
- Galvanized Steel
- Galvanized Steel Bolting
- Reinforced concrete
- Stainless Steel
- Stainless Steel Bolting

Environments

The Fuel Handling Building components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Air with Borated Water Leakage
- Condensation

- Groundwater/Soil
- Treated Borated Water
- Water – Flowing

Aging Effect Requiring Management

The following aging effects associated with the Fuel Handling Building components require management:

- Cracking
- Cracking and Distortion
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Cumulative Fatigue Damage
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength
- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Preload
- Loss of Sealing

Aging Management Programs

The following aging management programs manage the aging effects for the Fuel Handling Building components:

- 10 CFR Part 50, Appendix J (B.2.1.32)
- Boric Acid Corrosion (B.2.1.4)
- Masonry Walls (B.2.1.33)
- One-Time Inspection (B.2.1.20)
- Structures Monitoring (B.2.1.34)
- TLAA
- Water Chemistry (B.2.1.2)

3.5.2.1.9 Lake Screen Structures (Braidwood)

Materials

The materials of construction for the Lake Screen Structures (Braidwood) components are:

- Aluminum
- Carbon Steel

- Carbon and Low Alloy Steel Bolting
- Concrete Block
- Galvanized Steel
- Galvanized Steel Bolting
- Reinforced concrete

Environments

The Lake Screen Structures (Braidwood) components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Groundwater/Soil
- Raw Water
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the Lake Screen Structures (Braidwood) components require management:

- Cracking
- Cracking and Distortion
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength
- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Lake Screen Structures (Braidwood) components:

- Masonry Walls (B.2.1.33)
- RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)
- Structures Monitoring (B.2.1.34)

3.5.2.1.10 Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms

Materials

The materials of construction for the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms components are:

- Aluminum - (Byron only)
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Elastomer
- Polymers
- Reinforced concrete

Environments

The Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Groundwater/Soil
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms components require management:

- Change in Material Properties
- Cracking and Distortion
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength
- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Preload
- Loss of Sealing

Aging Management Programs

The following aging management programs manage the aging effects for the Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms components:

- Structures Monitoring (B.2.1.34)

3.5.2.1.11 Natural Draft Cooling Towers (Byron)

Materials

The materials of construction for the Natural Draft Cooling Towers (Byron) components are:

- Reinforced concrete

Environments

The Natural Draft Cooling Towers (Byron) components are exposed to the following environments:

- Air - Outdoor
- Groundwater/Soil
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the Natural Draft Cooling Towers (Byron) components require management:

- Cracking and Distortion
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength
- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking

Aging Management Programs

The following aging management programs manage the aging effects for the Natural Draft Cooling Towers (Byron) components:

- Structures Monitoring (B.2.1.34)

3.5.2.1.12 RWST Foundation and Tunnel

Materials

The materials of construction for the RWST Foundation and Tunnel components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Galvanized Steel
- Galvanized Steel Bolting

- Reinforced concrete
- Stainless Steel

Environments

The RWST Foundation and Tunnel components are exposed to the following environments:

- Air - Outdoor
- Air with Borated Water Leakage
- Condensation
- Groundwater/Soil
- Treated Borated Water
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the RWST Foundation and Tunnel components require management:

- Cracking and Distortion
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength
- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the RWST Foundation and Tunnel components:

- Boric Acid Corrosion (B.2.1.4)
- Structures Monitoring (B.2.1.34)

3.5.2.1.13 Radwaste and Service Building Complex

Materials

The materials of construction for the Radwaste and Service Building Complex components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Concrete Block

- Galvanized Steel
- Glass
- Reinforced concrete

Environments

The Radwaste and Service Building Complex components are exposed to the following environments:

- Air - Outdoor
- Air with Borated Water Leakage
- Groundwater/Soil
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the Radwaste and Service Building Complex components require management:

- Cracking
- Cracking and Distortion
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength
- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Radwaste and Service Building Complex components:

- Boric Acid Corrosion (B.2.1.4)
- Masonry Walls (B.2.1.33)
- Structures Monitoring (B.2.1.34)

3.5.2.1.14 River Screen House (Byron)

Materials

The materials of construction for the River Screen House (Byron) components are:

- Aluminum
- Carbon Steel

- Carbon and Low Alloy Steel Bolting
- Concrete Block
- Galvanized Steel
- Galvanized Steel Bolting
- Polymers
- Reinforced concrete
- Soil, Rip-Rap, Sand, Gravel
- Stainless Steel Bolting

Environments

The River Screen House (Byron) components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Groundwater/Soil
- Raw Water
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the River Screen House (Byron) components require management:

- Change in Material Properties
- Cracking
- Cracking and Distortion
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength
- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Material or Loss of Form
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the River Screen House (Byron) components:

- Masonry Walls (B.2.1.33)
- RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)
- Structures Monitoring (B.2.1.34)

3.5.2.1.15 Structural Commodity Group

Materials

The materials of construction for the Structural Commodity Group components are:

- Aluminum
- Aluminum Bolting
- Calcium Silicate
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Ceramic Fiber
- Elastomer
- Fiberglass
- Foamed Plastic
- Galvanized Steel
- Galvanized Steel Bolting
- Glass
- Grout
- Lead
- Mineral Fiber
- PVC
- Polymers
- Stainless Steel
- Stainless Steel Bolting

Environments

The Structural Commodity Group components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Air with Borated Water Leakage
- Concrete
- Groundwater/Soil
- Raw Water

Aging Effect Requiring Management

The following aging effects associated with the Structural Commodity Group components require management:

- Change in Material Properties
- Change in Material Properties, Loss of Material
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Preload
- Loss of Sealing

Aging Management Programs

The following aging management programs manage the aging effects for the Structural Commodity Group components:

- Boric Acid Corrosion (B.2.1.4)
- Structures Monitoring (B.2.1.34)

3.5.2.1.16 Switchyard Structures

Materials

The materials of construction for the Switchyard Structures components are:

- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Concrete Block
- Galvanized Steel

- Galvanized Steel Bolting
- Reinforced concrete

Environments

The Switchyard Structures components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Groundwater/Soil
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the Switchyard Structures components require management:

- Cracking
- Cracking and Distortion
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength
- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Switchyard Structures components:

- Masonry Walls (B.2.1.33)
- Structures Monitoring (B.2.1.34)

3.5.2.1.17 Turbine Building Complex

Materials

The materials of construction for the Turbine Building Complex components are:

- Aluminum
- Carbon Steel
- Carbon and Low Alloy Steel Bolting
- Concrete Block
- Galvanized Steel

- Galvanized Steel Bolting
- Polymers
- Reinforced concrete

Environments

The Turbine Building Complex components are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air - Outdoor
- Groundwater/Soil
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the Turbine Building Complex components require management:

- Change in Material Properties
- Cracking
- Cracking and Distortion
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength
- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Turbine Building Complex components:

- Masonry Walls (B.2.1.33)
- Structures Monitoring (B.2.1.34)

3.5.2.1.18 Yard Structures

Materials

The materials of construction for the Yard Structures components are:

- Aluminum
- Ductile Cast Iron
- Galvanized Steel

- Galvanized Steel Bolting
- Reinforced concrete

Environments

The Yard Structures components are exposed to the following environments:

- Air - Outdoor
- Groundwater/Soil
- Water - Flowing

Aging Effect Requiring Management

The following aging effects associated with the Yard Structures components require management:

- Cracking and Distortion
- Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)
- Increase in Porosity and Permeability, Loss of Strength
- Loss of Material
- Loss of Material (Spalling, Scaling) and Cracking
- Loss of Preload

Aging Management Programs

The following aging management programs manage the aging effects for the Yard Structures components:

- Structures Monitoring (B.2.1.34)

3.5.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

NUREG-1801 provides the basis for identifying those programs that warrant further evaluation by the reviewer in the license renewal application. For the Structures and Component Supports, those programs are addressed in the following subsections.

3.5.2.2.1 PWR and BWR Containments

3.5.2.2.1.1 Cracking and Distortion due to Increased Stress Levels from Settlement; Reduction of Foundation Strength, and Cracking due to Differential Settlement and Erosion of Porous Concrete Subfoundations

Cracking and distortion due to increased stress levels from settlement could occur in PWR and BWR concrete and steel containments. The existing program relies on ASME Section XI, Subsection IWL to manage these aging effects. Also, reduction of foundation strength and cracking, due to differential settlement and erosion of porous concrete subfoundations could occur in all types of PWR and BWR containments. The existing program relies on the structures monitoring program to manage these aging effects. However, some plants may rely on a de-watering system to lower the site ground water level. If the plant's current licensing basis (CLB) credits a de-watering system to control settlement, the GALL Report recommends further evaluation to verify the continued functionality of the de-watering system during the period of extended operation.

Item Number 3.5.1-1 is applicable for BBS. The foundations of the Containment Structures at Byron and Braidwood Stations are supported on the underlying bedrock, as described in UFSAR Section 2.5.4.10.2.3 for Byron and UFSAR Section 2.5.4.10.1.1 for Braidwood. A settlement monitoring program was implemented during construction, and shortly thereafter, to monitor for settlement of Category I structure foundations at Braidwood. Predicted and measured values, for settlement of the Braidwood Containment Structures showed that plant settlement is complete and less than the values considered in the design of the structures. The results of calculations for settlement of the Byron Containment Structures showed negligible total and differential settlement. Therefore, cracking and distortion due to increased stress levels from settlement is not a significant aging effect expected to occur. However, inaccessible below-grade Containment concrete surfaces will be examined by the Structures Monitoring (B.2.1.34) program when excavated for any reason.

Item Number 3.5.1-2 is not applicable to Byron and Braidwood Stations. Byron and Braidwood Stations do not have any porous concrete subfoundations, therefore, this aging effect and mechanism is not applicable.

3.5.2.2.1.2 Reduction of Strength and Modulus due to Elevated Temperature

Reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR and BWR concrete and steel containments. The implementation of 10 CFR 50.55a and ASME Section XI, Subsection IWL would not be able to identify the reduction of strength and modulus of concrete due to elevated temperature. Subsection CC-3440 of ASME Section III, Division 2, specifies the concrete temperature limits for normal operation or any other long-term period. The GALL Report recommends further *evaluation of a plant-specific aging management program if any portion of the concrete containment components exceeds specified temperature limits, i.e., general area temperature greater than 66°C (150°F) and local area temperature greater than 93°C (200°F). Higher temperatures may be allowed if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations. Acceptance criteria are described in Branch Technical Position RLSB-1.*

Item Number 3.5.1-3 is not applicable to the BBS concrete Containment Structures. The BBS internal containment average temperature is limited to 120˚F in accordance with Technical Specification 3.6.5 limits, through recirculation of air by the Containment Ventilation System. However, the maximum local area temperature seen inside the pressurizer enclosures under normal conditions is 151˚F. The pressurizer enclosures consists of concrete walls surrounding the pressurizers that extend up to the top of the pressurizers, but are open on the very top so that the air within the pressurizer enclosure areas can communicate with the surrounding containment air limited to 120˚F. Because the enclosures are open at the tops, and the surrounding containment air temperature is limited to 120˚F, the average resulting temperature at and throughout the concrete pressurizer enclosure walls is not greater than 150˚F. The Containment Ventilation System also limits the reactor cavity area and surrounding primary shield wall concrete temperature to 150˚F. A review of the BBS Containment Structure operating experience has not revealed any reports of localized concrete temperatures exceeding 200˚F. The design of the higher temperature containment penetrations includes cooling by the Component Cooling System to ensure that concrete temperatures are a maximum of 200˚F.

3.5.2.2.1.3 Loss of Material due to General, Pitting and Crevice Corrosion

1. *Loss of material due to general, pitting, and crevice corrosion could occur in steel elements of inaccessible areas for all types of PWR and BWR containments. The existing program relies on ASME Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J, to manage this aging effect. The GALL Report recommends further evaluation of plant-specific programs to manage this aging effect if corrosion is indicated from the IWE examinations. Acceptance criteria are described in Branch Technical Position RLSB-1.*

   Item Number 3.5.1-4 is applicable to BWRs only, and therefore is not applicable for BBS. However, Item Number 3.5.1-5 is applicable for BBS. ASME Section XI, Subsection IWE (B.2.1.29) and 10 CFR Part 50, Appendix J (B.2.1.32) programs will be used to manage the loss of material of steel elements in inaccessible areas of the containment.

   At BBS, visual examinations of the containment liner below the moisture barrier, conducted in accordance with ASME Section XI, Subsection IWE, have identified loss of material due to general corrosion on the inside surface of the carbon steel containment liner below the moisture barrier. Ultrasonic testing (UT) of these areas has revealed that there is no corrosion on the outside of the liner, in contact with the concrete containment shell. Since IWE examinations have identified corrosion, the condition established in NUREG-1801 Item Number II.A1.CP-98 is met, and further evaluation is required to determine if additional plant-specific activities are warranted for inaccessible areas of the containment liner.

This evaluation applies to Byron and Braidwood Stations.

- The containment is a prestressed-concrete shell structure made up of a cylinder with a shallow dome roof and a flat foundation slab. The entire containment structure is lined on the inside with steel plate which acts as a leak tight membrane. Concrete meeting the requirements of ACI 318, Building Code Requirements for Reinforced Concrete, and the guidance of ACI 201.2R with respect to chlorine ion content was used for the containment concrete in contact with the embedded containment liner. This ensures that the contact with the concrete containment shell or concrete base mat will not cause corrosion of the liner, liner anchors, or other steel elements embedded in the concrete.

- The moisture barrier, at the junction where the containment liner becomes embedded between the bottom of the containment concrete shell and the base mat, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements.

- The interior and exterior surfaces of the Containment Structures are monitored by the ASME Section XI, Subsection IWL (B.2.1.30) and Structures Monitoring (B.2.1.34) programs to ensure that the concrete is free of penetrating cracks that provide a path for water seepage to an inaccessible surface of the containment liner. If any penetrating cracks that could provide a path for water seepage to an inaccessible surface of containment liner are identified, the condition is entered in the corrective action program and the concrete cracks are accepted by evaluation or repaired.

- At BBS, borated water leakage is managed in accordance with the Boric Acid Corrosion (B.2.1.4) program. A review of plant operating experience did not identify degradation of the containment liner due to borated water leakage. Additionally, leak rates inside containment are limited by Technical Specifications.

There are multiple barriers to prevent water-induced corrosion of the steel containment liner. Inside the containment, the containment liner is protected from water leaks on the containment floor by a circumferential open trench and drain system at the outside edge of the interior base mat. The steel-channeled, open trench on the containment floor is designed to collect floor drainage and direct it to the containment building sumps before reaching the containment liner. Additionally, the inaccessible surface of the containment liner is protected from moisture intrusion by a circumferential moisture barrier located between the open trench and the containment liner at the junction where the containment liner becomes embedded between the bottom of the containment concrete shell and the base mat.

Byron and Braidwood implemented the ASME IWE inspection program in the 1999 and 2000 timeframe as required by 10 CFR 50.55a.

On Braidwood Unit 2 in 1999 and on Braidwood Unit 1 in 2000, the initial IWE inspections identified localized areas of general corrosion on the containment liner below the moisture barrier, after the moisture barrier and underlying ceramic fiber blanket material had been removed to allow for inspection of the containment liner. The inspections revealed that the ceramic fiber blanket was wet, the adjacent liner area was wet, the original liner coating was degraded, and the containment liner exhibited corrosion. All of the localized areas of corrosion were identified, recorded, and accepted after engineering evaluation. Following these inspections, the liner below the moisture barrier was recoated with a zinc-rich coating, which was the same as the original liner coating. Additionally, the ceramic fiber blanket material and moisture barrier were replaced with new material. Subsequent follow-up inspections revealed further containment liner corrosion below the moisture barrier. More details are provided in the Operating Experience section of Appendix B of the ASME Section XI, Subsection IWE (B.2.1.29) program for Braidwood. The most likely cause of containment liner corrosion, below the moisture barrier prior to implementation of the IWE program, is the lack of regular inspection of the moisture barrier before implementation of the IWE program. The most likely cause of containment liner corrosion, below the moisture barrier after implementation of the IWE program, is an event caused by improper surface preparation of the liners when the zinc-rich coating was applied in 1999 and 2000 causing subsequent localized areas of liner corrosion. Plans have been developed to make weld repairs to the liners in localized areas to restore the liners to their nominal thickness. These repairs are planned in conjunction with the integrated leak rate test during the Unit 1 and Unit 2 refuel outages in 2013 and 2014 respectively. Based on these initial inspections and subsequent inspections, the ASME Section XI, Subsection IWE (B.2.1.29) program has been effective in detecting areas of localized containment liner corrosion, correcting the underlying cause of the corrosion, initiating repairs to the liner coating, and establishing plans for weld repairs to the liner at localized areas that will restore the liner to its nominal thickness.

Byron containment liners are the same design as Braidwood, and Byron implemented the IWE program during the same timeframe as Braidwood. However, initial and follow-up inspections at Byron have confirmed that the containment liner thickness has not been impacted by an event similar to the event at Braidwood. Visual examinations and UTs have verified that the inaccessible surfaces of the containment liners at Byron Units 1 and 2 are in better condition than Braidwood Units 1 and 2. More details are provided in the Operating Experience section of Appendix B of the ASME Section XI, Subsection IWE (B.2.1.29) program for Byron.

For BBS, no additional plant-specific activities are warranted beyond those described above and those that are currently established for inaccessible areas of the containment liner beyond those activities that are currently established as part of the ASME Section XI, Subsection IWE (B.2.1.29) program. The corrective actions taken, the corrective actions planned, the continued monitoring of the containment liner in accordance with the ASME Section XI, Subsection IWE (B.2.1.29) program, and the testing conducted in accordance with the 10 CFR Part 50, Appendix J (B.2.1.32) program provide reasonable assurance that the loss of material due to corrosion of steel elements on inaccessible areas of the containment will be detected prior to a loss of intended function. These activities and programs provide assurance that the containment liner will remain capable of performing its design function through the period of extended operation. The ASME Section XI, Subsection IWE (B.2.1.29) program and the 10 CFR Part 50, Appendix J (B.2.1.32) program are described in Appendix B.

2. *Loss of material due to general, pitting, and crevice corrosion could occur in steel torus shell of Mark I containments. The existing program relies on ASME Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J, to manage this aging effect. The GALL Report recommends further evaluation of plant-specific programs to manage this aging effect if corrosion is significant. Acceptance criteria are described in Branch Technical Position RLSB-1.*

   Item Number 3.5.1-6 is applicable to BWRs only and is not used for BBS.

3. *Loss of material due to general, pitting, and crevice corrosion could occur in steel torus ring girders and downcomers of Mark I containments, downcomers of Mark II containments, and interior surface of suppression chamber shell of Mark III containments. The existing program relies on ASME Section XI, Subsection IWE to manage this aging effect. The GALL Report recommends further evaluation of plant-specific programs to manage this aging effect if corrosion is significant. Acceptance criteria are described in Branch Technical Position RLSB-1.*

   Item Number 3.5.1-7 is applicable to BWRs only and is not used for BBS.

3.5.2.2.1.4 Loss of Prestress due to Relaxation, Shrinkage, Creep, and Elevated Temperature

Loss of prestress forces due to relaxation, shrinkage, creep, and elevated temperature for PWR prestressed concrete containments and BWR Mark II prestressed concrete containments is a Time-Limited Aging Analysis (TLAA) as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.5, "Concrete Containment Tendon Prestress Analysis."

Item Number 3.5.1-8 is applicable for BBS. Loss of prestress forces due to relaxation, shrinkage, creep, and elevated temperature for the Containment Structures is an aging effect assessed by a time-limited aging analysis (TLAA). TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The TLAA evaluation of loss of prestress forces due to relaxation, shrinkage, creep, and elevated temperature for Containment Structures is discussed in LRA Section 4.5.

3.5.2.2.1.5 Cumulative Fatigue Damage

If included in the current licensing basis, fatigue analyses of suppression pool steel shells (including welded joints) and penetrations (including penetration sleeves, dissimilar metal welds, and penetration bellows) for all types of PWR and BWR containments and BWR vent header, vent line bellows, and downcomers are TLAAs as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.6, "Containment Liner Plates, Metal Containments, and Penetrations Fatigue Analysis."

Item Number 3.5.1-9 is applicable for BBS. Cumulative fatigue damage, for the BBS penetration sleeves, penetration expansion bellows, and containment hatches and liner, is an aging effect assessed by a TLAA. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The TLAA evaluations of fatigue, for the BBS containment penetration sleeves, penetration bellows, and containment hatches and liner, are addressed separately in LRA Section 4.6.

3.5.2.2.1.6 Cracking due to Stress Corrosion Cracking

Cracking due to stress corrosion cracking of stainless steel penetration bellows and dissimilar metal welds could occur in all types of PWR and BWR containments. The existing program relies on ASME Section XI, Subsection IWE and10 CFR Part 50, Appendix J, to manage this aging effect. The GALL Report recommends further evaluation of additional appropriate examinations/evaluations implemented to detect these aging effects for stainless steel penetration bellows and dissimilar metal welds.

Item Number 3.5.1-10 is applicable for BBS. However, cracking due to stress corrosion cracking of stainless steel containment penetration bellows and dissimilar metal welds at containment penetration sleeves is not expected to occur because stress corrosion cracking requires a concentration of chloride or sulfate contaminants which are not normally present in significant quantities as well as high stress and temperatures greater than 140˚F.

- At BBS, only the fuel transfer tube penetration sleeves and recirculation sump effluent pipe penetration sleeves are fitted with expansion bellows. There are three (3) single ply expansion bellows on each fuel transfer tube penetration sleeve and one (1) expansion bellow on each recirculation sump effluent pipe penetration sleeve. However, only the fuel transfer tube penetration sleeves are required to maintain containment integrity. The expansion bellows on the recirculation sump effluent pipes are flood seals, and are not required to maintain containment integrity.

  Surface examinations of the fuel transfer tube penetration sleeves and single ply expansion bellows are not possible due to accessibility limitations, even though it is included within the scope of the ASME Section XI, Subsection IWE (B.2.1.29) program. Therefore, the 10 CFR Part 50, Appendix J (B.2.1.32) program will be used to manage cracking of stainless steel containment penetration bellows. The local leak rate test conducted on these inaccessible pressure boundary components tests the entire space between the 20” diameter fuel transfer tube and the 24” diameter penetration sleeves and single ply expansion bellows.

- At BBS, the Containment Structure has containment penetration sleeves which are carbon steel. Some of these containment penetration sleeves have stainless steel piping passing through the sleeve. There are dissimilar metal welds associated with the head fittings, which are welded to containment penetration sleeves, and the stainless steel piping. Inspections of these dissimilar metal welds are conducted in accordance with the ASME Section XI, Subsection IWE (B.2.1.29) program. The integrated leak rate test of the Containment Structure under the 10 CFR Part 50, Appendix J (B.2.1.32) program tests whether there are any leaks at the dissimilar metal welds. These dissimilar metal welds are located in an air with borated water leakage environment which is not considered corrosive for stainless steel. Aging management reviews have concluded that stress corrosion cracking of stainless steel in an air with borated water leakage environment is not considered credible because stress corrosion cracking of stainless steel requires a concentration of chloride or sulfate contaminants which are not normally present in significant quantities.

Additionally, stress corrosion cracking of stainless steel requires high stress and temperatures greater than 140˚F. No containment pipe penetration breaks have been postulated in UFSAR Section 3.6.2.1.2.1.2.2 since the design stress limits have been met. There are no penetration sleeves to process pipe welds contained in piping covered under the augmented inservice inspection program. The dissimilar metal weld is between the head fitting and the penetration sleeve. The stress is lower at the dissimilar metal weld between the head fitting and the penetration sleeve than at the weld between the head fitting and the process pipe, since the pipe sleeve is a larger diameter than the process pipe. In addition, Technical Specification limits the average air temperature inside the containment during normal plant operation to 120˚F.

Consequently, while the aging effect of cracking of stainless steel containment penetration bellows and dissimilar metal welds at containment penetration sleeves is not expected to occur, the testing conducted in accordance with the 10 CFR Part 50, Appendix J (B.2.1.32) program and inspections conducted in accordance with the ASME Section XI, Subsection IWE (B.2.1.29) program are applied to manage this aging effect and provide reasonable assurance that the cracking of stainless steel containment penetration bellows and dissimilar metal welds at containment penetration sleeves will be detected prior to a loss of intended function. The ASME Section XI, Subsection IWE (B.2.1.29) program and the 10 CFR Part 50, Appendix J (B.2.1.32) program are described in Appendix B.

3.5.2.2.1.7 Loss of Material (Scaling, Spalling) and Cracking due to Freeze-Thaw

Loss of material (scaling, spalling) and cracking due to freeze-thaw could occur in inaccessible areas of PWR and BWR concrete containments. The GALL Report recommends further evaluation of this aging effect for plants located in moderate to severe weathering conditions.

Item Number 3.5.1-11 is applicable for BBS. At BBS, ASME Section XI, Subsection IWL program (B.2.1.30), will be used to manage loss of material (scaling, cracking, and spalling) due to freeze-thaw of accessible Containment Structure concrete elements.

The BBS Containment Structures are located in regions where weathering conditions are considered severe as shown in ASTM C33-90, Figure 1. At BBS, the Containment Structures are designed in accordance with ACI 318 and constructed in accordance with ACI 301. The type and size of aggregate, slump, cement and additives have been established to produce durable concrete. The Portland cement conforms to ASTM C150, Type II. Concrete aggregates conform to the requirements of ASTM C33. Aggregates were tested in accordance with ASTM Specification C289 for potential reactivity and were also tested in accordance with ASTM Specifications C29, C40, C87, C88, C117, C123, C127, C128, C131 or C535, C136, C142, C235, and C566. Air entrainment content conformed to the design requirements of ACI 211.1 and was determined by ASTM C231. For nominal 3/8" aggregate, the allowable limits for total air content was 7-9%, nominal 3/4" aggregate, the allowable limits for total air content was 5-7%, for nominal 1" aggregate, the allowable limits for total air content was 4-6%. The air entrainment content for concrete requiring freeze-thaw resistance meets the minimum air entrainment requirements of Table CC-2231-2 of ASME Section III Division 2, which allows a variance of not more than 1.5% from the following values: 6% for 3/8" aggregate; 5% for 3/4" aggregate; and 4.5% for 1" aggregate.

Exposed portions of below grade concrete will be examined by the Structures Monitoring (B.2.1.34) program when excavated for any reason and groundwater chemistry will be monitored periodically in accordance with the Structures Monitoring (B.2.1.34) program. In the event that unacceptable conditions due to freeze thaw are identified in the accessible areas of structures, corrective actions will be initiated to evaluate the acceptability of inaccessible portions of structures. Since the number of freeze-thaw cycles is expected to be greater for concrete above grade, and the potential moisture content in the concrete is expected to also be significant at the grade surface, below grade portions of the Containment Structure are expected to be less susceptible to freeze-thaw damage than exposed areas of the Containment Structure.

As described above, the design and construction of the Containment Structures concrete is in accordance with ACI standards that preclude significant loss of material (scaling, cracking, and spalling) due to freeze-thaw. Operating experience review has not identified significant loss of material (scaling, cracking, and spalling) of the accessible Containment Structure concrete. Evaluation of spalling and cracking concluded they have no significant impact on structural integrity of the Containment Structure.

Therefore, loss of material (scaling, spalling) and cracking due to freeze-thaw of inaccessible concrete is insignificant and is adequately managed by ASME Section XI, Subsection IWL (B.2.1.30). In addition, BBS will examine exposed portions of the below-grade concrete, when excavated for any reason, in accordance with the Structures Monitoring (B.2.1.34) program. The ASME Section XI, Subsection IWL program (B.2.1.30) and the Structures Monitoring (B.2.1.34) program are described in Appendix B.

3.5.2.2.1.8 Cracking due to Expansion from Reaction with Aggregates

Cracking due to expansion from reaction with aggregates could occur in inaccessible areas of concrete elements of PWR and BWR concrete and steel containments. The GALL Report recommends further evaluation to determine if a plant-specific aging management program is required to manage this aging effect. Acceptance criteria are described in Branch Technical Position RLSB-1.

Item Number 3.5.1-12 is not applicable to BBS. This aging effect and mechanism combination does not apply to BBS concrete Containment Structures. Concrete fine and course aggregates conform to ASTM C33. Petrographic examinations of aggregates used in concrete were performed in accordance with ASTM C295, "Petrographic Examination of Aggregates for Concrete", and ASTM C289, "Potential Reactivity of Aggregates", to demonstrate that the aggregates do not adversely react within the concrete. In addition, concrete structures were constructed in accordance with ACI 318 per UFSAR Table 3.8-2.

Cracking associated with expansion due to reaction with aggregates has not been observed on BBS concrete structures, including Containment Structures. Nevertheless, the ASME Section XI, Subsection IWL (B.2.1.30) program and the Structures Monitoring (B.2.1.34) program will continue to inspect and monitor the concrete Containment Structures for cracking due to any mechanism. BBS will also examine exposed portions of the below-grade concrete, when excavated for any reason, in accordance with the Structures Monitoring (B.2.1.34) program. The BBS structural concrete was constructed as recommended to preclude cracking due to this mechanism; therefore, no aging management or further evaluation of inaccessible below grade concrete for this mechanism is required. The ASME Section XI, Subsection IWL program (B.2.1.30) and the Structures Monitoring (B.2.1.34) program are described in Appendix B.

3.5.2.2.1.9 Increase in Porosity and Permeability due to Leaching of Calcium Hydroxide and Carbonation

Increase in porosity and permeability due to leaching of calcium hydroxide and carbonation could occur in inaccessible areas of concrete elements of PWR and BWR concrete and steel containments. The GALL Report recommends further evaluation if leaching is observed in accessible areas that impact intended functions. Acceptance criteria are described in Branch Technical Position RLSB-1.

Item Number 3.5.1-13 is applicable to PWR metal containments and BWRs only, and therefore is not applicable for the BBS concrete containments. However, Item Number 3.5.1-14 is applicable for BBS. The BBS Containment Structures are designed in accordance with ACI 318 and constructed in accordance with ACI 301. The type and size of aggregate, slump, Type II cement and additives have been selected to produce durable concrete, resistant to leaching. However, leaching of calcium hydroxide is applicable for a flowing water environment; therefore, the potential for leaching to occur to a limited extent in accessible or inaccessible portions of structures due to groundwater intrusion through narrow concrete cracks is considered to be applicable. Recent monitoring of the groundwater chemistry at BBS has revealed that the groundwater is not aggressive with respect to pH or sulphates. The pH test results were above the threshold limit, pH > 5.5, and the sulphates were lower than the threshold limit, sulphates < 1500 ppm, and thus indicate a non-aggressive environment. Therefore, an increase in porosity and permeability due to leaching of calcium hydroxide is not expected to occur at the Containment Structure.

The effects of carbonation have not been observed on BBS concrete. Recent concrete testing in 2012 at the Byron Essential Service Water Cooling Towers revealed that carbonation penetration was less than one-half the depth of the concrete cover in the worst case and there were no effects of carbonation observed during the testing. Carbonation rates are expected to be greater at surfaces exposed to air and accessible, and the carbonation rate of penetration slows over time. The same concrete specification that was used for all the Containment Structures was also used for the Byron Essential Service Water Cooling Towers, such that these results are representative of the expected effects of carbonation at the Containment Structures.

Therefore, the effects of carbonation, an increase in porosity and permeability, are not expected to occur at the Containment Structure.

Operating experience at BBS has found that increase in porosity and permeability and loss of strength due to these mechanisms is not significant and is adequately managed by the ASME Section XI, Subsection IWL (B.2.1.30) and Structures Monitoring (B.2.1.34) programs. Although an increase in porosity and permeability and loss of strength of concrete in inaccessible areas of structures within the scope of license renewal is not expected, the ASME Section XI, Subsection IWL (B.2.1.30) and Structures Monitoring (B.2.1.34) programs will be used to manage this potential aging effect through inspections of accessible areas, and inaccessible areas whenever they become accessible for inspection. The ASME Section XI, Subsection IWL program (B.2.1.30) and the Structures Monitoring (B.2.1.34) program are described in Appendix B.

3.5.2.2.2 Safety-Related and Other Structures and Component Supports

3.5.2.2.2.1 Aging Management of Inaccessible Areas

1. *Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Groups 1-3, 5 and 7-9 structures. The GALL Report recommends further evaluation of this aging effect for inaccessible areas of these Groups of structures for plants located in moderate to severe weathering conditions.*

   Item Number 3.5.1-42 is applicable to BBS. Structures other than Containment at BBS consist of Groups 3 through 8. The Structures Monitoring (B.2.1.34) program will be used to manage loss of material (spalling, scaling) and cracking in both accessible and inaccessible areas. At BBS, structures are located in a region where weathering conditions are considered severe, as shown in ASTM C33-90, Figure 1. The loss of material (spalling, scaling) and cracking due to freeze-thaw is applicable to BBS structures. However, these concrete structures are designed and constructed in accordance with ACI 318 and ACI 301 as listed in the UFSAR Table 3.8-2. The design provides for low permeability and adequate air entrainment such that the concrete has good freeze-thaw resistance. Air entrainment content conformed to the design requirements of ACI 211.1 and was determined by ASTM C231. For nominal 3/8” aggregate, the allowable limits for total air content was 7-9%, nominal 3/4” aggregate, the allowable limits for total air content was 5-7%, for nominal 1” aggregate, the allowable limits for total air content was 4-6%. The air entrainment content for concrete requiring freeze-thaw resistance meets the minimum air entrainment requirements of Table CC-2231-2 of ASME Section III Division 2, which allows a variance of not more than 1.5% from the following values: 6% for 3/8” aggregate; 5% for 3/4” aggregate; and 4.5% for 1” aggregate.

   Operating experience has not identified significant loss of material (spalling, scaling) and cracking due to freeze-thaw of reinforced concrete structures within the scope of license renewal, except at the Byron Essential Service Water Cooling Towers, in only limited areas below the cooling tower fill, where the water exposure and freeze-thaw cycles are much more severe than at the other structures. As a result, the Byron Essential Service Water Cooling Towers may be used as a leading indicator for exposure to weathering conditions. More details are provided in the Operating Experience section of Appendix B of the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program for Byron. The corrective actions associated with the operating experience are incorporated as enhancements to the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program. Although operating experience has not identified significant loss of material and cracking due to freeze thaw at the other structures within the scope of license renewal, the Structures Monitoring (B.2.1.34) program does include inspection for this aging effect in the accessible areas. The condition of accessible and above grade concrete is used as an indicator for the condition of the inaccessible and below grade structural components and provides reasonable assurance that degradation of inaccessible structural components will be detected before a loss of an intended function.

In the event that unacceptable conditions due to freeze thaw are identified in the accessible areas of structures, corrective actions will be initiated to evaluate the acceptability of inaccessible portions of structures. Since the number of freeze-thaw cycles is expected to be greater for concrete above grade, and the potential moisture content in the concrete is expected to also be significant at the grade surface, below grade, inaccessible portions, of the structures are expected to be less susceptible to freeze-thaw damage than exposed areas of the structures. In addition, BBS will examine exposed portions of the below-grade concrete, when excavated for any reason, in accordance with the Structures Monitoring (B.2.1.34) program. These inspections are included as an enhancement to the Structures Monitoring (B.2.1.34) program. The Structures Monitoring (B.2.1.34) program is described in Appendix B.

2. *Cracking due to expansion and reaction with aggregates could occur in below-grade inaccessible concrete areas for Groups 1-5 and 7-9 structures. The GALL Report recommends further evaluation of inaccessible areas of these Groups of structures if concrete was not constructed in accordance with the recommendations in the GALL Report.*

   Item Number 3.5.1-43 is not applicable to BBS. Structures other than Containment at BBS consist of Groups 3 through 8. This aging effect and mechanism combination does not apply to BBS concrete structures. Concrete fine and course aggregates conform to ASTM C33. Petrographic examinations of aggregates used in concrete were performed in accordance with ASTM C295, “Petrographic Examination of Aggregates for Concrete”, and ASTM C289, “Potential Reactivity of Aggregates”, to demonstrate that the aggregates do not adversely react within the concrete. In addition, concrete structures were constructed in accordance with ACI 318, per UFSAR Table 3.8-2. Thus, cracking due to expansion and reaction with aggregates is not applicable and requires no aging management.

   Cracking associated with expansion due to reaction with aggregates has not been observed on BBS concrete structures. Nevertheless, the Structures Monitoring (B.2.1.34) program continues to inspect and monitor concrete structures for cracking due to any mechanism. BBS will also examine exposed portions of the below-grade concrete, when excavated for any reason, in accordance with the Structures Monitoring (B.2.1.34) program. The BBS structural concrete was constructed as recommended to preclude cracking due to this mechanism; therefore, no aging management or further evaluation of inaccessible below grade concrete for this mechanism is required. The Structures Monitoring (B.2.1.34) program is described in Appendix B.

3. *Cracking and distortion due to increased stress levels from settlement could occur in below-grade inaccessible concrete areas of structures for all Groups, and reduction in foundation strength, and cracking due to differential settlement and erosion of porous concrete subfoundations could occur in below-grade inaccessible concrete areas of Groups 1-3, 5 -9 structures. The existing program relies on structure monitoring programs to manage these aging effects. Some plants may rely on a de-watering system to lower the site ground water level. If the plant's CLB credits a de-watering system, the GALL Report recommends verification of the continued functionality of the de-watering system during the period of extended operation. The GALL Report recommends no further evaluation if this activity is included in the scope of the applicant's structures monitoring program.*

Item Number 3.5.1-45 is applicable to BWRs only and is not used for BBS.

Item Number 3.5.1-46 is not applicable to BBS. BBS structures do not utilize porous concrete subfoundations and do not rely on a de-watering system to control settlement.

Item Number 3.5.1-44 is applicable to BBS structures, which are not founded on rock. Structures other than Containment at BBS consist of Groups 3 through 8. The Structures Monitoring (B.2.1.34) program will be used to manage cracking and distortion of below-grade exterior and foundation concrete exposed to a ground water and soil environment. At Braidwood, plant structures are founded on overconsolidated till, bedrock, or compacted granular fill. Predicted and measured values, for settlement of the Braidwood plant structures, showed that plant settlement is complete and less than the values considered in the design of the structures. At Byron, structures are founded on grouted bedrock or crushed rock, except the Byron River Screen House, which was founded on granular soils. Predicted and measured values, for settlement of the Byron structures founded on bedrock or crushed rock, showed negligible total and differential settlement for the structures. The settlement records for the Byron River Screen House reveal that settlement is complete. Other nonsafety-related structures within the scope of license renewal at BBS are founded on bedrock, natural soil, or structural fill. This aging effect and mechanism combination does apply to those BBS concrete structures founded on soil. Cracking and distortion due to settlement has not been observed in BBS concrete structures and the potential for settlement and distortion is considered insignificant for BBS structures. Nevertheless, the Structures Monitoring (B.2.1.34) program continues to inspect and monitor concrete structures for cracking due to any mechanism as described in the Byron UFSAR Section 2.5.4.10.2.3. The condition of accessible and above grade concrete are used as an indicator for the condition of the inaccessible and below grade structural components and provides reasonable assurance that degradation of inaccessible structural components will be detected before a loss of an intended function. In the event that unacceptable conditions due to this mechanism were identified in the accessible areas of structures, procedures require that extent of condition be determined and additional inspections or evaluations would address inaccessible and below grade portions of any affected structure. No further evaluation of this aging effect and mechanism is required since BBS did not use porous concrete subfoundations, does not rely on a dewatering system to control settlement, and the Structures Monitoring (B.2.1.34) program continues to inspect and monitor concrete structures within the scope of license renewal for cracking due to any mechanism. The Structures Monitoring (B.2.1.34) program is described in Appendix B.

4. *Increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide and carbonation could occur in below-grade inaccessible concrete areas of Groups 1-5 and 7-9 structures. The GALL Report recommends further evaluation if leaching is observed in accessible areas that impact intended functions.*

   Item Number 3.5.1-47 is applicable to BBS Group 3, 5, and 7 structures. The Structures Monitoring (B.2.1.34) program will be used to manage increase in porosity and permeability and loss of strength in below-grade inaccessible concrete areas and foundations. BBS reinforced concrete is designed in accordance with ACI 318 and constructed in accordance with ACI 301. The type and size of aggregate, slump, Type II cement and additives have been selected to produce durable concrete. However, leaching of calcium hydroxide is applicable for a flowing water environment; therefore, the potential for leaching to occur to a limited extent in accessible or inaccessible portions of structures due to groundwater intrusion through narrow concrete cracks is considered to be applicable. Recent monitoring of the groundwater chemistry at BBS has revealed that the groundwater is not aggressive with respect to pH or sulphates. The pH test results were above the threshold limit, pH > 5.5, and the sulphates were lower than the threshold limit, sulphates < 1500 ppm, and thus indicate a non-aggressive environment. Therefore, an increase in porosity and permeability due to leaching of calcium hydroxide is not expected to occur.

   The effects of carbonation have not been observed on BBS concrete. Recent concrete testing in 2012 at the Byron Essential Service Water Cooling Towers revealed that carbonation penetration was less than one-half the depth of the concrete cover in the worst case and there were no effects of carbonation observed during this testing. Carbonation rates are expected to be greater at surfaces exposed to air and accessible, and the carbonation rate of penetration slows over time. The same concrete specification was used for all structures at Byron and Braidwood Stations, including the Byron Essential Service Water Cooling Towers, such that these results are representative of the expected effects of carbonation of all Groups 3, 4, 5, 7, and 8 structures within the scope of license renewal. Therefore, the effects of carbonation, an increase in porosity and permeability, are not expected to occur at the Groups 3, 4, 5, 7, and 8 structures of BBS.

   Operating experience at BBS has found that increase in porosity and permeability and loss of strength due to these mechanisms is not significant and is adequately managed by the Structures Monitoring (B.2.1.34) program. Although an increase in porosity and permeability and loss of strength of concrete in inaccessible areas of structures within the scope of license renewal is not expected, the Structures

Monitoring (B.2.1.34) program will be used to manage this potential aging effect through inspections of accessible areas, and inaccessible areas whenever they become accessible for inspection. The Structures Monitoring (B.2.1.34) program is described in Appendix B.

3.5.2.2.2.2 Reduction of Strength and Modulus due to Elevated Temperature

Reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR and BWR Group 1-5 concrete structures. For any concrete elements that exceed specified temperature limits, further evaluations are recommended. Appendix A of ACI 349-85 specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 66°C (150°F) except for local areas, which are allowed to have increased temperatures not to exceed 93°C (200°F). The GALL Report recommends further evaluation of a plant-specific program if any portion of the safety-related and other concrete structures exceeds specified temperature limits, i.e., general area temperature greater than 66°C (150°F) and local area temperature greater than 93°C (200°F). Higher temperatures may be allowed if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations. The acceptance criteria are described in Branch Technical Position RLSB-1.

Item Number 3.5.1-48 is not applicable to BBS. Group 1 and 2 structures do not exist at BBS. Group 3 and 5 structures are not subject to general area temperatures greater than 150˚F, as shown in UFSAR Table 3.11-2. The refuel floor and spent fuel storage pool are part of the Fuel Handling Building, which is a Group 5 structure. The spent fuel pool water temperature is maintained below 150˚F under normal plant operating conditions.

For Group 4 structures inside the Containment Structures, Technical Specification 3.6.5 limits the internal containment average temperature to 120°F. The average temperature for Group 4 structures is maintained within the Technical Specification limits by recirculating air through the Containment Ventilation System. The normal maximum localized area temperature within the pressurizer enclosure is 151˚F. However, since there is no top to the enclosure, and the surrounding ambient air temperature is less than 120˚F inside containment, the average resulting temperature at and throughout the concrete pressurizer enclosure walls is not greater than 150˚F. The Containment Ventilation System also limits the reactor vessel cavity area and surrounding primary shield wall concrete temperature to 150˚F.

High energy line penetrations have been designed to limit surrounding concrete surfaces to temperatures less than 200˚F, except for the special pipe whip restraints that are located around each feedwater and main steam pipe as it passes through the concrete wall separating the main steam isolation valve room from the main steam tunnel. The design documents for the concrete at these pipe whip restraints include an evaluation for elevated temperatures, which determined that the concrete temperature up to 300˚F at the local areas around the pipes was acceptable. Plant operating experience has not identified elevated general and local area temperature as a concern for concrete structural components. Therefore, the aging effects of reduction of strength and modulus of concrete due to elevated temperatures are not expected to occur at the Group 3 structures of BBS.

3.5.2.2.2.3 Aging Management of Inaccessible Areas for Group 6 Structures

The GALL Report recommends further evaluation for inaccessible areas of certain Group 6 structure/aging effect combinations as identified below, whether or not they are covered by inspections in accordance with the GALL Report, Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," or FERC/US Army Corp of Engineers dam inspection and maintenance procedures.

1. *Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Group 6 structures. The GALL Report recommends further evaluation of this aging effect for inaccessible areas for plants located in moderate to severe weathering conditions.*

   Item Number 3.5.1-49 is applicable to BBS. The Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) aging management program will be used to manage loss of material (spalling, scaling) and cracking in both accessible and inaccessible areas. BBS Group 6 structures are located in a region where weathering conditions are considered severe, as shown in ASTM C33-90, Figure 1. The loss of material (spalling, scaling) and cracking due to freeze-thaw is applicable to BBS concrete structures. However, these concrete structures are designed and constructed in accordance with ACI 318 and ACI 301 as listed in the UFSAR Table 3.8-2. The design provides for low permeability and adequate air entrainment such that the concrete has good freeze-thaw resistance. Air entrainment content conformed to the design requirements of ACI 211.1 and was determined by ASTM C231. For nominal 3/8" aggregate, the allowable limits for total air content was 7-9%, nominal 3/4" aggregate, the allowable limits for total air content was 5-7%, for nominal 1" aggregate, the allowable limits for total air content was 4-6%. The air entrainment content for concrete requiring freeze-thaw resistance meets the minimum air entrainment requirements of Table CC-2231-2 of ASME Section III Division 2, which allows a variance of not more than 1.5% from the following values: 6% for 3/8" aggregate; 5% for 3/4" aggregate; and 4.5% for 1" aggregate.

   Operating experience review of structural concrete has not identified significant of loss of material (spalling, scaling) and cracking due freeze-thaw of reinforced concrete structures within the scope of license renewal, except at the Byron Essential Service Water Cooling Towers, in only limited areas below the cooling tower fill, where the water exposure and freeze-thaw cycles are much more severe than at the other structures. As a result, the Byron Essential Service Water Cooling Towers may be used as a leading indicator for exposure to weathering conditions. More details are provided in the Operating Experience section of Appendix B of the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program for Byron. The corrective actions associated with the operating experience are incorporated as enhancements to the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program. Inspection for this aging effect is performed in by the Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) aging management program.

The condition of accessible and above grade concrete is used as an indicator for the condition of the inaccessible and below grade structural components and provides reasonable assurance that degradation of inaccessible structural components will be detected before a loss of an intended function. In the event that unacceptable conditions due to freeze thaw are identified in the accessible areas of structures, corrective actions will be initiated to evaluate the acceptability of inaccessible portions of structures. Since the number of freeze-thaw cycles is expected to be greater for concrete above grade, and the potential moisture content in the concrete is expected to also be significant at the grade surface, inaccessible portions of the Group 6 structures are expected to be less susceptible to freeze-thaw damage than exposed areas of the Byron Essential Service Water Cooling Towers that are below the cooling tower fill. In addition, BBS will examine exposed portions of the below-grade concrete, when excavated for any reason, in accordance with the Structures Monitoring (B.2.1.34) program. These inspections are included as an enhancement to the Structures Monitoring (B.2.1.34) program. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program, and the Structures Monitoring (B.2.1.34) program are described in Appendix B.

2. *Cracking due to expansion and reaction with aggregates could occur in below-grade inaccessible reinforced concrete areas of Group 6 structures. The GALL Report recommends further evaluation to determine if a plant-specific aging management program is required to manage this aging effect. Acceptance criteria are described in Branch Technical Position RLSB-1.*

   Item Number 3.5.1-50 is not applicable to BBS. This aging effect and mechanism combination does not apply to BBS Group 6 concrete structures. Concrete fine and course aggregates conform to ASTM C33. Petrographic examinations of aggregates used in concrete were performed in accordance with ASTM C295, “Petrographic Examination of Aggregates for Concrete”, and ASTM C289, “Potential Reactivity of Aggregates”, to demonstrate that the aggregates do not adversely react within the concrete. In addition, concrete structures were constructed in accordance with ACI 318, per UFSAR Table 3.8-2.

   Cracking associated with expansion due to reaction with aggregates has not been observed on BBS Group 6 concrete structures. Nevertheless, the Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) aging management program continues to inspect and monitor Group 6 concrete structures for cracking due to any mechanism. The condition of accessible and above grade concrete is used as an indicator for the condition of the inaccessible and below grade structural components and provides reasonable assurance that degradation of inaccessible structural components will be detected before a loss of an intended function. BBS will also examine exposed portions of the below grade concrete, when excavated for any reason, in accordance with the Structures Monitoring (B.2.1.34) program. The BBS structural concrete was constructed as recommended to preclude cracking due to this mechanism. Therefore, no aging management is required of inaccessible, below grade, Group 6 concrete structures for this mechanism. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program, and the Structures Monitoring (B.2.1.34) program are described in Appendix B.

3. *Increase in porosity and permeability and loss of strength due to leaching of calcium hydroxide and carbonation could occur in inaccessible areas of concrete elements of Group 6 structures. The GALL Report recommends further evaluation if leaching is observed in accessible areas that impact intended functions. Acceptance criteria are described in Branch Technical Position RLSB-1.*

   Item Number 3.5.1-51 is applicable to BBS. The Structures Monitoring (B.2.1.34) and Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) programs will be used to manage increase in porosity and permeability and loss of strength for concrete elements in accessible and inaccessible areas of Group 6 structures. BBS reinforced concrete is designed in accordance with ACI 318 and constructed in accordance with ACI 301. The type and size of aggregate, slump, Type II cement and additives have been selected to produce durable concrete. However, leaching of calcium hydroxide is applicable for a flowing water environment; therefore, the potential for leaching to occur due to the water flowing environment is considered Recent monitoring of the groundwater chemistry at BBS has revealed that the groundwater is not aggressive with respect to pH or sulphates. The pH test results were above the threshold limit, pH > 5.5, and the sulphates were lower than the threshold limit, sulphates < 1500 ppm, and thus indicate a non-aggressive environment. Therefore, an increase in porosity and permeability due to leaching of calcium hydroxide is not expected to occur at the Group 6 structures of BBS.

   The effects of carbonation have not been observed on BBS concrete. Recent concrete testing in 2012 at the Byron Essential Service Water Cooling Towers revealed that carbonation penetration was less than one-half the depth of the concrete cover in the worst case and there were no effects of carbonation observed during this testing. Carbonation rates are expected to be greater at surfaces exposed to air and accessible, and the carbonation rate of penetration slows over time. The same concrete specification was used for all structures at Byron and Braidwood Stations, including the Byron Essential Service Water Cooling Towers, such that these results are representative of the expected effects of carbonation of all structures within the scope of license renewal. Therefore, the effects of carbonation, an increase in porosity and permeability, are not expected to occur at the Group 6 structures of BBS.

   Operating experience at BBS has found that increase in porosity and permeability and loss of strength due to these mechanisms is not significant and is adequately managed by the Structures Monitoring (B.2.1.34) and Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) programs. The condition of accessible concrete is used as an indicator for the condition of the inaccessible and below grade or submerged structural components, and provides reasonable assurance that degradation of inaccessible structural components will be detected before a loss of an intended function. BBS will examine exposed portions of the below-grade concrete, when excavated for any reason in accordance with the Structures Monitoring (B.2.1.34) program. Furthermore, periodic visual inspections of submerged portions of Group 6 structures are performed every five years in accordance with the Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power plants (B.2.1.35) program. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program, and the Structures Monitoring (B.2.1.34) program are described in Appendix B.

3.5.2.2.2.4 Cracking due to Stress Corrosion Cracking, and Loss of Material due to Pitting and Crevice Corrosion

Cracking due to stress corrosion cracking and loss of material due to pitting and crevice corrosion could occur for Group 7 and 8 stainless steel tank liners exposed to standing water. The GALL Report recommends further evaluation of plant-specific programs to manage these aging effects. The acceptance criteria are described in Branch Technical Position RLSB-1.

Item Number 3.5.1-52 is not applicable for BBS. The only Group 7 or 8 tanks present at Byron and Braidwood Stations with a stainless steel liner are the refueling water storage tanks. For the purposes of aging management, the stainless steel refueling water storage tank liners were evaluated as tanks within the Safety Injection System and assigned NUREG-1801 line items from NUREG-1801, Chapter V. Loss of material due to pitting and crevice corrosion will be managed by the Water Chemistry (B.2.1.2) program and One-Time Inspection (B.2.1.20) program. Cracking due to stress corrosion cracking of stainless steel components exposed to treated borated water rarely occurs when the operating environment is less than 140˚F. The normal operating environment for the refueling water storage tanks is limited to 100˚F in accordance with Technical Specification 3.5.4. Therefore, cracking due to stress corrosion cracking is not an aging applicable effect for the refueling water storage tank liners. The Water Chemistry (B.2.1.2) program and One-Time Inspection (B.2.1.20) program are described in Appendix B.

3.5.2.2.2.5 Cumulative Fatigue Damage due to Fatigue

Fatigue of component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports is a TLAA as defined in 10 CFR 54.3 only if a CLB fatigue analysis exists. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.3, "Metal Fatigue Analysis."

Item Number 3.5.1-53 is applicable at BBS for the Component Supports Commodity Group. Cumulative fatigue damage of Group B1.1 component supports is an aging effect assessed by a TLAA. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). No fatigue analysis currently exists in the CLB for B1.2 and B1.3 component supports. The evaluation of fatigue as a TLAA for the Group B1.1 component supports, ASME class 1 component supports, is addressed separately in LRA Section 4.3.

3.5.2.2.3 Quality Assurance for Aging Management of Nonsafety-Related Components

QA provisions applicable to License Renewal are discussed in Section B.1.3.

3.5.2.3 Time-Limited Aging Analysis

The time-limited aging analyses identified below are associated with the Structures and Component Supports:

- Section 4.3, Metal Fatigue
- Section 4.5, Concrete Containment Tendon Prestress
- Section 4.6, Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analyses

3.5.3 CONCLUSION

The Containments, Structures, and Component Supports that are subject to aging management review have been identified in accordance with the requirements of 10 CFR 54.4. The aging management programs selected to manage aging effects for the Containments, Structures, and Component Supports are identified in the summaries in Section 3.5.2.1 above.

A description of these aging management programs is provided in Appendix B, along with the demonstration that the identified aging effects will be managed for the period of extended operation.

Therefore, based on the conclusions provided in Appendix B, the effects of aging associated with the Containments, Structures, and Component Supports components will be adequately managed so that there is reasonable assurance that the intended functions are maintained consistent with the current licensing basis during the period of extended operation.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-1	Concrete: dome; wall; basemat; ring girders; buttresses, Concrete elements, all	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S2, "ASME Section XI, Subsection IWL" or Chapter XI.S6, "Structure Monitoring" If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes, if a de-watering system is relied upon to control settlement	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage cracking and distortion of the concrete dome, wall, basemat, and buttresses in inaccessible areas of the Containment Structure exposed to a groundwater and soil environment. BBS do not rely upon a de-watering system to control settlement. See subsection 3.5.2.2.1.1.
3.5.1-2	Concrete: foundation; subfoundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	Chapter XI.S6, "Structures Monitoring" If a de-watering system is relied upon for control of erosion, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes, if a de-watering system is relied upon to control settlement	Not Applicable. The Containment Structure is not founded on a porous concrete subfoundation and, therefore, this aging effect and mechanism is not applicable to BBS. See subsection 3.5.2.2.1.1.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-3	Concrete: dome; wall; basemat; ring girders; buttresses, Concrete: containment; wall; basemat, Concrete: basemat, concrete fill-in annulus	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	A plant-specific aging management program is to be evaluated.	Yes, if temperature limits are exceeded	Not Applicable. The average temperature inside the Containment Structure at BBS is maintained less than 120˚F, in accordance with Technical Specification limits, by the Containment Ventilation System. Localized concrete temperatures exceeding 200˚F have not been reported. See subsection 3.5.2.2.1.2.
3.5.1-4	BWR Only				
3.5.1-5	Steel elements (inaccessible areas): liner; liner anchors; integral attachments, Steel elements (inaccessible areas): suppression chamber; drywell; drywell head; embedded shell; region shielded by diaphragm floor (as applicable)	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, “ASME Section XI, Subsection IWE” and Chapter XI.S4, “10 CFR Part 50, Appendix J”	Yes, if corrosion is indicated from the IWE examinations	Consistent with NUREG-1801. The ASME Section XI, Subsection IWE (B.2.1.29) program and 10 CFR Part 50, Appendix J (B.2.1.32) program will be used to manage loss of material of the steel containment liner, liner anchors, and integral attachments. See subsection 3.5.2.2.1.3.1.
3.5.1-6	BWR Only				

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-7	BWR Only				
3.5.1-8	Prestressing system: tendons	Loss of prestress due to relaxation; shrinkage; creep; elevated temperature	Yes, TLAA	Yes, TLAA	Loss of prestress forces of containment tendons is an aging effect assessed by a TLAA; further evaluation is documented in Subsection 3.5.2.2.1.4.
3.5.1-9	Penetration sleeves; penetration bellows, Steel elements: torus; vent line; vent header; vent line bellows; downcomers, Suppression pool shell; unbraced downcomers, Steel elements: vent header; downcomers	Cumulative fatigue damage due to fatigue (Only if CLB fatigue analysis exists)	Yes, TLAA	Yes, TLAA	Fatigue is an aging effect assessed by a TLAA; further evaluation is documented in Subsection 3.5.2.2.1.5.
3.5.1-10	Penetration sleeves; Penetration bellows	Cracking due to stress corrosion cracking	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801. The ASME Section XI, Subsection IWE (B.2.1.29) and 10 CFR Part 50, Appendix J (B.2.1.32) programs will be used to manage cracking of stainless steel penetration sleeves and penetration bellows inside the Containment Structure exposed to an air with borated water leakage environment. See subsection 3.5.2.2.1.6.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-11	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses, Concrete (inaccessible areas): basemat, Concrete (inaccessible areas): dome; wall; basemat	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Further evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557).	Yes, for plants located in moderate to severe weathering conditions	The ASME Section XI, Subsection IWL (B.2.1.30) program will be used to manage loss of material (spalling, scaling) and cracking of the concrete dome, wall, basemat, and buttresses in inaccessible areas of the Containment Structure exposed to an outdoor air environment. See subsection 3.5.2.2.1.7.
3.5.1-12	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses, Concrete (inaccessible areas): basemat, Concrete (inaccessible areas): containment; wall; basemat, Concrete (inaccessible areas): basemat, concrete fill-in annulus	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed.	Yes, if concrete is not constructed as stated function	Not Applicable. This aging effect/mechanism does not apply to BBS Containment Structures. Fine and course aggregates conform to ASTM C33. Petrographic examinations of aggregates were performed in accordance with ASTM C295 and ASTM C289. In addition, concrete structures were constructed in accordance with ACI 318. Cracking associated with expansion due to reaction with aggregates has not been observed on accessible portions of the BBS Containment Structures. See subsection 3.5.2.2.1.8.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-13	Concrete (inaccessible areas): basemat, Concrete (inaccessible areas): dome; wall; basemat	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed.	Yes, if leaching is observed in accessible areas that impact intended function	Not Applicable. This Item Number is associated with PWR metal containments and BWR containments. BBS have prestressed concrete containment structures. See subsection 3.5.2.2.1.9.
3.5.1-14	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses, Concrete (inaccessible areas): containment; wall; basemat	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed.	Yes, if leaching is observed in accessible areas that impact intended function	The ASME Section XI, Subsection IWL (B.2.1.30) program and Structures Monitoring (B.2.1.34) program will be used to manage increase in porosity and permeability and loss of strength of the concrete dome, wall, basemat, and buttresses in inaccessible areas of the Containment Structure exposed to a flowing water environment. See subsection 3.5.2.2.1.9.
3.5.1-15	Concrete (accessible areas): basemat	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No	Not Applicable. This Item Number is associated with PWR metal containments and BWR containments. BBS have prestressed concrete containment structures.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-16	Concrete (accessible areas): basemat, Concrete: containment; wall; basemat	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S2, "ASME Section XI, Subsection IWL," or Chapter XI.S6, "Structures Monitoring"	No	Not Applicable. This Item Number is associated with PWR metal containments and BWR containments. BBS have prestressed concrete containment structures.
3.5.1-17	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S2, "ASME Section XI, Subsection IWL"	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWL (B.2.1.30) program will be used to manage increase in porosity and permeability, cracking, and loss of material (spalling, scaling) of the concrete dome, wall, basemat and buttresses in accessible areas of the Containment Structure exposed to an air with borated water leakage environment.
3.5.1-18	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses, Concrete (accessible areas): basemat	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S2, "ASME Section XI, Subsection IWL"	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWL (B.2.1.30) program will be used to manage loss of material (spalling, scaling) and cracking of the concrete dome, wall, basemat, and buttresses in accessible areas of the Containment Structure exposed to an outdoor air environment.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-19	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses, Concrete (accessible areas): basemat, Concrete (accessible areas): containment; wall; basemat, Concrete (accessible areas): basemat, concrete fill-in annulus	Cracking due to expansion from reaction with aggregates	Chapter XI.S2, "ASME Section XI, Subsection IWL"	No	Not Applicable. This aging effect/mechanism does not apply to BBS Containment Structures. Fine and course aggregates conform to ASTM C33. Petrographic examinations of aggregates were performed in accordance with ASTM C295 and ASTM C289. In addition, concrete structures were constructed in accordance with ACI 318. Cracking associated with expansion due to reaction with aggregates has not been observed on accessible portions of the BBS Containment Structures.
3.5.1-20	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses, Concrete (accessible areas): containment; wall; basemat	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S2, "ASME Section XI, Subsection IWL"	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWL (B.2.1.30) program will be used to manage increase in porosity and permeability and loss of strength of the concrete dome, wall, basemat, and buttresses in accessible areas of the Containment Structure exposed to a flowing water environment.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-21	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses; reinforcing steel, Concrete (accessible areas): basemat; reinforcing steel, Concrete (accessible areas): dome; wall; basemat; reinforcing steel	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S2, "ASME Section XI, Subsection IWL"	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWL (B.2.1.30) program will be used to manage cracking, loss of bond, and loss of material (spalling, scaling) of the concrete dome, wall, basemat, and buttresses in accessible areas of the Containment Structure exposed to indoor air, air with borated water leakage, and outdoor air environments.
3.5.1-22	BWR Only				
3.5.1-23	Concrete (inaccessible areas): basemat; reinforcing steel, Concrete (inaccessible areas): dome; wall; basemat; reinforcing steel	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S2, "ASME Section XI, Subsection IWL," or Chapter XI.S6, "Structures Monitoring"	No	Not Applicable. This Item Number is associated with PWR metal containments and BWR containments. BBS have prestressed concrete containment structures. This component type, material, environment, and aging effect combination is addressed under Item Number 3.5.1-25.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-24	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses, Concrete (inaccessible areas): basemat, Concrete (accessible areas): dome; wall; basemat	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S2, "ASME Section XI, Subsection IWL," or Chapter XI.S6, "Structures Monitoring"	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage increase in porosity and permeability, cracking, and loss of material (spalling, scaling) of the concrete dome, wall, basemat, and buttresses in inaccessible areas of the Containment Structure exposed to groundwater and soil environments. The Structures Monitoring (B.2.1.34) program will select a structure based on groundwater chemistry results and perform inspections to be used as a leading indicator for the condition of the below grade inaccessible concrete exposed to ground water and soil environments.
3.5.1-25	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses; reinforcing steel	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S2, "ASME Section XI, Subsection IWL," or Chapter XI.S6, "Structures Monitoring"	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWL (B.2.1.30) program will be used to manage cracking, loss of bond, and loss of material (spalling, scaling) of the concrete dome, wall, basemat, and buttresses in inaccessible areas of the Containment Structure exposed to an outdoor air environment.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-26	Moisture barriers (caulking, flashing, and other sealants)	Loss of sealing due to wear, damage, erosion, tear, surface cracks, or other defects	Chapter XI.S1, "ASME Section XI, Subsection IWE"	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWE (B.2.1.29) program will be used to manage loss of sealing of the sealant associated with the Containment Structure moisture barrier between the containment liner and interior concrete base mat exposed to an air with borated water leakage environment.
3.5.1-27	penetration sleeves; penetration bellows, Steel elements: torus; vent line; vent header; vent line bellows; downcomers, Suppression pool shell	Cracking due to cyclic loading (CLB fatigue analysis does not exist)	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No	Not Applicable. BBS does have CLB fatigue analyses associated with penetration sleeves and bellows, therefore, this aging effect and mechanism is addressed under Item Number 3.5.1-9.
3.5.1-28	Personnel airlock, equipment hatch, CRD hatch	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWE (B.2.1.29) program and 10 CFR Part 50, Appendix J (B.2.1.32) program will be used to manage loss of material of the Containment Structure, steel personnel airlock and equipment hatch exposed to outdoor air and air with borated water leakage environments.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-29	Personnel airlock, equipment hatch, CRD hatch: locks, hinges, and closure mechanisms	Loss of leak tightness due to mechanical wear of locks, hinges and closure mechanisms	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWE (B.2.1.29) program and 10 CFR Part 50, Appendix J (B.2.1.32) program will be used to manage loss of leak tightness of the Containment Structure, steel personnel airlock and equipment hatch exposed to outdoor air and air with borated water leakage environments.
3.5.1-30	Pressure-retaining bolting	Loss of preload due to self-loosening	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWE (B.2.1.29) program and 10 CFR Part 50, Appendix J (B.2.1.32) program will be used to manage loss of preload of the steel and stainless steel containment closure bolting exposed to an air with borated water leakage environment.
3.5.1-31	Pressure-retaining bolting, Steel elements: downcomer pipes	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE"	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWE (B.2.1.29) program will be used to manage loss of material of steel containment closure bolting exposed to an air with borated water leakage environment.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-32	Prestressing system: tendons; anchorage components	Loss of material due to corrosion	Chapter XI.S2, “ASME Section XI, Subsection IWL”	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWL (B.2.1.30) program will be used to manage loss of material of the steel tendons, grease caps, and tendon anchorages associated with the prestressing system exposed to indoor air and outdoor air environments.
3.5.1-33	Seals and gaskets	Loss of sealing due to wear, damage, erosion, tear, surface cracks, or other defects	Chapter XI.S4, “10 CFR Part 50, Appendix J "	No	Consistent with NUREG-1801. The 10 CFR Part 50, Appendix J (B.2.1.32) program will be used to manage loss of sealing of seals and gaskets at the containment boundary and elastomeric electrical and instrumentation penetration assemblies associated with the Containment Structure exposed to air with borated water leakage and outdoor air environments.
3.5.1-34	Service Level I coatings	Loss of coating integrity due to blistering, cracking, flaking, peeling, or physical damage	Chapter XI.S8, "Protective Coating Monitoring and Maintenance"	No	Consistent with NUREG-1801. The Protective Coating Monitoring and Maintenance Program (B.2.1.36) will be used to manage loss of coating integrity of the Containment Structure internal Service Level 1 coatings exposed to an air with borated water leakage environment.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-35	Steel elements (accessible areas): liner; liner anchors; integral attachments, Penetration sleeves, Steel elements (accessible areas): drywell shell; drywell head; drywell shell in sand pocket regions;, Steel elements (accessible areas): suppression chamber; drywell; drywell head; embedded shell; region shielded by diaphragm floor (as applicable), Steel elements (accessible areas): drywell shell; drywell head	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	No	Consistent with NUREG-1801. The ASME Section XI, Subsection IWE (B.2.1.29) program and 10 CFR Part 50, Appendix J (B.2.1.32) program will be used to manage loss of material of steel penetrations, penetration sleeves, penetration bellows, and accessible portions of the containment liner exposed to an air with borated water leakage environment.
3.5.1-36	BWR Only				
3.5.1-37	BWR Only				
3.5.1-38	BWR Only				
3.5.1-39	BWR Only				

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-40	BWR Only				
3.5.1-41	BWR Only				
3.5.1-42	Groups 1-3, 5, 7-9:Concrete (inaccessible areas): foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Further evaluation is required for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557)	Yes, for plants located in moderate to severe weathering conditions	The Structures Monitoring (B.2.1.34) program will be used to manage loss of material (spalling, scaling) and cracking of inaccessible concrete surfaces for Group 3 and 5 structures exposed to an outdoor air environment. See subsection 3.5.2.2.2.1.1.
3.5.1-43	All Groups except Group 6:Concrete (inaccessible areas): all	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed.	Yes, if concrete is not constructed as stated	Not Applicable. The aging effect/mechanism does not apply to BBS concrete structures. Fine and course aggregates conform to ASTM C33. Petrographic examinations of aggregates were performed in accordance with ASTM C295 and ASTM C289. In addition, concrete structures were constructed in accordance with ACI 318. Cracking associated with expansion due to reaction with aggregates has not been observed on accessible portions of BBS concrete structures. See subsection 3.5.2.2.2.1.2.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-44	All Groups: concrete: all	Cracking and distortion due to increased stress levels from settlement	Chapter XI.S6, “Structures Monitoring” If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes, if a de-watering system is relied upon to control settlement	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage cracking and distortion of below-grade exterior and foundation concrete, equipment supports, and manholes, handholes, and duct banks exposed to a ground water and soil environment. BBS do not rely upon a de-watering system to control settlement. See subsection 3.5.2.2.2.1.3.
3.5.1-45	BWR Only				
3.5.1-46	Groups 1-3, 5-9: concrete: foundation; subfoundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	Chapter XI.S6, “Structures Monitoring” If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Yes, if a de-watering system is relied upon to control settlement	Not Applicable. BBS structures are not founded on porous concrete subfoundations and do not rely upon a de-watering system to control settlement. Therefore, this aging effect and mechanism is not applicable to BBS. See subsection 3.5.2.2.2.1.3.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-47	Groups 1-5, 7-9: concrete (inaccessible areas): exterior above- and below-grade; foundation	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed.	Yes, if leaching is observed in accessible areas that impact intended function	The Structures Monitoring (B.2.1.34) program will be used to manage increase in porosity and permeability and loss of strength of inaccessible concrete surfaces for Group 3, 5, and 7 structures exposed to a flowing water environment. See subsection 3.5.2.2.2.1.4.
3.5.1-48	Groups 1-5: concrete: all	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	A plant-specific aging management program is to be evaluated.	Yes, if temperature limits are exceeded	Not Applicable. BBS Group 3-5 structures are not subject to general area temperatures greater than 150°F or local areas >200°F, except for the main steam tunnel and main steam isolation valve room walls which have been evaluated and found acceptable for temperatures up to 300˚F. See Subsection 3.5.2.2.2.2.
3.5.1-49	Groups 6 - concrete (inaccessible areas): exterior above- and below-grade; foundation; interior slab	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Further evaluation is required for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557)	Yes, for plants located in moderate to severe weathering conditions	The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program will be used to manage loss of material (spalling, scaling) and cracking of inaccessible concrete surfaces for Group 6 structures exposed to an outdoor air environment. See subsection 3.5.2.2.2.3.1.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-50	Groups 6: concrete (inaccessible areas): all	Cracking due to expansion from reaction with aggregates	Further evaluation is required to determine if a plant-specific aging management program is needed.	Yes, if concrete is not constructed as stated	Not Applicable. The aging effect/mechanism does not apply to BBS Group 6 concrete structures. Fine and course aggregates conform to ASTM C33. Petrographic examinations of aggregates were performed in accordance with ASTM C295 and ASTM C289. In addition, concrete structures were constructed in accordance with ACI 318. See Subsection 3.5.2.2.2.3.2.
3.5.1-51	Groups 6: concrete (inaccessible areas): exterior above- and below-grade; foundation; interior slab	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Further evaluation is required to determine if a plant-specific aging management program is needed.	Yes, if leaching is observed in accessible areas that impact intended function	The Structures Monitoring (B.2.1.34) program and the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program will be used to manage increase in porosity and permeability and loss of strength of inaccessible above-grade, below-grade, and foundation concrete surfaces for Group 6 structures exposed to a flowing water environment. See Subsection 3.5.2.2.2.3.3.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-52	Groups 7, 8 - steel components: tank liner	Cracking due to stress corrosion cracking; Loss of material due to pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Yes, plant-specific	Not Applicable. The stainless steel refueling water storage tank liner exposed to treated borated water is addressed by Item Number 3.2.1-22 for managing loss of material. The normal operating environment is less than 100˚F, therefore, cracking is not an applicable aging effect. See subsection 3.5.2.2.2.4.
3.5.1-53	Support members; welds; bolted connections; support anchorage to building structure	Cumulative fatigue damage due to fatigue (Only if CLB fatigue analysis exists)	Yes, TLAA	Yes, TLAA	Fatigue is an aging effect addressed by a TLAA; further evaluation is documented in Subsection 3.5.2.2.2.5.
3.5.1-54	All groups except 6: concrete (accessible areas): all	Cracking due to expansion from reaction with aggregates	Chapter XI.S6, “Structures Monitoring”	No	Not Applicable. The aging effect/mechanism does not apply to BBS Group 6 concrete structures. Fine and course aggregates conform to ASTM C33. Petrographic examinations of aggregates were performed in accordance with ASTM C295 and ASTM C289. In addition, concrete structures were constructed in accordance with ACI 318.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-55	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	Chapter XI.S6, "Structures Monitoring"	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage reduction in concrete anchor capacity in building concrete locations of expansion and grouted anchors, and grout pads for support base plates exposed to indoor air, air with borated water leakage, and outdoor air environments.
3.5.1-56	Concrete: exterior above- and below-grade; foundation; interior slab	Loss of material due to abrasion; cavitation	Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	Consistent with NUREG-1801. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program will be used to manage loss of material for exterior above-grade and below-grade concrete exposed to a flowing water environment. The Structures Monitoring (B.2.1.34) program has been substituted and will be used to manage loss of material for exterior above-grade and below-grade concrete exposed to a flowing water environment at the Circulating Water Pump House and Natural Draft Cooling Towers at Byron. These structures provide a source of water for the Fire Protection System and are not associated with emergency cooling water or flood protection. Therefore, the Structures Monitoring (B.2.1.34) program has been substituted for the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-57	Constant and variable load spring hangers; guides; stops	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	Chapter XI.S3, "ASME Section XI, Subsection IWF"	No	Consistent with NUREG-1801 with exceptions. The ASME Section XI, Subsection IWF (B.2.1.31) program will be used to manage loss of mechanical function of the steel constant and variable load spring hangers, guides and stops exposed to indoor air and air with borated water leakage environments. Exceptions apply to the NUREG-1801 recommendations for ASME Section XI, Subsection IWF (B.2.1.31) implementation.
3.5.1-58	Earthen water-control structures: dams; embankments; reservoirs; channels; canals and ponds	Loss of material; loss of form due to erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, seepage	Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	Consistent with NUREG-1801. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program will be used to manage loss of material or loss of form of the earthen water-control structures exposed to a flowing water environment.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-59	Group 6: concrete (accessible areas): all	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	Consistent with NUREG-1801. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program will be used to manage cracking, loss of bond, and loss of material (spalling, scaling) of the accessible above-grade, below-grade, and interior concrete in Group 6 structures exposed to indoor air and outdoor air environments.
3.5.1-60	Group 6: concrete (accessible areas): exterior above- and below-grade; foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	Consistent with NUREG-1801. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program will be used to manage loss of material (spalling, scaling) and cracking of the accessible above-grade and below-grade concrete in Group 6 structures exposed to an outdoor air environment.
3.5.1-61	Group 6: concrete (accessible areas): exterior above- and below-grade; foundation; interior slab	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	Consistent with NUREG-1801. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program will be used to manage increase in porosity and permeability and loss of strength of the accessible above-grade concrete in Group 6 structures exposed to a flowing water environment.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-62	Group 6: Wooden Piles; sheeting	Loss of material; change in material properties due to weathering, chemical degradation, and insect infestation repeated wetting and drying, fungal decay	Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	Not Applicable. There are no wooden piles or sheeting in the Structures and Component Supports group.
3.5.1-63	Groups 1-3, 5, 7-9: concrete (accessible areas): exterior above- and below-grade; foundation	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Chapter XI.S6, "Structures Monitoring"	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage increase in porosity and permeability and loss of strength for accessible interior concrete in Group 3 structures exposed to a flowing water environment.
3.5.1-64	Groups 1-3, 5, 7-9: concrete (accessible areas): exterior above- and below-grade; foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S6, “Structures Monitoring"	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage loss of material (spalling, scaling) and cracking of accessible concrete in Groups 3, 5, 7, and 8 structures exposed to an outdoor air environment.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-65	Groups 1-3, 5, 7-9: concrete (inaccessible areas): below-grade exterior; foundation, Groups 1-3, 5, 7-9: concrete (accessible areas): below-grade exterior; foundation, Groups 6: concrete (inaccessible areas): all	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage cracking, loss of bond, and loss of material (spalling, scaling) of inaccessible concrete in Groups 3 and 5-8 structures exposed to air with borated water leakage, air outdoor, groundwater, and soil environments. The Structures Monitoring (B.2.1.34) program will select a structure based on groundwater chemistry results and perform inspections to be used as a leading indicator for the condition of the below grade inaccessible concrete exposed to ground water and soil environments.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-66	Groups 1-5, 7, 9: concrete (accessible areas): interior and above-grade exterior	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring"	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage cracking, loss of bond, and loss of material (spalling, scaling) of concrete interior and above-grade exterior for Groups 3-5 and 7 structures exposed to air with borated water leakage, indoor air, and outdoor air environments. Masonry walls have also been aligned to this item. Components in the Fire Protection System have been aligned to this item number based on the material, environment, and aging effect. The Fire Protection (B.2.1.15) program will be used to supplement the Structures Monitoring (B.2.1.34) program in managing cracking, loss of bond, and loss of material of fire barrier masonry walls exposed to air with borated water leakage, indoor air, and outdoor air environments.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-67	Groups 1-5, 7, 9: Concrete: interior; above-grade exterior, Groups 1-3, 5, 7-9 - concrete (inaccessible areas): below-grade exterior; foundation, Group 6: concrete (inaccessible areas): all	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Chapter XI.S6, "Structures Monitoring"	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage increase in porosity and permeability, cracking, and loss of material (spalling, scaling) of accessible and inaccessible concrete in Groups 3-8 structures exposed to air with borated water leakage, ground water, and soil environments. The Structures Monitoring (B.2.1.34) program will select a structure based on groundwater chemistry results and perform inspections to be used as a leading indicator for the condition of the below grade inaccessible concrete exposed to ground water and soil environments.
3.5.1-68	High-strength structural bolting	Cracking due to stress corrosion cracking	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No	Consistent with NUREG-1801 with exceptions. The ASME Section XI, Subsection IWF (B.2.1.31) program will be used to manage cracking of SA540 high strength structural bolting for NSSS component supports exposed to an air with borated leakage environment. Exceptions apply to the NUREG-1801 recommendations for ASME Section XI, Subsection IWF (B.2.1.31) implementation.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-69	High-strength structural bolting	Cracking due to stress corrosion cracking	Chapter XI.S6, "Structures Monitoring" Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated for these bolts.	No	Not Applicable. ASTM A325 and A490 structural bolts are used at BBS and have not been shown to be prone to SCC. Therefore, SCC is not an applicable aging effect for these material types in structural bolting. Other high strength bolting materials potentially susceptible to stress corrosion cracking have not been used at BBS for applications within the scope of the Structures Monitoring (B.2.1.34) program.
3.5.1-70	Masonry walls: all	Cracking due to restraint shrinkage, creep, and aggressive environment	Chapter XI.S5, "Masonry Walls"	No	Consistent with NUREG-1801. The Masonry Walls (B.2.1.33) program will be used to manage cracking of masonry walls exposed to air with borated water leakage, indoor air, and outdoor air environments. Components in the Fire Protection System have been aligned to this item number based on the material, environment, and aging effect. The Fire Protection (B.2.1.15) program will be used to supplement the Masonry Walls (B.2.1.33) program in managing cracking of fire barrier masonry walls exposed to air with borated water leakage, indoor air, and outdoor air environments.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-71	Masonry walls: all	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Chapter XI.S5, “Masonry Walls"	No	Consistent with NUREG-1801. The Masonry Walls (B.2.1.33) program will be used to manage loss of material (spalling, scaling) and cracking of masonry walls exposed to an outdoor air environment.
3.5.1-72	Seals; gasket; moisture barriers (caulking, flashing, and other sealants)	Loss of sealing due to deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	Chapter XI.S6, “Structures Monitoring”	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage loss of sealing of elastomeric seals, gaskets moisture barriers, flood barriers, and roofing exposed to various environments. The ASME Section XI, Subsection IWL (B.2.1.30) program has been substituted and will be used to manage loss of sealing of elastomeric gaskets for the containment tendon grease caps at the tendon anchorages exposed to indoor air and outdoor air environments.
3.5.1-73	Service Level I coatings	Loss of coating integrity due to blistering, cracking, flaking, peeling, physical damage	Chapter XI.S8, "Protective Coating Monitoring and Maintenance"	No	Consistent with NUREG-1801. The Protective Coating Monitoring and Maintenance Program (B.2.1.36) will be used to manage loss of coating integrity of the Containment Structure internal Service Level 1 coatings exposed to air with borated water leakage.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-74	Sliding support bearings; sliding support surfaces	Loss of mechanical function due to corrosion, distortion, dirt, debris, overload, wear	Chapter XI.S6, “Structures Monitoring”	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage loss of mechanical function of Lubrite sliding support surfaces exposed to indoor air and air with borated water leakage environments.
3.5.1-75	Sliding surfaces	Loss of mechanical function due to corrosion, distortion, dirt, debris, overload, wear	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No	Consistent with NUREG-1801 with exceptions. The ASME Section XI, Subsection IWF (B.2.1.31) program will be used to manage loss of mechanical function of graphitic tool steel and Lubrite ASME Class 1, 2, and 3 sliding surfaces exposed to air with borated water leakage environments. Exceptions apply to the NUREG-1801 recommendations for ASME Section XI, Subsection IWF (B.2.1.31) implementation.
3.5.1-76	Sliding surfaces: radial beam seats in BWR drywell	Loss of mechanical function due to corrosion, distortion, dirt, overload, wear	Chapter XI.S6, “Structures Monitoring"	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage loss of mechanical function of the Lubrite sliding surfaces used to support the Containment Structure floor beams exposed to an air with borated water leakage environment.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-77	Steel components: all structural steel	Loss of material due to corrosion	Chapter XI.S6, “Structures Monitoring” If protective coatings are relied upon to manage the effects of aging, the structures monitoring program is to include provisions to address protective coating monitoring and maintenance.	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage loss of material of steel and galvanized steel miscellaneous structural steel components exposed to indoor air, air with borated water leakage, condensation, and outdoor air environments. Protective coatings are not relied upon to manage the effects of aging of miscellaneous structural steel components at BBS.
3.5.1-78	Steel components: fuel pool liner	Cracking due to stress corrosion cracking; Loss of material due to pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," and Monitoring of the spent fuel pool water level in accordance with technical specifications and leakage from the leak chase channels.	No, unless leakages have been detected through the SFP liner that cannot be accounted for from the leak chase channels	Consistent with NUREG-1801. The Water Chemistry (B.2.1.2) program will be used to manage loss of material of the stainless steel fuel transfer tube, spent fuel pool liner, and refueling cavity liner. The spent fuel pool water level is monitored in accordance with Technical Specifications. Monitoring of leak chase channels is performed as part of the Structures Monitoring (B.2.1.34) program. Cracking is not an expected aging effect since the normal spent fuel pool and refueling cavity temperatures are less than 140˚F. However, the above programs and actions will adequately manage cracking as a potential aging effect.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-79	Steel components: piles	Loss of material due to corrosion	Chapter XI.S6, “Structures Monitoring”	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage loss of material of steel and galvanized steel components exposed to a groundwater and soil environment.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-80	Structural bolting	Loss of material due to general, pitting and crevice corrosion	Chapter XI.S6, “Structures Monitoring”	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage loss of material of steel structural bolting and supports exposed to indoor air and air with borated water leakage environments. Structural bolting components in the Cranes and Hoists System and Fuel Handling & Fuel Storage System have been aligned to this item number based on material, environment, and aging effect. The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13) program has been substituted and will be used to manage loss of material of steel structural bolting for cranes and hoists exposed to indoor air and air with borated water leakage environments in the Cranes and Hoists System and Fuel Handing & Fuel Storage System. The ASME Section XI, Subsection IWL (B.2.1.30) program has been substituted and will be used to manage loss of material of the tendon grease cap steel structural bolting exposed to an indoor air environment.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-81	Structural bolting	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No	Consistent with NUREG-1801 with exceptions. The ASME Section XI, Subsection IWF (B.2.1.31) program will be used to manage loss of material of steel structural bolting for ASME Class 1, 2, and 3 supports exposed to indoor air and air with borated water leakage environments. Exceptions apply to the NUREG-1801 recommendations for ASME Section XI, Subsection IWF (B.2.1.31) implementation.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-82	Structural bolting	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S6, “Structures Monitoring”	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage loss of material of steel and galvanized steel structural bolting and galvanized steel miscellaneous structural components exposed to an outdoor air environment. Structural bolting components in the Cranes and Hoists System have been aligned to this item number based on material, environment, and aging effect. The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13) program has been substituted and will be used to manage loss of material of steel structural bolting for cranes and hoists exposed to an outdoor air environment. The ASME Section XI, Subsection IWL (B.2.1.30) program has been substituted and will be used to manage loss of material of the tendon grease cap steel structural bolting exposed to an outdoor air environment.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-83	Structural bolting	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	Consistent with NUREG-1801. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program will be used to manage loss of material of steel and galvanized steel structural bolting and miscellaneous structural components associated with Group 6 structures in outdoor air and raw water environments.
3.5.1-84	Structural bolting	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” and Chapter XI.S3, “ASME Section XI, Subsection IWF”	No	Consistent with NUREG-1801 with exceptions. The Water Chemistry (B.2.1.2) program and ASME Section XI, Subsection IWF (B.2.1.31) program will be used to manage loss of material of stainless steel structural bolting and supports for ASME Class MC supports exposed to treated borated water. Exceptions apply to the NUREG-1801 recommendations for ASME Section XI, Subsection IWF (B.2.1.31) implementation.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-85	Structural bolting	Loss of material due to pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for BWR water, and Chapter XI.S3, "ASME Section XI, Subsection IWF"	No	Consistent with NUREG-1801 with exceptions. The ASME Section XI, Subsection IWF (B.2.1.31) program and the Water Chemistry (B.2.1.2) program will be used to manage loss of material of stainless steel structural bolting and supports for ASME Class 2 and 3 piping and components exposed to treated borated water. Exceptions apply to the NUREG-1801 recommendations for ASME Section XI, Subsection IWF (B.2.1.31) implementation.
3.5.1-86	Structural bolting	Loss of material due to pitting and crevice corrosion	Chapter XI.S3, "ASME Section XI, Subsection IWF"	No	Consistent with NUREG-1801 with exceptions. The ASME Section XI, Subsection IWF (B.2.1.31) program will be used to manage loss of material of galvanized steel structural bolting and supports used for ASME Class 2 and 3 piping and component supports exposed to an outdoor air environment. Exceptions apply to the NUREG-1801 recommendations for ASME Section XI, Subsection IWF (B.2.1.31) implementation.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-87	Structural bolting	Loss of preload due to self-loosening	Chapter XI.S3, "ASME Section XI, Subsection IWF"	No	Consistent with NUREG-1801 with exceptions. The ASME Section XI, Subsection IWF (B.2.1.31) program will be used to manage loss of preload of steel, galvanized steel, and stainless steel structural bolting used for ASME Class 1, 2, 3 and MC piping and components supports exposed to any environment. Exceptions apply to the NUREG-1801 recommendations for ASME Section XI, Subsection IWF (B.2.1.31) implementation.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-88	Structural bolting	Loss of preload due to self-loosening	Chapter XI.S6, "Structures Monitoring"	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage loss of preload of the aluminum, steel, galvanized steel, and stainless steel structural bolting in any environment. In order to manage the loss of preload, steel and stainless steel structural bolting exposed to any environment in the Cranes and Hoists System and Fuel Handling & Fuel Storage System have been aligned to this item number. The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13) program has been substituted and will be used to manage loss of preload of steel bolting exposed to any environment through visual inspection techniques. The Structures Monitoring (B.2.1.34) program supplements the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13) program with applicable preventive measures to ensure structural bolting integrity. The ASME Section XI, Subsection IWL (B.2.1.30) program has been substituted and will be used to manage loss of preload of the tendon grease cap steel structural bolting exposed to indoor and outdoor air environments.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-89	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	No	Consistent with NUREG-1801. The Boric Acid Corrosion (B.2.1.4) program will be used to manage loss of material due to boric acid corrosion of aluminum, steel, and galvanized steel miscellaneous structural components, support members, welds, bolted connections, and support anchorage to building structure for piping and component supports exposed to an air with borated water leakage environment.
3.5.1-90	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to general (steel only), pitting, and crevice corrosion	Chapter XI.M2, "Water Chemistry," for BWR water, and Chapter XI.S3, "ASME Section XI, Subsection IWF"	No	Not Applicable. There are no support members, welds, bolted connections, or support anchorage to building structure for Class 1 piping and component supports exposed to treated water at BBS. The Class 1 piping and component supports are only located inside the Containment Structures and are not exposed to a treated borated water environment at BBS. Class 2 and 3 piping and component supports exposed to treated borated water have been aligned to Item Number 3.5.1-85. Class MC supports exposed to treated borated water have been aligned to Item Number 3.5.1-84.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-91	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to general and pitting corrosion	Chapter XI.S3, “ASME Section XI, Subsection IWF”	No	Consistent with NUREG-1801 with exceptions. The ASME Section XI, Subsection IWF (B.2.1.31) program will be used to manage loss of material of steel support members, welds, bolted connections, and support anchorage to building structure for ASME Class 1, 2 and 3 piping and component supports exposed to air with borated water leakage and indoor air environments. Exceptions apply to the NUREG-1801 recommendations for ASME Section XI, Subsection IWF (B.2.1.31) implementation.
3.5.1-92	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to general and pitting corrosion	Chapter XI.S6, “Structures Monitoring”	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage loss of material of steel and galvanized steel miscellaneous structural components including doors, penetration sleeves, enclosures, as well as support members, welds, bolted connections, and support anchorage to building structures exposed to indoor air, air with borated water leakage, and outdoor air environments.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.5.1-93	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring"	No	Consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program will be used to manage loss of material of aluminum, galvanized steel, and stainless steel miscellaneous structural components including doors, conduit, enclosures, and structural commodity components, as well as support members, welds, bolted connections, and support anchorages to building structures for non-ASME piping and component supports exposed to an outdoor air environment.
3.5.1-94	Vibration isolation elements	Reduction or loss of isolation function due to radiation hardening, temperature, humidity, sustained vibratory loading	Chapter XI.S3, "ASME Section XI, Subsection IWF"	No	Not consistent with NUREG-1801. The Structures Monitoring (B.2.1.34) program has been substituted and will be used to manage the reduction or loss of isolation function of elastomeric vibration isolation elements associated with non-ASME supports, primarily HVAC equipment, exposed to an indoor air environment. BBS do not have vibration element components in Class 1, 2, or Class 3 non-exempt supports.

Table 3.5.1 Summary of Aging Management Evaluations for the Structures and Component Supports					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.5.1-95	Aluminum, galvanized steel and stainless steel Support members; welds; bolted connections; support anchorage to building structure exposed to Air – indoor, uncontrolled	None	None	NA - No AEM or AMP	Consistent with NUREG-1801. BBS aging management review concluded that aluminum, galvanized, and stainless steel components exposed to indoor air environments have no applicable aging effects requiring management. For aluminum and galvanized steel components exposed to an indoor air with borated water leakage environment, loss of material due to boric acid corrosion is addressed by Item Number 3.5.1-89. Stainless steel components exposed to air with borated water leakage have no applicable aging effects requiring management.

Table 3.5.2-1
Auxiliary Building
Summary of Aging Management Evaluation

Table 3.5.2-1 **Auxiliary Building**

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.A3.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
		Galvanized Steel Bolting	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
		Stainless Steel Bolting	Air with Borated Water Leakage	Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.A3.TP-248	3.5.1-80	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
Concrete Curbs	Direct Flow	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
Concrete Embedments	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Concrete: Above-grade exterior (accessible areas)	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (accessible areas)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Structural Pressure Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
Concrete: Above-grade exterior (inaccessible areas)	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 1
	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 1
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 1
	Structural Pressure Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 1

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (inaccessible areas)	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 1
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Missile Barrier	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Structural Pressure Barrier	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
Concrete: Interior	Flood Barrier	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
	HELB Shielding	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
	Missile Barrier	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
	Shelter, Protection	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air with Borated Water Leakage	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
	Shielding	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
	Structural Pressure Barrier	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
	Structural Support	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
	Water retaining boundary	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-24	3.5.1-63	C

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Encapsulation Components/Valve Chambers	Structural Pressure Barrier	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A, 2
					Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.EP-43	3.2.1-47	A, 2
		Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A, 2
		Stainless Steel	Air with Borated Water Leakage	None	None	V.F.EP-19	3.2.1-63	A, 3
Encapsulation Components/Valve Chambers (Bellows)	Structural Pressure Barrier	Stainless Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
Hatches/Plugs	Flood Barrier	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
	Missile Barrier	Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Hatches/Plugs	Missile Barrier	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
	Shielding	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Hatches/Plugs	Shielding	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
Masonry walls: Interior	Missile Barrier	Concrete Block	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A, 5
	Shelter, Protection	Concrete Block	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A, 5
	Shielding	Concrete Block	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A, 5
	Structural Support	Concrete Block	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A, 5
Metal components: All structural members	Shelter, Protection	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
	Structural Support	Aluminum	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
		Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Metal components: All structural members	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
Metal decking	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
Offgas Stack and Flue	Gaseous Release Path	Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Spray Shields	Shelter, Protection	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Steel Components	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Galvanized Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steel Components (Atmospheric vent with screen)	Direct Flow	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A, 6
					Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.E-29	3.2.1-44	A, 6
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A, 6
	Flood Barrier	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A, 6
					Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.E-29	3.2.1-44	A, 6
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A, 6
	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	External Surfaces Monitoring of Mechanical Components (B.2.1.23)	V.E.E-44	3.2.1-40	A, 6
					Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25)	V.A.E-29	3.2.1-44	A, 6
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A, 6
Steel components: Sump screen and trench cover	Shelter, Protection	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C

Table 3.5.2-1 Auxiliary Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steel components: Sump screen and trench cover	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
Steel elements: liner, liner anchors, integral attachments (accessible areas)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
	Water retaining boundary	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Waste Water	Loss of Material	Structures Monitoring (B.2.1.34)			G, 7
Steel elements: liner, liner anchors, integral attachments (inaccessible areas)	Structural Support	Carbon Steel	Concrete	None	None	VII.J.AP-282	3.3.1-112	C
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Waste Water	Loss of Material	Structures Monitoring (B.2.1.34)			G, 7
	Water retaining boundary	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Waste Water	Loss of Material	Structures Monitoring (B.2.1.34)			G, 7

Table 3.5.2-1 Auxiliary Building (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

2. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) program and External Surfaces Monitoring of Mechanical Components (B.2.1.23) program are used to manage the aging effect(s) applicable to this component type, material, and environment combination for the valve chambers around the RHR containment isolation valves.

3. No aging effect is postulated for the stainless steel portion of the valve chambers around the RHR containment isolation valves, for this component type, material, and environment combination.

4. The TLAA designation in the Aging Management Program columns indicates fatigue of this component is evaluated in Section 4.6.

5. The Structures Monitoring (B.2.1.34) program was evaluated and determined to contain the 10 attributes associated with the Masonry Walls (B.2.1.33) Program. Therefore, the Structures Monitoring (B.2.1.34) program will be used to implement the Masonry Walls (B.2.1.33) program.

6. The atmospheric vents for the fuel oil tank rooms and air intake for the diesel driven auxiliary feedwater pumps extend inside the turbine building.

Table 3.5.2-1 **Auxiliary Building** **(Continued)**

Plant Specific Notes: (continued)

7. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination for the plates lining the sumps exposed to waste water.

Table 3.5.2-2
Circulating Water Pump House (Byron)
Summary of Aging Management Evaluation

Table 3.5.2-2 Circulating Water Pump House (Byron)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
		Galvanized Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
		Galvanized Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A

Table 3.5.2-2 Circulating Water Pump House (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete Embedments	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Raw Water	Loss of Material	Structures Monitoring (B.2.1.34)			F, 1
Concrete: Above-grade exterior (accessible areas)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
Concrete: Below-grade exterior (inaccessible areas)	Direct Flow	Reinforced concrete	Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)			H, 2
				Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 3
				Loss of Material	Structures Monitoring (B.2.1.34)	III.A6.T-20	3.5.1-56	E, 4
	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A

Table 3.5.2-2 Circulating Water Pump House (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 5
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)			H, 2
				Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 3
				Loss of Material	Structures Monitoring (B.2.1.34)	III.A6.T-20	3.5.1-56	E, 4
	Water retaining boundary	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)			H, 2
				Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 3

Table 3.5.2-2 Circulating Water Pump House (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Water retaining boundary	Reinforced concrete	Water - Flowing	Loss of Material	Structures Monitoring (B.2.1.34)	III.A6.T-20	3.5.1-56	E, 4
Concrete: Foundation, subfoundation (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 5
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 5
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A

Table 3.5.2-2 Circulating Water Pump House (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Interior	Structural Support	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
Hatches/Plugs	Shelter, Protection	Aluminum	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
Masonry walls: Interior	Shelter, Protection	Concrete Block	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A, 6
	Structural Support	Concrete Block	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A, 6
Metal decking	Structural Support	Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
Precast Panel	Shelter, Protection	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Structural Support	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A

Table 3.5.2-2 Circulating Water Pump House (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steel Components	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Steel Components (Anti-vortex components)	Direct Flow	Stainless Steel	Raw Water	Loss of Material	Structures Monitoring (B.2.1.34)			F, 1
Steel Components (Trash Rack Bars)	Filter	Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Raw Water	Loss of Material	Structures Monitoring (B.2.1.34)			G, 1

Table 3.5.2-2 Circulating Water Pump House (Byron) (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) of loss of material for steel components in a raw water environment.

2. The reinforced concrete walls of the Circulating Water Pump House pump bays and flume in a water flowing environment are also susceptible to cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded or reinforcing steel. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

3. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination for the Circulating Water Pump House pump bay walls and flume.

4. The Structures Monitoring (B.2.1.34) program is substituted to manage the aging effect(s) applicable to this component type, material, and environment combination.

5. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination due to groundwater intrusion.

Table 3.5.2-2 Circulating Water Pump House (Byron) (Continued)

Plant Specific Notes: (continued)

6. The Structures Monitoring (B.2.1.34) program was evaluated and determined to contain the 10 attributes associated with the Masonry Walls (B.2.1.33) program, therefore the Structures Monitoring (B.2.1.34) program will be used to implement the Masonry Walls (B.2.1.33) program.

Table 3.5.2-3
Component Supports Commodity Group
Summary of Aging Management Evaluation

Table 3.5.2-3 **Component Supports Commodity Group**

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for ASME Class 1 piping and components (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Grout	Air with Borated Water Leakage	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B1.1.TP-42	3.5.1-55	A
		Reinforced concrete	Air with Borated Water Leakage	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B1.1.TP-42	3.5.1-55	A
Supports for ASME Class 1 piping and components (Constant and variable load spring hangers; guides; stops)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	A
					ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.1.T-24	3.5.1-91	B
				Loss of Mechanical Function	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.1.T-28	3.5.1-57	B
Supports for ASME Class 1 piping and components (High-strength bolting for NSSS component supports)	Structural Support	High Strength Low Alloy Steel Bolting with Yield Strength of 150 ksi or Greater	Air with Borated Water Leakage	Cracking	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.1.TP-41	3.5.1-68	B

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for ASME Class 1 piping and components (High-strength bolting for NSSS component supports)	Structural Support	High Strength Low Alloy Steel Bolting with Yield Strength of 150 ksi or Greater	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	A
					ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.1.T-24	3.5.1-91	B
Supports for ASME Class 1 piping and components (Sliding Surfaces – NSSS component supports)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.1.T-24	3.5.1-91	D
				Loss of Mechanical Function	ASME Section XI, Subsection IWF (B.2.1.31)			F, 1
		Graphitic Tool Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	A
				Loss of Mechanical Function	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.1.TP-45	3.5.1-75	B
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	III.B1.1.T-26	3.5.1-53	A, 2
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	A
					ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.1.T-24	3.5.1-91	B

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for ASME Class 1 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	A
					ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.1.TP-226	3.5.1-81	B
				Loss of Preload	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.1.TP-229	3.5.1-87	B
		Galvanized Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.TP-3	3.5.1-89	A
		Galvanized Steel Bolting	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.TP-3	3.5.1-89	A
				Loss of Preload	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.1.TP-229	3.5.1-87	B
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.1.TP-4	3.5.1-95	A
		Stainless Steel Bolting	Air with Borated Water Leakage	Loss of Preload	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.1.TP-229	3.5.1-87	B
Supports for ASME Class 2 and 3 piping and components (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Grout	Air - Indoor Uncontrolled	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B1.2.TP-42	3.5.1-55	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for ASME Class 2 and 3 piping and components (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Grout	Air - Outdoor	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B1.2.TP-42	3.5.1-55	A
			Air with Borated Water Leakage	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B1.2.TP-42	3.5.1-55	A
		Reinforced concrete	Air - Indoor Uncontrolled	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B1.2.TP-42	3.5.1-55	A
			Air - Outdoor	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B1.2.TP-42	3.5.1-55	A
			Air with Borated Water Leakage	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B1.2.TP-42	3.5.1-55	A
Supports for ASME Class 2 and 3 piping and components (Constant and variable load spring hangers; guides; stops)	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.T-24	3.5.1-91	B
				Loss of Mechanical Function	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.T-28	3.5.1-57	B
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.2.T-25	3.5.1-89	A
					ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.T-24	3.5.1-91	B
				Loss of Mechanical Function	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.T-28	3.5.1-57	B

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for ASME Class 2 and 3 piping and components (Sliding surfaces)	Structural Support	Lubrite	Air with Borated Water Leakage	Loss of Mechanical Function	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-45	3.5.1-75	B
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.T-24	3.5.1-91	B
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.2.T-25	3.5.1-89	A
					ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.T-24	3.5.1-91	B
			Raw Water (Byron Only)	Loss of Material	ASME Section XI, Subsection IWF (B.2.1.31)	VII.C1.AP-183	3.3.1-38	E, 3
		Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-226	3.5.1-81	B
				Loss of Preload	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-229	3.5.1-87	B
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.2.T-25	3.5.1-89	A
					ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-226	3.5.1-81	B
				Loss of Preload	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-229	3.5.1-87	B
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B1.1.TP-8	3.5.1-95	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-235	3.5.1-86	D
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1-2.TP-3	3.5.1-89	A
		Galvanized Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-229	3.5.1-87	B
			Air - Outdoor	Loss of Material	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-235	3.5.1-86	B
				Loss of Preload	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-229	3.5.1-87	B
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1-2.TP-3	3.5.1-89	A
				Loss of Preload	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-229	3.5.1-87	B
		Stainless Steel	Air - Indoor Uncontrolled	None	None	III.B1.2.TP-8	3.5.1-95	A
			Air with Borated Water Leakage	None	None	III.B1.2.TP-4	3.5.1-95	A
			Treated Borated Water	Loss of Material	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-232	3.5.1-85	D
					Water Chemistry (B.2.1.2)	III.B1.2.TP-232	3.5.1-85	C
		Stainless Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-229	3.5.1-87	B
			Air with Borated Water Leakage	Loss of Preload	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-229	3.5.1-87	B

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for ASME Class 2 and 3 piping and components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel Bolting	Treated Borated Water	Loss of Material	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-232	3.5.1-85	B
					Water Chemistry (B.2.1.2)	III.B1.2.TP-232	3.5.1-85	A
				Loss of Preload	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.2.TP-229	3.5.1-87	B
Supports for ASME Class MC components (Sliding Surfaces)	Structural Support	Stainless Steel	Treated Borated Water	Loss of Material	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.3.TP-232	3.5.1-84	D
					Water Chemistry (B.2.1.2)	III.B1.3.TP-232	3.5.1-84	C
				Loss of Mechanical Function	ASME Section XI, Subsection IWF (B.2.1.31)			F, 1
		Stainless Steel Bolting	Treated Borated Water	Loss of Material	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.3.TP-232	3.5.1-84	B
					Water Chemistry (B.2.1.2)	III.B1.3.TP-232	3.5.1-84	A
				Loss of Preload	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.3.TP-229	3.5.1-87	B
Supports for ASME Class MC components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.3.TP-4	3.5.1-95	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for ASME Class MC components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Stainless Steel	Treated Borated Water	Loss of Material	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.3.TP-232	3.5.1-84	D
					Water Chemistry (B.2.1.2)	III.B1.3.TP-232	3.5.1-84	C
		Stainless Steel Bolting	Air with Borated Water Leakage	Loss of Preload	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.3.TP-229	3.5.1-87	B
			Treated Borated Water	Loss of Material	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.3.TP-232	3.5.1-84	B
					Water Chemistry (B.2.1.2)	III.B1.3.TP-232	3.5.1-84	A
				Loss of Preload	ASME Section XI, Subsection IWF (B.2.1.31)	III.B1.3.TP-229	3.5.1-87	B
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-43	3.5.1-92	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B2.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.B2.TP-43	3.5.1-92	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B2.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B2.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.B2.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B2.TP-261	3.5.1-88	A
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B2.TP-8	3.5.1-95	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B2.TP-3	3.5.1-89	A
		Galvanized Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B2.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B2.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B2.TP-3	3.5.1-89	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air with Borated Water Leakage	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B2.TP-261	3.5.1-88	A
		Stainless Steel	Air - Indoor Uncontrolled	None	None	III.B2.TP-8	3.5.1-95	A
			Air with Borated Water Leakage	None	None	III.B2.TP-4	3.5.1-95	A
		Stainless Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B2.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B2.TP-261	3.5.1-88	A
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Grout	Air - Indoor Uncontrolled	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B2.TP-42	3.5.1-55	A
			Air - Outdoor	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B2.TP-42	3.5.1-55	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Grout	Air with Borated Water Leakage	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B2.TP-42	3.5.1-55	A
		Reinforced concrete	Air - Indoor Uncontrolled	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B2.TP-42	3.5.1-55	A
			Air - Outdoor	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B2.TP-42	3.5.1-55	A
			Air with Borated Water Leakage	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B2.TP-42	3.5.1-55	A
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Sliding support bearings; sliding support surfaces)	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B4.TP-43	3.5.1-92	C
				Loss of Mechanical Function	Structures Monitoring (B.2.1.34)			F, 4
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B4.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.B4.TP-43	3.5.1-92	C

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for Cable Trays, Conduit, HVAC Ducts, Tube Track, Instrument Tubing, Non-ASME Piping and Components (Sliding support bearings; sliding support surfaces)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Mechanical Function	Structures Monitoring (B.2.1.34)			F, 4
		Lubrite	Air - Indoor Uncontrolled	Loss of Mechanical Function	Structures Monitoring (B.2.1.34)	III.B4.TP-46	3.5.1-74	A
			Air with Borated Water Leakage	Loss of Mechanical Function	Structures Monitoring (B.2.1.34)	III.B4.TP-46	3.5.1-74	A
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc. Mechanical Equipment (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Grout	Air - Indoor Uncontrolled	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B4.TP-42	3.5.1-55	A
			Air - Outdoor	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B4.TP-42	3.5.1-55	A
			Air with Borated Water Leakage	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B4.TP-42	3.5.1-55	A
		Reinforced concrete	Air - Indoor Uncontrolled	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B4.TP-42	3.5.1-55	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc. Mechanical Equipment (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Reinforced concrete	Air - Outdoor	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B4.TP-42	3.5.1-55	A
			Air with Borated Water Leakage	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B4.TP-42	3.5.1-55	A
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc. Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B4.TP-43	3.5.1-92	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B4.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.B4.TP-43	3.5.1-92	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc. Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B4.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B4.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B4.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.B4.TP-43	3.5.1-92	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B4.TP-261	3.5.1-88	A
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B4.TP-8	3.5.1-95	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B4.TP-6	3.5.1-93	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B4.TP-3	3.5.1-89	A
		Galvanized Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B4.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B4.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B4.TP-261	3.5.1-88	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc. Mechanical Equipment (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B4.TP-3	3.5.1-89	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B4.TP-261	3.5.1-88	A
		Stainless Steel	Air - Indoor Uncontrolled	None	None	III.B4.TP-8	3.5.1-95	A
			Air with Borated Water Leakage	None	None	III.B4.TP-4	3.5.1-95	A
			Raw Water (Byron Only)	Loss of Material	Structures Monitoring (B.2.1.34)	VII.C1.A-54	3.3.1-40	E, 5
		Stainless Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B4.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B4.TP-261	3.5.1-88	A
			Raw Water (Byron Only)	Loss of Preload	Structures Monitoring (B.2.1.34)	VII.I.AP-264	3.3.1-15	E, 5

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for Emergency Diesel Generator, HVAC System Components, and Other Misc. Mechanical Equipment (Vibration isolation elements)	Vibration Isolation	Elastomer	Air - Indoor Uncontrolled	Reduction or Loss of Isolation Function	Structures Monitoring (B.2.1.34)	III.B4.TP-44	3.5.1-94	E, 6
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc. Structures (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Grout	Air - Indoor Uncontrolled	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B5.TP-42	3.5.1-55	A
			Air - Outdoor	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B5.TP-42	3.5.1-55	A
			Air with Borated Water Leakage	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B5.TP-42	3.5.1-55	A
		Reinforced concrete	Air - Indoor Uncontrolled	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B5.TP-42	3.5.1-55	A
			Air - Outdoor	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B5.TP-42	3.5.1-55	A
			Air with Borated Water Leakage	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B5.TP-42	3.5.1-55	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc. Structures (Support members; welds; bolted connections; support anchorage to building structure)	Pipe Whip Restraint	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	A
		Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.B5.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	A
	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc. Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	A
		Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.B5.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B4.TP-6	3.5.1-93	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	A
		Galvanized Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-274	3.5.1-82	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for Platforms, Pipe Whip Restraints, Jet Impingement Shields, Masonry Walls, and Other Misc. Structures (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
		Stainless Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	A
			Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	A
		Stainless Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Building concrete at location of expansion and grouted anchors; grout pads for support base plates)	Structural Support	Grout	Air - Indoor Uncontrolled	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B3.TP-42	3.5.1-55	A
			Air - Outdoor	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B3.TP-42	3.5.1-55	A
			Air with Borated Water Leakage	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B3.TP-42	3.5.1-55	A
		Reinforced concrete	Air - Indoor Uncontrolled	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B3.TP-42	3.5.1-55	A
			Air - Outdoor	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B3.TP-42	3.5.1-55	A
			Air with Borated Water Leakage	Reduction in Concrete Anchor Capacity	Structures Monitoring (B.2.1.34)	III.B3.TP-42	3.5.1-55	A
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B3.TP-43	3.5.1-92	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B3.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.B3.TP-43	3.5.1-92	A
		Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B3.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B3.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B3.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.B3.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B3.TP-261	3.5.1-88	A
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B3.TP-8	3.5.1-95	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B4.TP-6	3.5.1-93	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B3.TP-3	3.5.1-89	A
		Galvanized Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B3.TP-261	3.5.1-88	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Supports for Racks, Panels, Cabinets, and Enclosures for Electrical Equipment and Instrumentation (Support members; welds; bolted connections; support anchorage to building structure)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B3.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B3.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B3.TP-3	3.5.1-89	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B3.TP-261	3.5.1-88	A
		Stainless Steel	Air - Indoor Uncontrolled	None	None	III.B3.TP-8	3.5.1-95	A
			Air with Borated Water Leakage	None	None	III.B3.TP-4	3.5.1-95	A
		Stainless Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B3.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B3.TP-261	3.5.1-88	A

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The aging effects for carbon and stainless steel sliding surfaces in air with borated water leakage and treated borated water environments include loss of mechanical function due to corrosion, distortion, dirt, debris, overload, wear. The ASME Section XI, Subsection IWF (B.2.1.31) program is used to manage the identified aging effect(s) applicable to these component types, materials, and environment combinations.

2. The TLAA designation in the Aging Management Program column indicates that cumulative fatigue damage for this component is evaluated in Section 4.3.

3. The ASME Section XI, Subsection IWF (B.2.1.31) program is substituted to manage the aging effect(s) applicable to this component type, material, and environment combination.

4. The aging effects for carbon steel sliding surfaces in air-indoor and air with borated water leakage environments include loss of mechanical function due to corrosion, distortion, dirt, debris, overload, wear. The Structures Monitoring (B.2.1.34) program is used to manage the identified aging effect(s) applicable to these component types, materials, and environment combinations.

5. The Structures Monitoring (B.2.1.34) program is substituted to manage the aging effect(s) applicable to this component type, material, and environment combination.

Table 3.5.2-3 Component Supports Commodity Group (Continued)

Plant Specific Notes: (continued)

6. The aging mechanisms for this component type includes wear, which results in an aging effect of, "Reduction or Loss of Isolation function". The Structures Monitoring (B.2.1.34) program is substituted to manage the aging effect(s) applicable to this component type, material, and environment combination.

Table 3.5.2-4
Containment Structure
Summary of Aging Management Evaluation

Table 3.5.2-4 Containment Structure

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Containment Closure)	Pressure Boundary	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-148	3.5.1-31	A
				Loss of Preload	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-150	3.5.1-30	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-150	3.5.1-30	A
		Stainless Steel Bolting	Air with Borated Water Leakage	Loss of Preload	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-150	3.5.1-30	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-150	3.5.1-30	A
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A4.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A4.TP-261	3.5.1-88	A
		Galvanized Steel Bolting	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A4.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A4.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.TP-3	3.5.1-89	C

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air with Borated Water Leakage	Loss of Preload	Structures Monitoring (B.2.1.34)	III.A4.TP-261	3.5.1-88	A
		Stainless Steel Bolting	Air with Borated Water Leakage	Loss of Preload	Structures Monitoring (B.2.1.34)	III.A4.TP-261	3.5.1-88	A
			Treated Borated Water	Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 1
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A4.TP-261	3.5.1-88	A
Coatings (Service Level 1- Containment Boundary)	Maintain Adhesion	Coatings	Air with Borated Water Leakage	Loss of Coating Integrity	Protective Coating Monitoring and Maintenance Program (B.2.1.36)	II.A3.CP-152	3.5.1-34	A
Coatings (Service Level 1- Containment Internal Structures)	Maintain Adhesion	Coatings	Air with Borated Water Leakage	Loss of Coating Integrity	Protective Coating Monitoring and Maintenance Program (B.2.1.36)	III.A4.TP-301	3.5.1-73	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.A4.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A4.TP-261	3.5.1-88	A
Concrete Curbs	Direct Flow	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-28	3.5.1-67	A
Concrete Embedments	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.A4.TP-302	3.5.1-77	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (accessible areas of exterior features)	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Shielding	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
Concrete: Above-grade exterior (inaccessible areas of exterior features)	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (inaccessible areas of exterior features)	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2
	Shielding	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2
Concrete: Below-grade exterior (inaccessible areas of exterior features)	Flood Barrier	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	II.A1.CP-102	3.5.1-14	E, 2

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas of exterior features)	Missile Barrier	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	II.A1.CP-102	3.5.1-14	E, 2
	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	II.A1.CP-102	3.5.1-14	E, 2
	Shielding	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas of exterior features)	Shielding	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	II.A1.CP-102	3.5.1-14	E, 2
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	II.A1.CP-102	3.5.1-14	E, 2
Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel (accessible areas)	Flood Barrier	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
				Loss of Material (Spalling, Scaling) and Cracking	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-31	3.5.1-18	A
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-87	3.5.1-17	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel (accessible areas)	Flood Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-32	3.5.1-20	A
	HELB Shielding	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
				Loss of Material (Spalling, Scaling) and Cracking	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-31	3.5.1-18	A
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-87	3.5.1-17	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-32	3.5.1-20	A
	Missile Barrier	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
				Loss of Material (Spalling, Scaling) and Cracking	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-31	3.5.1-18	A
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel (accessible areas)	Missile Barrier	Reinforced concrete	Air with Borated Water Leakage	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-87	3.5.1-17	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-32	3.5.1-20	A
	Pressure Boundary	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
				Loss of Material (Spalling, Scaling) and Cracking	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-31	3.5.1-18	A
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-87	3.5.1-17	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-32	3.5.1-20	A
	Shelter, Protection	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
				Loss of Material (Spalling, Scaling) and Cracking	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-31	3.5.1-18	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel (accessible areas)	Shelter, Protection	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-87	3.5.1-17	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-32	3.5.1-20	A
	Shielding	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
				Loss of Material (Spalling, Scaling) and Cracking	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-31	3.5.1-18	A
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-87	3.5.1-17	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-32	3.5.1-20	A
	Structural Support	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel (accessible areas)	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
				Loss of Material (Spalling, Scaling) and Cracking	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-31	3.5.1-18	A
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-68	3.5.1-21	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-87	3.5.1-17	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-32	3.5.1-20	A
Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel (inaccessible areas)	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-97	3.5.1-25	A
				Loss of Material (Spalling, Scaling) and Cracking	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-147	3.5.1-11	E, 3
			Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel (inaccessible areas)	Flood Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-102	3.5.1-14	E, 3
	HELB Shielding	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-97	3.5.1-25	A
				Loss of Material (Spalling, Scaling) and Cracking	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-147	3.5.1-11	E, 3
			Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-102	3.5.1-14	E, 3
	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-97	3.5.1-25	A
				Loss of Material (Spalling, Scaling) and Cracking	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-147	3.5.1-11	E, 3
			Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel (inaccessible areas)	Missile Barrier	Reinforced concrete	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-102	3.5.1-14	E, 3
	Pressure Boundary	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-97	3.5.1-25	A
				Loss of Material (Spalling, Scaling) and Cracking	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-147	3.5.1-11	E, 3
			Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-102	3.5.1-14	E, 3
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-97	3.5.1-25	A
				Loss of Material (Spalling, Scaling) and Cracking	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-147	3.5.1-11	E, 3
			Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-102	3.5.1-14	E, 3
	Shielding	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-97	3.5.1-25	A
				Loss of Material (Spalling, Scaling) and Cracking	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-147	3.5.1-11	E, 3
			Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-102	3.5.1-14	E, 3
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-97	3.5.1-25	A
				Loss of Material (Spalling, Scaling) and Cracking	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-147	3.5.1-11	E, 3

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.CP-102	3.5.1-14	E, 3
Concrete: Foundation, subfoundation (inaccessible areas)	Flood Barrier	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	II.A1.CP-102	3.5.1-14	E, 2
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	II.A1.CP-102	3.5.1-14	E, 2
Concrete: Interior	HELB Shielding	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-28	3.5.1-67	A
	Missile Barrier	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-28	3.5.1-67	A
	Pipe Whip Restraint	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-28	3.5.1-67	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-28	3.5.1-67	A
	Shielding	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-28	3.5.1-67	A
	Structural Support	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-28	3.5.1-67	A
Concrete: Interior (Exterior structural features)	Flood Barrier	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
	Missile Barrier	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
	Shelter, Protection	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
	Shielding	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Interior (Exterior structural features)	Structural Support	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
Concrete: Interior (Leak Chase System)	Direct Flow	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-28	3.5.1-67	A
Containment Liner (accessible)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A1.CP-35	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A1.CP-35	3.5.1-35	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A1.CP-35	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A1.CP-35	3.5.1-35	A
Containment Liner (inaccessible)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A1.CP-98	3.5.1-5	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Containment Liner (inaccessible)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage	Loss of Material	ASME Section XI, Subsection IWE (B.2.1.29)	II.A1.CP-98	3.5.1-5	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A1.CP-98	3.5.1-5	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A1.CP-98	3.5.1-5	A
Electrical and Instrumentation and Control Penetration Assemblies (Containment Boundary)	Flood Barrier	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
		Elastomer	Air with Borated Water Leakage	Loss of Sealing	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-41	3.5.1-33	A
	HELB Shielding	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Electrical and Instrumentation and Control Penetration Assemblies (Containment Boundary)	HELB Shielding	Elastomer	Air with Borated Water Leakage	Loss of Sealing	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-41	3.5.1-33	A
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
		Elastomer	Air with Borated Water Leakage	Loss of Sealing	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-41	3.5.1-33	A
	Shelter, Protection	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
		Elastomer	Air with Borated Water Leakage	Loss of Sealing	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-41	3.5.1-33	A
	Structural Support	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Electrical and Instrumentation and Control Penetration Assemblies (Containment Boundary)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
		Elastomer	Air with Borated Water Leakage	Loss of Sealing	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-41	3.5.1-33	A
Hatches/Plugs	HELB Shielding	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-28	3.5.1-67	A
	Missile Barrier	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-28	3.5.1-67	A
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.2.TP-4	3.5.1-95	C
			Treated Borated Water	Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 5
	Shelter, Protection	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A4.TP-302	3.5.1-77	A
		Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-26	3.5.1-66	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Hatches/Plugs	Shelter, Protection	Reinforced concrete	Air with Borated Water Leakage	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-28	3.5.1-67	A
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.2.TP-4	3.5.1-95	C
			Treated Borated Water	Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 5
	Shielding	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-28	3.5.1-67	A
	Water retaining boundary	Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.2.TP-4	3.5.1-95	C
			Treated Borated Water	Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 5
Masonry walls: Interior (Removable)	Shielding	Concrete Block	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A5.T-12	3.5.1-70	A, 6
Mechanical Penetrations (Containment Boundary)	Flood Barrier	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
		Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Mechanical Penetrations (Containment Boundary)	Flood Barrier	Stainless Steel	Air with Borated Water Leakage	Cracking	ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A
				Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
	HELB Shielding	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
		Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A
				Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
		Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Mechanical Penetrations (Containment Boundary)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
	Shelter, Protection	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
		Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A
				Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
	Structural Support	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
		Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A
				Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Metal components: All structural members	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.2.TP-4	3.5.1-95	C
Metal decking (Inside Containment Supporting Concrete Floors)	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.TP-3	3.5.1-89	C
Metal decking (Outside Containment in Buttress and Walkway Enclosure)	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A4.TP-302	3.5.1-77	A
		Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A4.TP-274	3.5.1-82	C
Metal panels (Buttress and Walkway Enclosures)	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A4.TP-302	3.5.1-77	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.2.TP-4	3.5.1-95	C
			Treated Borated Water	Cracking	Structures Monitoring (B.2.1.34)			F, 7
				Loss of Material	Structures Monitoring (B.2.1.34)			F, 7
Penetration Bellows (Containment Boundary)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Penetration Bellows (Containment Boundary)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.2.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
		Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A
				Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
	Shelter, Protection	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.2.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
		Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A
				Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
	Structural Support	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.2.T-25	3.5.1-89	C

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Penetration Bellows (Containment Boundary)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
		Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A
				Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
Penetration sleeves (Guard pipe for fuel transfer tube)	Pressure Boundary	Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A
				Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
			Condensation	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)			G, 8
				Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 8
			Treated Borated Water	Cracking	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 9
				Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 9
	Shelter, Protection	Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A
				Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Penetration sleeves (Guard pipe for fuel transfer tube)	Shelter, Protection	Stainless Steel	Condensation	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)			G, 8
				Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 8
			Treated Borated Water	Cracking	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 9
				Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 9
	Structural Support	Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A
				Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
			Condensation	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)			G, 8
				Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 8
			Treated Borated Water	Cracking	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 9
				Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 9
	Water retaining boundary	Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A
				Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
			Condensation	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)			G, 8
				Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 8
			Treated Borated Water	Cracking	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 9
				Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 9

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Penetration sleeves (Guard pipe for recirculation sump effluent pipe)	Pressure Boundary	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.2.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
			Condensation	Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 10
		Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A
				Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
			Condensation	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)			G, 10
				Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 10
	Shelter, Protection	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.2.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
			Condensation	Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 10

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Penetration sleeves (Guard pipe for recirculation sump effluent pipe)	Shelter, Protection	Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A
				Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
			Condensation	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)			G, 10
				Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 10
	Structural Support	Carbon Steel	Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.2.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-36	3.5.1-35	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-36	3.5.1-35	A
			Condensation	Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 10
		Stainless Steel	Air with Borated Water Leakage	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-38	3.5.1-10	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-38	3.5.1-10	A
				Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
			Condensation	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)			G, 10
				Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 10

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Penetration sleeves (Guard pipe for recirculation sump effluent pipe)	Water retaining boundary	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Condensation	Cracking	10 CFR Part 50, Appendix J (B.2.1.32)			G, 10
				Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 10
			Waste Water	Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 10
					Structures Monitoring (B.2.1.34)			G, 11
Penetration sleeves (in refueling cavity for instruments)	Shelter, Protection	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Treated Borated Water	Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 12
	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Treated Borated Water	Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 12
	Water retaining boundary	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Treated Borated Water	Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	C, 12
Personnel airlock, equipment hatch	Pressure Boundary	Carbon Steel	Air - Outdoor	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Leaktightness	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-39	3.5.1-29	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-39	3.5.1-29	A
				Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.C-16	3.5.1-28	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Personnel airlock, equipment hatch	Pressure Boundary	Carbon Steel	Air - Outdoor	Loss of Material	ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.C-16	3.5.1-28	A
			Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Leaktightness	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-39	3.5.1-29	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-39	3.5.1-29	A
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.C-16	3.5.1-28	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.C-16	3.5.1-28	A
	Shelter, Protection	Carbon Steel	Air - Outdoor	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Leaktightness	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-39	3.5.1-29	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-39	3.5.1-29	A
				Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.C-16	3.5.1-28	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.C-16	3.5.1-28	A
			Air with Borated Water Leakage	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Leaktightness	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-39	3.5.1-29	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-39	3.5.1-29	A
				Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Personnel airlock, equipment hatch	Shelter, Protection	Carbon Steel	Air with Borated Water Leakage	Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.C-16	3.5.1-28	A
					ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.C-16	3.5.1-28	A
Pipe Whip Restraints and Jet Impingement Shields (Energy Absorbing Material)	Pipe Whip Restraint	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	A
Prestressing system (Grease cap at tendon anchorage)	Shelter, Protection	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.C-10	3.5.1-32	A
			Air - Outdoor	Loss of Material	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.C-10	3.5.1-32	A
		Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	ASME Section XI, Subsection IWL (B.2.1.30)	III.A4.TP-248	3.5.1-80	E, 13
				Loss of Preload	ASME Section XI, Subsection IWL (B.2.1.30)	III.A4.TP-261	3.5.1-88	E, 13
			Air - Outdoor	Loss of Material	ASME Section XI, Subsection IWL (B.2.1.30)	III.A4.TP-274	3.5.1-82	E, 13
				Loss of Preload	ASME Section XI, Subsection IWL (B.2.1.30)	III.A4.TP-261	3.5.1-88	E, 13
Prestressing system (Tendons)	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Prestress	TLAA	II.A1.C-11	3.5.1-8	A, 14
Prestressing system (Tendons, Anchorage Components)	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.C-10	3.5.1-32	A
			Air - Outdoor	Loss of Material	ASME Section XI, Subsection IWL (B.2.1.30)	II.A1.C-10	3.5.1-32	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Seals, gaskets, and moisture barriers (Gaskets and seals for refueling cavity and sumps)	Water retaining boundary	Elastomer	Treated Borated Water	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
Seals, gaskets, and moisture barriers (Gaskets for grease caps at tendon anchorages)	Shelter, Protection	Elastomer	Air - Indoor Uncontrolled	Loss of Sealing	ASME Section XI, Subsection IWL (B.2.1.30)	III.A6.TP-7	3.5.1-72	E, 13
			Air - Outdoor	Loss of Sealing	ASME Section XI, Subsection IWL (B.2.1.30)	III.A6.TP-7	3.5.1-72	E, 13
Seals, gaskets, and moisture barriers (Moisture barrier between bottom of containment liner and interior base mat)	Shelter, Protection	Silicone	Air with Borated Water Leakage	Loss of Sealing	ASME Section XI, Subsection IWE (B.2.1.29)	II.A3.CP-40	3.5.1-26	A
Seals, gaskets, and moisture barriers (Seals at containment boundary)	Pressure Boundary	Elastomer	Air - Outdoor	Loss of Sealing	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-41	3.5.1-33	A
			Air with Borated Water Leakage	Loss of Sealing	10 CFR Part 50, Appendix J (B.2.1.32)	II.A3.CP-41	3.5.1-33	A
Sliding surfaces (support)	Structural Support	Lubrite	Air with Borated Water Leakage	Loss of Mechanical Function	Structures Monitoring (B.2.1.34)	III.A4.TP-35	3.5.1-76	A
Steel Components	Shielding	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A4.TP-302	3.5.1-77	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steel Components	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A4.TP-302	3.5.1-77	A
Steel components: Sump screen and trench cover	Filter	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A4.TP-302	3.5.1-77	A
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.2.TP-4	3.5.1-95	C
Steel elements: liner, liner anchors, integral attachments (Refueling cavity-accessible areas)	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.2.TP-4	3.5.1-95	C
			Treated Borated Water	Cracking	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	A, 15
				Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	A, 15
	Water retaining boundary	Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.2.TP-4	3.5.1-95	C
			Treated Borated Water	Cracking	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	A, 15
				Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	A, 15
Steel elements: liner, liner anchors, integral attachments (Refueling cavity-inaccessible areas)	Direct Flow	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A4.TP-302	3.5.1-77	A, 15
	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B1.1.T-25	3.5.1-89	C

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steel elements: liner, liner anchors, integral attachments (Refueling cavity-inaccessible areas)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Structures Monitoring (B.2.1.34)	III.A4.TP-302	3.5.1-77	A
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.2.TP-4	3.5.1-95	C
			Treated Borated Water	Cracking	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	A, 15
				Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	A, 15
	Water retaining boundary	Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.2.TP-4	3.5.1-95	C
			Treated Borated Water	Cracking	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	A, 15
				Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	A, 15
Steel elements: liner, liner anchors, integral attachments (Sumps-accessible areas)	Direct Flow	Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.2.TP-4	3.5.1-95	C
			Waste Water	Loss of Material	Structures Monitoring (B.2.1.34)			G, 11
Steel elements: liner, liner anchors, integral attachments (Sumps-inaccessible areas)	Direct Flow	Stainless Steel	Air with Borated Water Leakage	None	None	III.B1.2.TP-4	3.5.1-95	C
Tunnel (Tendon access gallery)	Shelter, Protection	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A4.TP-26	3.5.1-66	A
			Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	II.A1.CP-101	3.5.1-1	A

Table 3.5.2-4 Containment Structure (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Tunnel (Tendon access gallery)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	C
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	II.A1.CP-100	3.5.1-24	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	II.A1.CP-102	3.5.1-14	E, 2

Table 3.5.2-4 Containment Structure (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The stainless steel, structural bolts, with a treated borated water environment, are in the refueling cavity. The bolts in the refueling cavity are normally exposed to air except when the refueling cavity is filled with water during outages.

2. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

3. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The ASME Section XI, Subsection IWL (B.2.1.30) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

4. The TLAA designation in the Aging Management Programs column indicates that cumulative fatigue damage for this component is evaluated in Section 4.6.

5. The stainless steel hatches are at the bottom of the refueling cavity and provide access to the reactor vessel nozzles. The hatches are normally exposed to air except when the refueling cavity is filled with water during outages.

Table 3.5.2-4 Containment Structure (Continued)

Plant Specific Notes: (continued)

6. The Structures Monitoring (B.2.1.34) program was evaluated and determined to contain the 10 attributes associated with the Masonry Walls (B.2.1.33) program, therefore the Structures Monitoring (B.2.1.34) program will be used to implement the Masonry Walls (B.2.1.33) program.

7. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination at the refueling cavity.

8. The 10 CFR Part 50, Appendix J (B.2.1.32) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination in the gap between the guard pipe and the fuel transfer tube.

9. The ASME Section XI, Subsection IWE (B.2.1.29) program is also used to manage the aging effect(s) applicable to this component type, material, and environment combination where the guard pipe for the fuel transfer tube is exposed inside of the refueling cavity. The penetration sleeves in the refueling cavity are normally exposed to air except when the refueling cavity is filled with water during outages.

10. The 10 CFR Part 50, Appendix J (B.2.1.32) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination in the gap between the guard pipe and the recirculation sump effluent pipe.

11. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination for the sump liners.

12. The stainless steel, penetration sleeves are embedded in the concrete walls of the refueling cavity, to provide for instrumentation. The insides of the stainless steel sleeves are normally exposed to air except when the refueling cavity is filled with water during outages.

13. The ASME Section XI, Subsection IWL (B.2.1.30) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination for the grease caps used for the tendons.

14. The TLAA designation in the Aging Management Programs column indicates that cumulative fatigue damage for this component is evaluated in Section 4.5.

15. Leakage from the leak chase channels is monitored in accordance with the Structures Monitoring (B.2.1.34) program.

Table 3.5.2-5
Deep Well Enclosures (Byron)
Summary of Aging Management Evaluation

Table 3.5.2-5 Deep Well Enclosures (Byron)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
Concrete Embedments	Structural Support	Carbon Steel	Concrete	None	None	VII.J.AP-282	3.3.1-112	C
		Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Concrete: Above-grade exterior (accessible areas)	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A

Table 3.5.2-5 Deep Well Enclosures (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Structural Support	Grout	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
		Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
Concrete: Interior	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A

Table 3.5.2-5 Deep Well Enclosures (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Interior	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Steel elements: liner, liner anchors, integral attachments (inaccessible areas)	Shelter, Protection	Carbon Steel	Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C
			Raw Water	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C3.AP-194	3.3.1-37	C, 2
	Structural Support	Carbon Steel	Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C
			Raw Water	Loss of Material	Open-Cycle Cooling Water System (B.2.1.11)	VII.C3.AP-194	3.3.1-37	C, 2

Table 3.5.2-5 Deep Well Enclosures (Byron) (Continued)

Notes	**Definition of Note**
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

2. The Open-Cycle Cooling Water System (B.2.1.11) program is used to manage the identified aging effect(s) applicable to the carbon steel liner casings that structurally maintain the deep well configurations.

Table 3.5.2-6
Essential Service Cooling Pond (Braidwood)
Summary of Aging Management Evaluation

Table 3.5.2-6 Essential Service Cooling Pond (Braidwood)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Earthen water-control structures (Essential Service Cooling Pond)	Heat Sink	Soil, Rip-Rap, Sand, Gravel	Water - Flowing	Loss of Material or Loss of Form	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-22	3.5.1-58	A
	Water retaining boundary	Soil, Rip-Rap, Sand, Gravel	Water - Flowing	Loss of Material or Loss of Form	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-22	3.5.1-58	A
Earthen water-control structures (Spillway and Dike System)	Direct Flow	Soil, Rip-Rap, Sand, Gravel	Air - Outdoor	Loss of Material or Loss of Form	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			G, 1
			Water - Flowing	Loss of Material or Loss of Form	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-22	3.5.1-58	A
	Flood Barrier	Soil, Rip-Rap, Sand, Gravel	Air - Outdoor	Loss of Material or Loss of Form	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			G, 1
			Water - Flowing	Loss of Material or Loss of Form	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-22	3.5.1-58	A

Table 3.5.2-6 Essential Service Cooling Pond (Braidwood) (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) is the applicable aging management program for this component.

Table 3.5.2-7
Essential Service Water Cooling Towers (Byron)
Summary of Aging Management Evaluation

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
			Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
		Galvanized Steel Bolting	Air - Outdoor	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
			Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
		Stainless Steel Bolting	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Stainless Steel Bolting	Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			G, 1
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A6.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
Concrete Embedments	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			F, 2
Concrete: Above-grade exterior (accessible areas)	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
				Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-36	3.5.1-60	A
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (accessible areas)	Missile Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-37	3.5.1-61	A
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
				Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-36	3.5.1-60	A
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-37	3.5.1-61	A
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
				Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-36	3.5.1-60	A

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (accessible areas)	Structural Support	Reinforced concrete	Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-37	3.5.1-61	A
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
	Water retaining boundary	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
				Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-36	3.5.1-60	A
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-37	3.5.1-61	A
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
Concrete: Above-grade exterior (inaccessible areas)	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (inaccessible areas)	Missile Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-110	3.5.1-49	E, 4
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-109	3.5.1-51	E, 4
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-110	3.5.1-49	E, 4
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-109	3.5.1-51	E, 4
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (inaccessible areas)	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-110	3.5.1-49	E, 4
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-109	3.5.1-51	E, 4
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
	Water retaining boundary	Reinforced concrete	Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-109	3.5.1-51	E, 4
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier	Reinforced concrete	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-109	3.5.1-51	E, 4
					Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 5
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
	Missile Barrier	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-109	3.5.1-51	E, 4
					Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 5

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Missile Barrier	Reinforced concrete	Water - Flowing	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-109	3.5.1-51	E, 4
					Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 5
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Structural Support	Reinforced concrete	Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-109	3.5.1-51	E, 4
					Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 5
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
	Water retaining boundary	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-109	3.5.1-51	E, 4
					Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 5
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (inaccessible areas)	Flood Barrier	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A6.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 5
	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A6.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 5
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A6.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 5
Concrete: Interior	Flood Barrier	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
	Missile Barrier	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
	Shelter, Protection	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
	Structural Support	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
Cooling Tower Fill	Heat Sink	Ceramic Tile	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			J, 6
			Water - Flowing	Reduction of Heat Transfer	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			J, 7
Hatches/Plugs	Shelter, Protection	Carbon Steel	Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	C

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Hatches/Plugs	Shelter, Protection	Galvanized Steel	Air - Outdoor	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	C
			Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	C
		Stainless Steel	Air - Outdoor	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			F, 2
			Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			F, 1
Louver (Drift Eliminators)	Direct Flow	PVC	Air - Outdoor	Change in Material Properties	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			J, 8
			Raw Water	Change in Material Properties	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			J, 8
Metal components: All structural members (Lintels)	Structural Support	Gray Cast Iron	Air - Outdoor	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	C
			Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	C
					Selective Leaching (B.2.1.21)	VII.C1.A-51	3.3.1-72	C

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steel Components	Missile Barrier	Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	C
	Shelter, Protection	Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	C
Steel Components (Anti-vortex components)	Direct Flow	Galvanized Steel	Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	C
Steel Components (Trash Rack Assembly)	Filter	Galvanized Steel	Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	C
Support members; welds; bolted connections; support anchorage to building structure (Support Beams for Drift Eliminators)	Structural Support	Fiberglass	Air - Outdoor	Change in Material Properties	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			J, 9
			Raw Water	Change in Material Properties	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			J, 9

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The aging effects for stainless steel in a raw water environment include loss of material. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is used to manage the identified aging effect(s) applicable to this component type, material, and environment combination.

2. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

3. The reinforced concrete in a water flowing environment is also susceptible to cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded or reinforcing steel. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

4. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

Table 3.5.2-7 Essential Service Water Cooling Towers (Byron) (Continued)

Plant Specific Notes: (continued)

5. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination due to groundwater intrusion.

6. The ceramic tile (vitrified clay fill) in an air - outdoor environment is susceptible to loss of material (spalling, scaling) and cracking due to freeze-thaw. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

7. The ceramic tile (vitrified clay fill) in a water-flowing environment could be susceptible to reduction of heat transfer due to fouling. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

8. This material has a potential to experience a change in material properties in an air-outdoor and/or a water-flowing environment. Although exposed to outdoor air, the PVC louvers (drift eliminators) are internal to the cooling towers and sheltered from direct UV exposure. Industry operating experience has also shown good resistance of PVC materials to aging effects in raw water environments. Aging effects are not expected for these material and environment combinations. Nonetheless, the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is credited for ensuring the absence of any aging effects.

9. This material has a potential to experience a change in material properties in an air-outdoor and or a water-flowing environment. Although exposed to outdoor air, the fiberglass components are internal to the cooling towers and sheltered from direct UV exposure. Industry operating experience has also shown good resistance of fiberglass materials to aging effects in raw water environments. Aging effects are not expected for these material and environment combinations. Nonetheless, the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is credited for ensuring the absence of any aging effects.

Table 3.5.2-8
Fuel Handling Building
Summary of Aging Management Evaluation

Table 3.5.2-8 **Fuel Handling Building**

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.A5.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A5.TP-261	3.5.1-88	A
		Galvanized Steel Bolting	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A5.TP-261	3.5.1-88	A
		Stainless Steel Bolting	Air with Borated Water Leakage	Loss of Preload	Structures Monitoring (B.2.1.34)	III.A5.TP-261	3.5.1-88	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.A5.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A5.TP-261	3.5.1-88	A
Concrete Curbs	Direct Flow	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-28	3.5.1-67	A

Table 3.5.2-8 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete Embedments	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.A5.TP-302	3.5.1-77	A
Concrete Embedments (Scuppers)	Direct Flow	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Treated Borated Water	Loss of Material	Structures Monitoring (B.2.1.34)			F, 1
Concrete: Above-grade exterior (accessible areas)	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A5.TP-23	3.5.1-64	A
	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A5.TP-23	3.5.1-64	A
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A5.TP-23	3.5.1-64	A
	Shielding	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A5.TP-23	3.5.1-64	A
	Structural Pressure Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A5.TP-23	3.5.1-64	A

Table 3.5.2-8 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (accessible areas)	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A5.TP-23	3.5.1-64	A
Concrete: Above-grade exterior (inaccessible areas)	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2
	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2
	Shielding	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2
	Structural Pressure Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A

Table 3.5.2-8 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (inaccessible areas)	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A5.TP-67	3.5.1-47	E, 2
	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A5.TP-67	3.5.1-47	E, 2
	Structural Pressure Barrier	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A5.TP-67	3.5.1-47	E, 2

Table 3.5.2-8 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A5.TP-67	3.5.1-47	E, 2
Concrete: Foundation, subfoundation (inaccessible areas)	Flood Barrier	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A5.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A5.TP-67	3.5.1-47	E, 2
	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A5.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-29	3.5.1-67	A

Table 3.5.2-8 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (inaccessible areas)	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A5.TP-67	3.5.1-47	E, 2
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A5.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A5.TP-67	3.5.1-47	E, 2
Concrete: Interior	Flood Barrier	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-28	3.5.1-67	A
	Shelter, Protection	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-28	3.5.1-67	A
	Shielding	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	A

Table 3.5.2-8 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Interior	Shielding	Reinforced concrete	Air with Borated Water Leakage	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-28	3.5.1-67	A
	Structural Pressure Barrier	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-28	3.5.1-67	A
	Structural Support	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-28	3.5.1-67	A
Concrete: Interior (Leak Chase System)	Direct Flow	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-28	3.5.1-67	C
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A5.TP-67	3.5.1-47	E, 2
Door Seal (Roll-up doors of train shed)	Structural Pressure Barrier	Elastomer	Air - Indoor Uncontrolled	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Air - Outdoor	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
Doors (Roll-up doors of train shed)	Structural Pressure Barrier	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A5.TP-302	3.5.1-77	C

Table 3.5.2-8 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Doors (Roll-up doors of train shed)	Structural Pressure Barrier	Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A5.TP-302	3.5.1-77	C
Hatches/Plugs	Shelter, Protection	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
Masonry walls: Interior	Shelter, Protection	Concrete Block	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A5.T-12	3.5.1-70	A, 3
	Shielding	Concrete Block	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A5.T-12	3.5.1-70	A, 3
	Structural Support	Concrete Block	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A5.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A5.T-12	3.5.1-70	A, 3
Metal components: All structural members	Shelter, Protection	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
Metal decking	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Stainless Steel	Treated Borated Water	Loss of Material	Structures Monitoring (B.2.1.34)			F, 1
Penetration Bellows (Fuel Transfer Tube)	Expansion/ Separation	Stainless Steel	Condensation	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 5
			Treated Borated Water	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C

Table 3.5.2-8 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Penetration Bellows (Fuel Transfer Tube)	Expansion/ Separation	Stainless Steel	Treated Borated Water	Loss of Material	Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C
	Shelter, Protection	Stainless Steel	Condensation	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 5
	Water retaining boundary	Stainless Steel	Condensation	Cumulative Fatigue Damage	TLAA	II.A3.C-13	3.5.1-9	A, 4
				Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 5
			Treated Borated Water	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C
Penetration sleeves (Fuel Transfer Tube)	Shelter, Protection	Stainless Steel	Condensation	Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 5
	Structural Support	Stainless Steel	Condensation	Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 5
			Treated Borated Water	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C
	Water retaining boundary	Stainless Steel	Condensation	Loss of Material	10 CFR Part 50, Appendix J (B.2.1.32)			G, 5
			Treated Borated Water	Loss of Material	One-Time Inspection (B.2.1.20)	VII.A3.AP-79	3.3.1-125	C
					Water Chemistry (B.2.1.2)	VII.A3.AP-79	3.3.1-125	C
Spent fuel pool gates	Water retaining boundary	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Treated Borated Water	Loss of Material	Structures Monitoring (B.2.1.34)			F, 1

Table 3.5.2-8 Fuel Handling Building (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steel Components	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A5.TP-302	3.5.1-77	A
Steel elements: liner, liner anchors, integral attachments (accessible areas)	Water retaining boundary	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Treated Borated Water	Cracking	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	A, 6
				Cumulative Fatigue Damage	TLAA			H, 7
				Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	A, 6
Steel elements: liner, liner anchors, integral attachments (inaccessible areas)	Structural Support	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	A
			Treated Borated Water	Cracking	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	A, 6
				Cumulative Fatigue Damage	TLAA			H, 7
				Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	A, 6
	Water retaining boundary	Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Treated Borated Water	Cracking	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	A, 6
				Cumulative Fatigue Damage	TLAA			H, 7
				Loss of Material	Water Chemistry (B.2.1.2)	III.A5.T-14	3.5.1-78	A, 6

Table 3.5.2-8 Fuel Handling Building (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The Structures Monitoring (B.2.1.34) program is used to manage the applicable aging effect(s) for this component, material, and environment combination.

2. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

3. The Structures Monitoring (B.2.1.34) program was evaluated and determined to contain the 10 attributes associated with the Masonry Walls (B.2.1.33) program, therefore the Structures Monitoring (B.2.1.34) program will be used to implement the Masonry Walls program (B.2.1.33) .

4. The TLAA designation in the Aging Management Program columns indicates fatigue of this component is evaluated in Section 4.6.

5. The fuel transfer tube penetration sleeve and penetration bellows inside the Fuel Handling Building are tested concurrently with the fuel transfer tube penetration sleeve and penetration bellows inside the Containment Structure, which are tested in accordance with 10 CFR Part 50, Appendix J (B.2.1.32) program.

Table 3.5.2-8 Fuel Handling Building (Continued)

Plant Specific Notes: (continued)

6. The spent fuel pool water level is monitored in accordance with technical specifications. Leakage from the leak chase channels is monitored in accordance with the Structures Monitoring (B.2.1.34) program.
7. The TLAA designation in the Aging Management Program columns indicates fatigue of this component is evaluated in Section 4.3.

Table 3.5.2-9
Lake Screen Structures (Braidwood)
Summary of Aging Management Evaluation

Table 3.5.2-9 Lake Screen Structures (Braidwood)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A6.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
		Galvanized Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A6.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
		Galvanized Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A

Table 3.5.2-9 Lake Screen Structures (Braidwood) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete Anchors	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
Concrete Embedments	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			F, 1
Concrete: Above-grade exterior (accessible areas)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
				Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-36	3.5.1-60	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
				Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-36	3.5.1-60	A

Table 3.5.2-9 Lake Screen Structures (Braidwood) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (accessible areas)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
				Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-36	3.5.1-60	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
				Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-36	3.5.1-60	A
Concrete: Below-grade exterior (inaccessible areas)	Direct Flow	Reinforced concrete	Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 2
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-109	3.5.1-51	E, 3
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A

Table 3.5.2-9 Lake Screen Structures (Braidwood) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 4
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 2
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-109	3.5.1-51	E, 3
					Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 4
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
Concrete: Foundation, subfoundation (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A6.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A

Table 3.5.2-9 Lake Screen Structures (Braidwood) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 4
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A6.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 4
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
	Structural Support	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
Hatches/Plugs	Missile Barrier	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
	Shelter, Protection	Aluminum	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C

Table 3.5.2-9 Lake Screen Structures (Braidwood) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Hatches/Plugs	Shelter, Protection	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Masonry walls: Interior	Shelter, Protection	Concrete Block	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A6.T-12	3.5.1-70	A, 5
	Structural Support	Concrete Block	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A6.T-12	3.5.1-70	A, 5
Metal decking	Structural Support	Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
Precast Panel	Shelter, Protection	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
				Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-36	3.5.1-60	A
	Structural Support	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A

Table 3.5.2-9 Lake Screen Structures (Braidwood) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Precast Panel	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-36	3.5.1-60	A
Steel Components	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Steel Components (Trash Rack Bars)	Filter	Galvanized Steel	Air - Outdoor	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	C
			Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	C

Table 3.5.2-9 Lake Screen Structures (Braidwood) (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

2. The reinforced concrete walls of the lake screen house pump bays and essential service water discharge structure in a water flowing environment are also susceptible to cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded or reinforcing steel. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

3. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination for the lake screen house pump bay walls and the essential service water discharge structure.

4. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination due to groundwater intrusion.

Table 3.5.2-9 Lake Screen Structures (Braidwood) (Continued)

Plant Specific Notes: (continued)

5. The Structures Monitoring (B.2.1.34) program was evaluated and determined to contain the 10 attributes associated with the Masonry Walls (B.2.1.33) program, therefore the Structures Monitoring (B.2.1.34) program will be used to implement the Masonry Walls (B.2.1.33) program.

Table 3.5.2-10
Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms
Summary of Aging Management Evaluation

Table 3.5.2-10 Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Blowout Panels	Pressure Relief	Polymers	Air - Indoor Uncontrolled	Change in Material Properties	Structures Monitoring (B.2.1.34)			J, 1
			Air - Outdoor	Change in Material Properties	Structures Monitoring (B.2.1.34)			J, 1
	Shelter, Protection	Polymers	Air - Indoor Uncontrolled	Change in Material Properties	Structures Monitoring (B.2.1.34)			J, 1
			Air - Outdoor	Change in Material Properties	Structures Monitoring (B.2.1.34)			J, 1
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
Concrete: Above-grade exterior (accessible areas)	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A

Table 3.5.2-10 Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (accessible areas)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
Concrete: Above-grade exterior (inaccessible areas)	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2
	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 2
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A

Table 3.5.2-10 Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier	Reinforced concrete	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 2
	Missile Barrier	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 2
	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 2
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A

Table 3.5.2-10 Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Structural Support	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 2
Concrete: Foundation, subfoundation (inaccessible areas)	Flood Barrier	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 2
	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 2
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A

Table 3.5.2-10 Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 2
Concrete: Interior	Flood Barrier	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-24	3.5.1-63	C
	HELB Shielding	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-24	3.5.1-63	C
	Missile Barrier	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-24	3.5.1-63	C
	Shelter, Protection	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A

Table 3.5.2-10 Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Interior	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-24	3.5.1-63	C
	Structural Support	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-24	3.5.1-63	C
Flood Barriers	Flood Barrier	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Elastomer	Air - Indoor Uncontrolled	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
Hatches/Plugs	Flood Barrier	Aluminum - (Byron only)	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
		Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
	HELB Shielding	Aluminum - (Byron only)	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
		Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
	Missile Barrier	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Shelter, Protection	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A

Table 3.5.2-10 Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Hatches/Plugs	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
Pipe Whip Restraints and Jet Impingement Shields	Pipe Whip Restraint	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	A
Steel Components	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A

Table 3.5.2-10 Main Steam & Auxiliary Feedwater Tunnels and Isolation Valve Rooms (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The blowout panels are constructed of extruded polystyrene. The Structures Monitoring (B.2.1.34) program will be used to manage the applicable aging effects for this material and environment combination.

2. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

Table 3.5.2-11
Natural Draft Cooling Towers (Byron)
Summary of Aging Management Evaluation

Table 3.5.2-11 Natural Draft Cooling Towers (Byron)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (accessible areas)	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Water retaining boundary	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
Concrete: Above-grade exterior (inaccessible areas)	Structural Support	Reinforced concrete	Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)			H, 1
				Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 3
				Loss of Material	Structures Monitoring (B.2.1.34)	III.A6.T-20	3.5.1-56	E, 2
	Water retaining boundary	Reinforced concrete	Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)			H, 1
				Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 3
				Loss of Material	Structures Monitoring (B.2.1.34)	III.A6.T-20	3.5.1-56	E, 2

Table 3.5.2-11 Natural Draft Cooling Towers (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)			H, 1
				Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 3
				Loss of Material	Structures Monitoring (B.2.1.34)	III.A6.T-20	3.5.1-56	E, 2
	Water retaining boundary	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)			H, 1
				Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 3
				Loss of Material	Structures Monitoring (B.2.1.34)	III.A6.T-20	3.5.1-56	E, 2

Table 3.5.2-11 Natural Draft Cooling Towers (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 3
	Water retaining boundary	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 3

Table 3.5.2-11 Natural Draft Cooling Towers (Byron) (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The reinforced concrete in a water flowing environment is also susceptible to cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded or reinforcing steel. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

2. The Structures Monitoring (B.2.1.34) program is substituted to manage the aging effect(s) applicable to this component type, material, and environment combination.

3. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

Table 3.5.2-12
RWST Foundation and Tunnel
Summary of Aging Management Evaluation

Table 3.5.2-12 RWST Foundation and Tunnel

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A7.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A7.TP-261	3.5.1-88	A
		Galvanized Steel Bolting	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A7.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A7.TP-261	3.5.1-88	A
Concrete Curbs	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A7.TP-23	3.5.1-64	A
	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A7.TP-23	3.5.1-64	A
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A7.TP-23	3.5.1-64	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-26	3.5.1-66	A

Table 3.5.2-12 RWST Foundation and Tunnel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete Curbs	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A7.TP-23	3.5.1-64	A
Concrete Embedments	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Concrete: Above-grade exterior (accessible areas)	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-26	3.5.1-66	A, 1
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A7.TP-23	3.5.1-64	A, 1
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-26	3.5.1-66	A, 1
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A7.TP-23	3.5.1-64	A, 1
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-26	3.5.1-66	A, 1
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A7.TP-23	3.5.1-64	A, 1
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A7.TP-67	3.5.1-47	E, 2

Table 3.5.2-12 RWST Foundation and Tunnel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A7.TP-67	3.5.1-47	E, 2
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A7.TP-67	3.5.1-47	E, 2
Concrete: Foundation, subfoundation (accessible areas)	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A7.TP-23	3.5.1-64	A
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-28	3.5.1-67	A

Table 3.5.2-12 RWST Foundation and Tunnel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A7.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A7.TP-67	3.5.1-47	E, 2
Concrete: Interior	Flood Barrier	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-28	3.5.1-67	A
	Missile Barrier	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-28	3.5.1-67	A
	Shelter, Protection	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-26	3.5.1-66	A

Table 3.5.2-12 RWST Foundation and Tunnel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air with Borated Water Leakage	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-28	3.5.1-67	A
	Structural Support	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-28	3.5.1-67	A
Concrete: Interior (Leak Chase System)	Direct Flow	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A7.TP-28	3.5.1-67	C
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A7.TP-67	3.5.1-47	E, 2
Hatches/Plugs	Missile Barrier	Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A7.TP-302	3.5.1-77	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A7.TP-302	3.5.1-77	A
		Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A7.TP-302	3.5.1-77	A
			Condensation	Loss of Material	Structures Monitoring (B.2.1.34)	III.A7.TP-302	3.5.1-77	A
	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A7.TP-302	3.5.1-77	A

Table 3.5.2-12 RWST Foundation and Tunnel (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Hatches/Plugs	Shelter, Protection	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A7.TP-302	3.5.1-77	A
		Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A7.TP-302	3.5.1-77	A
			Condensation	Loss of Material	Structures Monitoring (B.2.1.34)	III.A7.TP-302	3.5.1-77	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, vents and louvers, platforms, etc.)	Structural Support	Stainless Steel	Treated Borated Water	Loss of Material	Structures Monitoring (B.2.1.34)			F, 3
Steel Components (Leak Chase System)	Direct Flow	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Structures Monitoring (B.2.1.34)	III.A7.TP-302	3.5.1-77	A, 4
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C

Table 3.5.2-12 RWST Foundation and Tunnel (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The internal stainless steel liner associated with the refueling water storage tank is evaluated with the Safety Injection System as a stainless steel tank component type.

2. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

3. The Structures Monitoring (B.2.1.34) program will be used to manage the applicable aging effects for the miscellaneous stainless steel inside the refueling water storage tank exposed to treated borated water.

4. Leakage from the leak chase channels is monitored in accordance with the Structures Monitoring (B.2.1.34) program.

Table 3.5.2-13
Radwaste and Service Building Complex
Summary of Aging Management Evaluation

Table 3.5.2-13 Radwaste and Service Building Complex

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.A3.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.A3.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
Concrete Embedments	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Concrete: Above-grade exterior (accessible areas)	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A

Table 3.5.2-13 Radwaste and Service Building Complex (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (accessible areas)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
Concrete: Above-grade exterior (inaccessible areas)	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 1
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 1
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E, 1
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A

Table 3.5.2-13 Radwaste and Service Building Complex (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Flood Barrier	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
Concrete: Foundation, subfoundation (accessible areas)	Flood Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A

Table 3.5.2-13 Radwaste and Service Building Complex (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (accessible areas)	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
Concrete: Foundation, subfoundation (inaccessible areas)	Flood Barrier	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A

Table 3.5.2-13 Radwaste and Service Building Complex (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
Concrete: Interior	Flood Barrier	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
	Shelter, Protection	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A
	Structural Support	Reinforced concrete	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-28	3.5.1-67	A

Table 3.5.2-13 Radwaste and Service Building Complex (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Masonry walls: Interior	Structural Support	Concrete Block	Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A, 2
Metal decking	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
Precast Panel	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
Steel Components	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Windows	Shelter, Protection	Glass	Air - Outdoor	None	None	VII.J.AP-167	3.3.1-117	C
			Air with Borated Water Leakage	None	None	VII.J.AP-96	3.3.1-117	C

Table 3.5.2-13 Radwaste and Service Building Complex (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

2. The Structures Monitoring (B.2.1.34) program was evaluated and determined to contain the 10 attributes associated with the Masonry Walls (B.2.1.33) program, therefore the Structures Monitoring (B.2.1.34) program will be used to implement the Masonry Walls (B.2.1.33) program.

Table 3.5.2-14
River Screen House (Byron)
Summary of Aging Management Evaluation

Table 3.5.2-14 River Screen House (Byron)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A6.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
			Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
		Galvanized Steel Bolting	Air - Outdoor	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
			Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A

Table 3.5.2-14 River Screen House (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
		Stainless Steel Bolting	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
			Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			G, 1
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A6.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
		Stainless Steel Bolting	Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			G, 1
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A6.TP-261	3.5.1-88	A
Concrete Embedments	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	A

Table 3.5.2-14 River Screen House (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete Embedments	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			F, 2
Concrete: Above-grade exterior (accessible areas)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
				Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-36	3.5.1-60	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
				Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-36	3.5.1-60	A
Concrete: Below-grade exterior (accessible areas)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
				Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-36	3.5.1-60	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A

Table 3.5.2-14 River Screen House (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (accessible areas)	Structural Support	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-36	3.5.1-60	A
Concrete: Below-grade exterior (inaccessible areas)	Direct Flow	Reinforced concrete	Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-109	3.5.1-51	E, 4
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 5
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A

Table 3.5.2-14 River Screen House (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Structural Support	Reinforced concrete	Water - Flowing	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)			H, 3
				Increase in Porosity and Permeability, Loss of Strength	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-109	3.5.1-51	E, 4
					Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 5
				Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-20	3.5.1-56	A
Concrete: Foundation, subfoundation (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A6.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 5
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A6.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A

Table 3.5.2-14 River Screen House (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-107	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A6.TP-109	3.5.1-51	E, 5
Concrete: Interior	Flood Barrier	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
	Shelter, Protection	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
	Structural Support	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-38	3.5.1-59	A
Earthen water-control structures	Direct Flow	Soil, Rip-Rap, Sand, Gravel	Water - Flowing	Loss of Material or Loss of Form	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.T-22	3.5.1-58	A
Hatches/Plugs	Shelter, Protection	Aluminum	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
Masonry walls: Interior	Structural Support	Concrete Block	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A6.T-12	3.5.1-70	A, 6
Metal decking	Structural Support	Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C

Table 3.5.2-14 River Screen House (Byron) (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Steel Components	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Steel Components (Trash Rack Bars)	Filter	Galvanized Steel	Air - Outdoor	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	C
			Raw Water	Loss of Material	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35)	III.A6.TP-221	3.5.1-83	C
Windows	Shelter, Protection	Aluminum	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
		Polymers	Air - Indoor Uncontrolled	Change in Material Properties	Structures Monitoring (B.2.1.34)			J, 7
			Air - Outdoor	Change in Material Properties	Structures Monitoring (B.2.1.34)			J, 7

Table 3.5.2-14 River Screen House (Byron) (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. The aging effects for stainless steel bolting in a raw water environment include loss of material. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is used to manage the identified aging effect(s) applicable to the stainless steel bolting of the ice boom unit.

2. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

3. The reinforced concrete walls of the River Screen House pump bays in a water flowing environment are also susceptible to cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded or reinforcing steel. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination for the River Screen House pump bay walls.

4. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.2.1.35) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination for the River Screen House pump bay walls.

Table 3.5.2-14 River Screen House (Byron) (Continued)

Plant Specific Notes: (continued)

5. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination due to groundwater intrusion.

6. The Structures Monitoring (B.2.1.34) program was evaluated and determined to contain the 10 attributes associated with the Masonry Walls (B.2.1.33) program, therefore the Structures Monitoring (B.2.1.34) program will be used to implement the Masonry Walls (B.2.1.33) program.

7. The River Screen House window panes are plexiglass (polymer material). The Structures Monitoring (B.2.1.34) program is used to manage the changes in material properties (cracking or degradation) applicable to this material and environment combination.

Table 3.5.2-15
Structural Commodity Group
Summary of Aging Management Evaluation

Table 3.5.2-15 **Structural Commodity Group**

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bird Screen	Filter	Aluminum	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
		Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	C
		Stainless Steel - (Byron only)	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
Bolting (Structural)	Structural Support	Aluminum Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
		Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
		Galvanized Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
		Stainless Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
			Air with Borated Water Leakage	Loss of Preload	Structures Monitoring (B.2.1.34)	III.B5.TP-261	3.5.1-88	A
Cable Trays	Shelter, Protection	Aluminum	Air - Indoor Uncontrolled	None	None	III.B2.TP-8	3.5.1-95	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B2.TP-8	3.5.1-95	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B2.TP-3	3.5.1-89	C
	Structural Support	Aluminum	Air - Indoor Uncontrolled	None	None	III.B2.TP-8	3.5.1-95	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B2.TP-8	3.5.1-95	C

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Cable Trays	Structural Support	Galvanized Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B2.TP-3	3.5.1-89	C
Compressible Joints and Seals	Shelter, Protection	Elastomer	Air - Indoor Uncontrolled	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Air - Outdoor	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Air with Borated Water Leakage	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Groundwater/Soil	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
Conduit	Shelter, Protection	Aluminum	Air - Indoor Uncontrolled	None	None	III.B2.TP-8	3.5.1-95	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B2.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B2.TP-3	3.5.1-89	C
			Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C
		PVC	Air - Indoor Uncontrolled	None	None	VII.J.AP-268	3.3.1-119	C
			Groundwater/Soil	None	None			J, 1
		Polymers	Air - Indoor Uncontrolled	None	None			J, 2
			Air with Borated Water Leakage	Change in Material Properties	Structures Monitoring (B.2.1.34)			J, 3
	Structural Support	Aluminum	Air - Indoor Uncontrolled	None	None	III.B2.TP-8	3.5.1-95	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B2.TP-8	3.5.1-95	C

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Conduit	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B2.TP-3	3.5.1-89	C
			Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C
		PVC	Air - Indoor Uncontrolled	None	None	VII.J.AP-268	3.3.1-119	C
			Groundwater/Soil	None	None			J, 1
		Polymers	Air - Indoor Uncontrolled	None	None			J, 2
			Air with Borated Water Leakage	Change in Material Properties	Structures Monitoring (B.2.1.34)			J, 3
Doors	Flood Barrier	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
	HELB Shielding	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
		Galvanized Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
	Shelter, Protection	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Doors	Shelter, Protection	Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
		Glass	Air - Indoor Uncontrolled	None	None	VII.J.AP-14	3.3.1-117	C
			Air - Outdoor	None	None	VII.J.AP-167	3.3.1-117	C
	Shielding	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
	Structural Pressure Barrier	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
		Glass	Air - Indoor Uncontrolled	None	None	VII.J.AP-14	3.3.1-117	C
			Air - Outdoor	None	None	VII.J.AP-167	3.3.1-117	C
Insulation	Thermal Insulation	Calcium Silicate	Air - Indoor Uncontrolled	None	None			J, 4
			Air - Outdoor	Change in Material Properties, Loss of Material	Structures Monitoring (B.2.1.34)			J, 5

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Insulation	Thermal Insulation	Calcium Silicate	Air with Borated Water Leakage	None	None			J, 4
		Ceramic Fiber	Air - Indoor Uncontrolled	None	None			J, 4
			Air - Outdoor	Change in Material Properties, Loss of Material	Structures Monitoring (B.2.1.34)			J, 5
		Fiberglass	Air - Indoor Uncontrolled	None	None			J, 4
			Air - Outdoor	Change in Material Properties, Loss of Material	Structures Monitoring (B.2.1.34)			J, 6
			Air with Borated Water Leakage	None	None			J, 4
		Foamed Plastic	Air - Indoor Uncontrolled	None	None			J, 4
			Air with Borated Water Leakage	None	None			J, 4
		Mineral Fiber	Air with Borated Water Leakage	None	None			J, 4
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
Insulation Jacketing	Thermal Insulation Jacket Integrity	Aluminum	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Insulation Jacketing	Thermal Insulation Jacket Integrity	Stainless Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
Louver	Shelter, Protection	Aluminum	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
Metal siding	Shelter, Protection	Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support	Aluminum	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
		Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Miscellaneous steel (catwalks, stairs, handrails, ladders, platforms, etc.)	Structural Support	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
			Raw Water	Loss of Material	Structures Monitoring (B.2.1.34)			G, 7
Panels, Racks, Cabinets, and Other Enclosures	Shelter, Protection	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B3.TP-43	3.5.1-92	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B3.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.B3.TP-43	3.5.1-92	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B3.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B3.TP-3	3.5.1-89	C
		Glass	Air - Outdoor	None	None	VII.J.AP-167	3.3.1-117	C
		Stainless Steel	Air - Indoor Uncontrolled	None	None	III.B3.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
			Air with Borated Water Leakage	None	None	III.B3.TP-4	3.5.1-95	C

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Panels, Racks, Cabinets, and Other Enclosures	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B3.TP-43	3.5.1-92	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B3.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.B3.TP-43	3.5.1-92	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B3.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B3.TP-3	3.5.1-89	C
		Stainless Steel	Air - Indoor Uncontrolled	None	None	III.B3.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
			Air with Borated Water Leakage	None	None	III.B3.TP-4	3.5.1-95	C
Penetration Seals	Flood Barrier	Elastomer	Air - Indoor Uncontrolled	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Air with Borated Water Leakage	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Groundwater/Soil	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
		Grout	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A, 8
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A, 8

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Penetration Seals	Flood Barrier	Grout	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A, 8
	HELB Shielding	Elastomer	Air with Borated Water Leakage	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
		Grout	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A, 8
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A, 8
	Shelter, Protection	Elastomer	Air - Indoor Uncontrolled	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Air - Outdoor	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Air with Borated Water Leakage	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Groundwater/Soil	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
		Grout	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A, 8
			Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A, 8
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A, 8
			Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A, 8

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Penetration Seals	Shielding	Grout	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A, 8
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A, 8
		Lead	Air - Indoor Uncontrolled	None	None			J, 9
			Air with Borated Water Leakage	None	None			J, 9
	Structural Pressure Barrier	Elastomer	Air - Indoor Uncontrolled	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Air with Borated Water Leakage	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
		Grout	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A, 8
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A, 8
	Structural Support	Grout	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A, 8
			Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A, 8
			Air with Borated Water Leakage	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A, 8
			Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A, 8
Penetration sleeves	Flood Barrier	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Penetration sleeves	Flood Barrier	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Concrete	None	None	VII.J.AP-282	3.3.1-112	C
			Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
			Concrete	None	None	VII.J.AP-282	3.3.1-112	C
			Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Concrete	None	None	VII.J.AP-19	3.3.1-120	C
	HELB Shielding	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Concrete	None	None	VII.J.AP-282	3.3.1-112	C
		Galvanized Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
			Concrete	None	None	VII.J.AP-282	3.3.1-112	C
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Concrete	None	None	VII.J.AP-19	3.3.1-120	C
	Pipe Whip Restraint	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Penetration sleeves	Pipe Whip Restraint	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B2.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Concrete	None	None	VII.J.AP-282	3.3.1-112	C
	Shelter, Protection	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Concrete	None	None	VII.J.AP-282	3.3.1-112	C
			Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
			Concrete	None	None	VII.J.AP-282	3.3.1-112	C
			Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Concrete	None	None	VII.J.AP-19	3.3.1-120	C
	Shielding	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Penetration sleeves	Shielding	Carbon Steel	Air with Borated Water Leakage	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
	Structural Pressure Barrier	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Concrete	None	None	VII.J.AP-282	3.3.1-112	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
			Concrete	None	None	VII.J.AP-282	3.3.1-112	C
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Concrete	None	None	VII.J.AP-19	3.3.1-120	C
	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.T-25	3.5.1-89	C
					Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Concrete	None	None	VII.J.AP-282	3.3.1-112	C

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Penetration sleeves	Structural Support	Carbon Steel	Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B5.TP-43	3.5.1-92	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B5.TP-3	3.5.1-89	C
			Concrete	None	None	VII.J.AP-282	3.3.1-112	C
			Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C
		Stainless Steel	Air with Borated Water Leakage	None	None	III.B5.TP-4	3.5.1-95	C
			Concrete	None	None	VII.J.AP-19	3.3.1-120	C
Roofing	Shelter, Protection	Elastomer	Air - Outdoor	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	C
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Flood Barrier	Elastomer	Air - Indoor Uncontrolled	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Air - Outdoor	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Air with Borated Water Leakage	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
	HELB Shielding	Elastomer	Air - Indoor Uncontrolled	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Air with Borated Water Leakage	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
		Elastomer	Air - Indoor Uncontrolled	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A

Table 3.5.2-15 Structural Commodity Group (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Seals, gaskets, and moisture barriers (caulking, flashing and other sealants)	Shelter, Protection	Elastomer	Air - Outdoor	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Air with Borated Water Leakage	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
		Stainless Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
	Shielding	Elastomer	Air with Borated Water Leakage	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
	Structural Pressure Barrier	Elastomer	Air - Indoor Uncontrolled	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Air - Outdoor	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
			Air with Borated Water Leakage	Loss of Sealing	Structures Monitoring (B.2.1.34)	III.A6.TP-7	3.5.1-72	A
Tube Track	Shelter, Protection	Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B2.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B2.TP-3	3.5.1-89	C
	Structural Support	Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B2.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
			Air with Borated Water Leakage	Loss of Material	Boric Acid Corrosion (B.2.1.4)	III.B2.TP-3	3.5.1-89	C

Table 3.5.2-15 Structural Commodity Group (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. This material and environment applies to PVC conduit in groundwater/soil environment. Based on plant operating experience, there are no aging effects requiring management for the combination of this material and environment. The material in this environment is not expected to experience significant aging effects.

2. This material and environment applies to the vinyl covering on flexible, liquid-tight conduit in air – indoor environment. Based on plant operating experience, there are no aging effects requiring management for the combination of these materials and environments. The material in this environment is not expected to experience significant aging effects.

3. This material and environment applies to the vinyl covering on flexible, liquid-tight conduit in air with borated water leakage environment. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

4. Operating experience has shown the air-indoor uncontrolled and air with borated water leakage environments to contain insignificant quantities of moisture, humidity, condensation, and contaminants during normal operation. Therefore, there are no aging effects associated with the insulation material in the normally dry, air - indoor uncontrolled and air with borated water leakage environments.

Table 3.5.2-15 Structural Commodity Group (Continued)

Plant Specific Notes: (continued)

5. This material and environment applies to the Calcium Silicate and Ceramic Fiber insulation attached to the emergency diesel generator exhaust and vent stack piping in air – outdoor environment. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

6. This material and environment applies to the fiberglass insulation attached to the condensate storage tank in air – outdoor environment. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

7. This material and environment applies to miscellaneous steel components in the River Screen House and Essential Service Water Cooling Tower at Byron. The loss of material aging effect will be managed by the Structures Monitoring (B.2.1.34) program.

8. NUREG-1801 does not contain grout penetration seals, however, cracking, loss of bond, loss of material, and increase in porosity and permeability are applicable aging effects for both grout and concrete, and are managed for grout penetration seals by the Structures Monitoring (B.2.1.34) program.

9. This material and environment applies to the lead wool used for packing penetrations for radiation shielding. Operating experience has shown the air-indoor uncontrolled and air with borated water leakage environments to contain insignificant quantities of moisture, humidity, condensation, and contaminants during normal operation. Therefore, there are no aging effects associated with the lead material in the normally dry, air - indoor uncontrolled and air with borated water leakage environments.

Table 3.5.2-16
Switchyard Structures
Summary of Aging Management Evaluation

Table 3.5.2-16 Switchyard Structures

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
		Galvanized Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
Concrete Anchors	Structural Support	Galvanized Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
Concrete Embedments	Structural Support	Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A

Table 3.5.2-16 Switchyard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Above-grade exterior (accessible areas)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1

Table 3.5.2-16 Switchyard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
	Structural Support	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A

Table 3.5.2-16 Switchyard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Equipment supports and foundations	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
			Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
Hatches/Plugs	Shelter, Protection	Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	C
Masonry walls: Above-grade exterior	Shelter, Protection	Concrete Block	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A, 2
				Loss of Material (Spalling, Scaling) and Cracking	Masonry Walls (B.2.1.33)	III.A5.TP-34	3.5.1-71	A, 2
	Structural Support	Concrete Block	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A, 2

Table 3.5.2-16 Switchyard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Masonry walls: Above-grade exterior	Structural Support	Concrete Block	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking	Masonry Walls (B.2.1.33)	III.A5.TP-34	3.5.1-71	A, 2
Masonry walls: Interior	Shelter, Protection	Concrete Block	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A, 2
	Structural Support	Concrete Block	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A, 2
Metal decking	Structural Support	Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
Steel Components	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Transmission Towers	Structural Support	Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C

Table 3.5.2-16 Switchyard Structures (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

2. The Structures Monitoring (B.2.1.34) program was evaluated and determined to contain the 10 attributes associated with the Masonry Walls (B.2.1.33) program, therefore the Structures Monitoring (B.2.1.34) program will be used to implement the Masonry Walls (B.2.1.33) program.

Table 3.5.2-17
Turbine Building Complex
Summary of Aging Management Evaluation

Table 3.5.2-17 Turbine Building Complex

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Blowout Panels	Pressure Relief	Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	C
	Shelter, Protection	Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	C
Bolting (Structural)	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-248	3.5.1-80	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
		Galvanized Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-248	3.5.1-80	A

Table 3.5.2-17 Turbine Building Complex (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete Anchors	Structural Support	Carbon and Low Alloy Steel Bolting	Air - Indoor Uncontrolled	Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
Concrete Embedments	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Concrete: Above-grade exterior (accessible areas)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
Concrete: Above-grade exterior (inaccessible areas)	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E,1
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A6.TP-104	3.5.1-65	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-108	3.5.1-42	E,1
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A

Table 3.5.2-17 Turbine Building Complex (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
Concrete: Foundation, subfoundation (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A

Table 3.5.2-17 Turbine Building Complex (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
Concrete: Interior	Flood Barrier	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
	Missile Barrier	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
	Shelter, Protection	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
	Structural Support	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
Hatches/Plugs	Shelter, Protection	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	C
		Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	C
	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	C

Table 3.5.2-17 Turbine Building Complex (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Hatches/Plugs	Structural Support	Carbon Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	C
		Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	C
Masonry walls: Interior	Shelter, Protection	Concrete Block	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A, 2
	Structural Support	Concrete Block	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Cracking	Masonry Walls (B.2.1.33)	III.A3.T-12	3.5.1-70	A, 2
Metal components: All structural members	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Metal decking	Structural Support	Galvanized Steel	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
Precast Panel	Shelter, Protection	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	C

Table 3.5.2-17 Turbine Building Complex (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Precast Panel	Structural Support	Reinforced concrete	Air - Indoor Uncontrolled	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
			Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	C
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	C
Steel Components	Structural Support	Carbon Steel	Air - Indoor Uncontrolled	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
Windows	Shelter, Protection	Aluminum	Air - Indoor Uncontrolled	None	None	III.B5.TP-8	3.5.1-95	C
			Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
		Polymers	Air - Indoor Uncontrolled	Change in Material Properties	Structures Monitoring (B.2.1.34)			J, 3
			Air - Outdoor	Change in Material Properties	Structures Monitoring (B.2.1.34)			J, 3

Table 3.5.2-17 Turbine Building Complex (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. NUREG-1801 requires a further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effect(s) applicable to this component type, material, and environment combination.

2. The Structures Monitoring (B.2.1.34) program was evaluated and determined to contain the 10 attributes associated with the Masonry Walls (B.2.1.33) Program. Therefore, the Structures Monitoring (B.2.1.34) program will be used to implement the Masonry Walls (B.2.1.33) program.

3. The turbine building window panes are plexiglas (polymer material). The Structures Monitoring (B.2.1.34) program is used to manage the changes in material properties applicable to this material and environment combination.

Table 3.5.2-18
Yard Structures
Summary of Aging Management Evaluation

Table 3.5.2-18 Yard Structures

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Bolting (Structural)	Structural Support	Galvanized Steel Bolting	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-274	3.5.1-82	A
				Loss of Preload	Structures Monitoring (B.2.1.34)	III.A3.TP-261	3.5.1-88	A
Concrete: Above-grade exterior (accessible areas)	Missile Barrier	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A

Table 3.5.2-18 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Below-grade exterior (inaccessible areas)	Shelter, Protection	Reinforced concrete	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A7.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
Concrete: Foundation, subfoundation (accessible areas)	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A8.TP-23	3.5.1-64	A
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A8.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A8.TP-212	3.5.1-65	A

Table 3.5.2-18 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Concrete: Foundation, subfoundation (inaccessible areas)	Structural Support	Reinforced concrete	Groundwater/Soil	Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A8.TP-29	3.5.1-67	A
Concrete: Interior	Shelter, Protection	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	C
	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	C
Equipment supports and foundations	Structural Support	Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
			Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
Hatches/Plugs	Missile Barrier	Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A

Table 3.5.2-18 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Hatches/Plugs	Missile Barrier	Reinforced concrete	Air - Outdoor	Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
	Shelter, Protection	Aluminum	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.B2.TP-6	3.5.1-93	C
		Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
Manholes, Handholes & Duct Banks	Shelter, Protection	Ductile Cast Iron	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C
		Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
			Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A

Table 3.5.2-18 Yard Structures (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Manholes, Handholes & Duct Banks	Shelter, Protection	Reinforced concrete	Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1
	Structural Support	Ductile Cast Iron	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
			Groundwater/Soil	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-219	3.5.1-79	C
		Galvanized Steel	Air - Outdoor	Loss of Material	Structures Monitoring (B.2.1.34)	III.A3.TP-302	3.5.1-77	A
		Reinforced concrete	Air - Outdoor	Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-26	3.5.1-66	A
				Loss of Material (Spalling, Scaling) and Cracking	Structures Monitoring (B.2.1.34)	III.A3.TP-23	3.5.1-64	A
			Groundwater/Soil	Cracking and Distortion	Structures Monitoring (B.2.1.34)	III.A3.TP-30	3.5.1-44	A
				Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-212	3.5.1-65	A
				Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling)	Structures Monitoring (B.2.1.34)	III.A3.TP-29	3.5.1-67	A
			Water - Flowing	Increase in Porosity and Permeability, Loss of Strength	Structures Monitoring (B.2.1.34)	III.A3.TP-67	3.5.1-47	E, 1

Table 3.5.2-18 **Yard Structures** **(Continued)**

Notes	**Definition of Note**
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. NUREG-1801 requires further evaluation to determine if a plant-specific program is needed. The Structures Monitoring (B.2.1.34) program is used to manage the aging effects applicable to this component type, material and environment combination.

3.6 AGING MANAGEMENT OF ELECTRICAL COMMODITIES

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

3.6.1 INTRODUCTION

This section provides the results of the aging management review for those components identified in Section 2.5, Electrical, as being subject to aging management review. The electrical commodity groups, which are addressed in this section, are described in the indicated sections.

- Cable Connections (Metallic Parts) (2.5.2.5.1)
- Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage (2.5.2.5.2)
- Fuse Holders (Not Part of Active Equipment): Metallic Clamps (2.5.2.5.3)
- High Voltage Insulators (2.5.2.5.4)
- Insulation Material for Electrical Cables and Connections (2.5.2.5.5)
- Metal Enclosed Bus (2.5.2.5.6)
- Switchyard Bus and Connections, Transmission Conductors, and Transmission Connectors (2.5.2.5.7)

3.6.2 RESULTS

The following table summarizes the results of the aging management review for Electrical Commodities.

Table 3.6.2-1 Electrical Commodities Summary of Aging Management Evaluation

3.6.2.1 Materials, Environments, Aging Effects Requiring Management And Aging Management Programs

3.6.2.1.1 Cable Connections (Metallic Parts)

Materials

The materials of construction for the Cable Connections (Metallic Parts) are:

- Various Metals Used for Electrical Connections

Environments

The Cable Connections (Metallic Parts) are exposed to the following environments:

- Air - Indoor Uncontrolled
- Air – Outdoor

Aging Effects Requiring Management

The following aging effect associated with the Cable Connections (Metallic Parts) requires management:

- Increased Resistance of Connection

Aging Management Programs

The following aging management program manages the aging effects for the Cable Connections (Metallic Parts):

- Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.2.1.42)

3.6.2.1.2 Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage

Materials

The materials of construction for the Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage are:

- Various Metals Used for Electrical Contacts

Environments

The Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage are exposed to the following environments:

- Air with Borated Water Leakage

Aging Effects Requiring Management

The following aging effects associated with the Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage components require management:

- Increased Resistance of Connection

Aging Management Programs

The following aging management program manages the aging effects for the Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage components:

- Boric Acid Corrosion (B.2.1.4)

3.6.2.1.3 Fuse Holders (Not Part of Active Equipment): Metallic Clamps

Materials

The materials of construction for the Fuse Holders (Not Part of Active Equipment): Metallic Clamps are:

- Various Metals Used for Electrical Connections

Environments

The Fuse Holders (Not Part of Active Equipment): Metallic Clamps are exposed to the following environments:

- Air - Indoor Uncontrolled

Aging Effects Requiring Management

Braidwood
The Fuse Holders (Not Part of Active Equipment): Metallic Clamps at Braidwood have no aging effects requiring management. See Section 3.6.2.3.1 for further evaluation.

Byron
The following aging effects associated with the Fuse Holders (Not Part of Active Equipment): Metallic Clamps components require management at Byron only:

- Increased Resistance of Connection
- Increased Resistance of Connection; Fatigue

Aging Management Programs

Braidwood
Because there are no aging effects requiring management, no aging management programs are required for the Fuse Holders (Not Part of Active Equipment): Metallic Clamps at Braidwood.

Byron
The following aging management program manages the aging effects for the Fuse Holders (Not Part of Active Equipment): Metallic Clamps components at Byron only:

- Fuse Holders (Byron Only) (B.2.1.41)

3.6.2.1.4 High Voltage Insulators

Materials

The materials of construction for the High Voltage Insulators are:

- Cement
- Metal
- Porcelain

Environments

The High Voltage Insulators are exposed to the following environment:

- Air – Outdoor

Aging Effects Requiring Management

The High Voltage Insulators have no aging effects requiring management. See Section 3.6.2.2.2 for further evaluation.

Aging Management Programs

Because there are no aging effects requiring management, no aging management programs are required for the High Voltage Insulators.

3.6.2.1.5 Insulation Material for Electrical Cables and Connections

The insulation material for electrical cables and connections commodity group was broken down for aging management review of insulation into subcategories based on categorization in NUREG-1801:

- Conductor Insulation for Inaccessible Power Cables Greater Than or Equal to 400V
- Insulation Material for Electrical Cables and Connections
- Insulation Material for Electrical Cables and Connections Used in Instrumentation Circuits

This commodity group includes insulation material for electrical cables and connections, splices, electrical penetration pigtails, terminal blocks, and fuse holders (not part of active equipment):insulation material.

Materials

The materials of construction for the Insulation Material for Electrical Cables and Connections are:

- Various Organic Polymers

Environments

The Insulation Material for Electrical Cables and Connections are exposed to the following environments:

- Adverse Localized Environment Caused by Significant Moisture
- Adverse Localized Environment Caused by Heat, Radiation, or Moisture

Aging Effects Requiring Management

The following aging effect associated with the Insulation Material for Electrical Cables and Connections requires management:

- Reduced Insulation Resistance

Aging Management Programs

The following aging management programs manage the aging effects for the Insulation Material for Electrical Cables and Connections:

- Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.2.1.39)
- Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.2.1.37)
- Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits (B.2.1.38)

3.6.2.1.6 Metal Enclosed Bus

Materials

The materials of construction for the Metal Enclosed Bus are:

- Various Metals Used for Electrical Bus and Connections
- Elastomers
- Aluminum
- Porcelain, Various Organic Polymers

Environments

The Metal Enclosed Bus are exposed to the following environments:

- Air – Indoor Uncontrolled
- Air – Outdoor

Aging Effects Requiring Management

The following aging effects associated with the Metal Enclosed Bus require management:

- Increased Resistance of Connection
- Surface Cracking, Crazing, Scuffing, Dimensional Change, Shrinkage, Discoloration, Hardening, and Loss of Strength
- Loss of Material
- Reduced Insulation Resistance

Aging Management Programs

The following aging management programs manage the aging effects for the Metal Enclosed Bus:

- Metal Enclosed Bus (B.2.1.40)

3.6.2.1.7 Switchyard Bus and Connections, Transmission Conductors, Transmission Connectors

Materials

The materials of construction for the Switchyard Bus and Connections, Transmission Conductors, and Transmission Connectors are:

- Aluminum
- Aluminum, Stainless Steel
- Aluminum, Steel

Environments

The Switchyard Bus and Connections, Transmission Conductors, and Transmission Connectors are exposed to the following environment:

- Air – Outdoor

Aging Effects Requiring Management

The Switchyard Bus and Connections, Transmission Conductors, and Transmission Connectors have no aging effects requiring management. See Section 3.6.2.2.3 for further evaluation.

Aging Management Programs

Because there are no aging effects requiring management, no aging management programs are required for the Switchyard Bus and Connections, Transmission Conductors, and Transmission Connectors.

3.6.2.2 AMR Results for Which Further Evaluation is Recommended by the GALL Report

NUREG-1801 provides the basis for identifying those programs that warrant further evaluation by the reviewer in the license renewal application. For the Electrical Commodities, those programs are addressed in the following subsections.

3.6.2.2.1 Electrical Equipment Subject to Environmental Qualification

Environmental qualification is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The evaluation of this TLAA is addressed separately in Section 4.4, "Environmental Qualification (EQ) of Electrical Equipment," of this SRP-LR.

The evaluation of this TLAA is addressed in Section 4.4, "Environmental Qualification (EQ) of Electric Components," of this application.

3.6.2.2.2 Reduced Insulation Resistance due to Presence of Any Salt Deposits and Surface Contamination, and Loss of Material due to Mechanical Wear Caused by Wind Blowing on Transmission Conductors

Reduced insulation resistance due to presence of any salt deposits and surface contamination could occur in high-voltage insulators. The GALL Report recommends further evaluation of a plant-specific AMP for plants located such that the potential exists for salt deposits or surface contamination (e.g., in the vicinity of salt water bodies or industrial pollution). Loss of material due to mechanical wear caused by wind blowing on transmission conductors could occur in high-voltage insulators. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).

The high voltage insulators evaluated for BBS are those used to support in scope, uninsulated, high voltage electrical commodities such as transmission conductors and switchyard bus. The supported commodities are those credited for recovery of offsite power following a station blackout.

Salt Deposits and Surface Contamination

Various airborne materials such as dust, salt, and industrial effluents can contaminate high voltage insulator surfaces. The buildup of surface contamination is gradual and such contamination is washed away by rain; the glazed insulator surface aids this contamination removal. A large buildup of contamination enables the conductor voltage to track along the surface more easily and can lead to high voltage insulator flashover. Surface contamination can be a problem in areas where there are greater concentrations of airborne particles such as near facilities that discharge soot or near the seacoast where salt spray is prevalent.

Byron and Braidwood are not located near the seacoast. They are located inland, in central Illinois. Both Byron and Braidwood are located in areas where industrial airborne particle concentrations are comparatively low, since they are located in rural areas with no heavy industry nearby. Minor high voltage insulator surface contamination is washed away by rainfall or snow, and cumulative build up has not been experienced and is not expected to occur.

Based on Byron's and Braidwood's location and confirmed by their operating experience, high voltage insulator surface contamination is not a significant aging effect for BBS. Therefore, aging management activities for high voltage insulator surface contamination from dust, salt, and industrial effluents are not required for the period of extended operation.

Mechanical Wear

Mechanical wear is an aging effect for strain and suspension insulators in that they are subject to movement. Movement can be caused by wind blowing the supported transmission conductor, causing it to swing from side to side. If this swinging is frequent enough, it could cause wear in the metal contact points of the insulator string and between an insulator and the supporting hardware. Although this mechanism is possible, experience has shown that the transmission conductors do not normally swing and that when they do, due to substantial wind, they do not continue to swing for very long once the wind has subsided.

Wind loading that can cause a transmission line and insulators to sway is considered in the design and installation. Although rare, surface rust of the metallic cap may form where galvanizing is burnt off due to flashover from lightning strikes. Surface rust is not a significant concern and would not cause a loss of intended function if left unmanaged for the period of extended operation. Wear and surface rust have not been identified during routine switchyard inspections.

Based on BBS design and confirmed by their operating experience, mechanical wear of high voltage insulators caused by wind blowing on transmission conductors is not significant enough to cause a loss of intended function. Therefore, aging management activities for loss of material due to mechanical wear is not required for the period of extended operation.

Conclusion

Aging management activities for BBS high voltage insulators are not required for the period of extended operation.

3.6.2.2.3 Loss of Material due to Wind-Induced Abrasion, Loss of Conductor Strength due to Corrosion, and Increased Resistance of Connection due to Oxidation or Loss of Pre-load

Loss of material due to wind-induced abrasion, loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of pre-load could occur in transmission conductors and connections, and in switchyard bus and connections. The GALL Report recommends further evaluation of a plant-specific AMP *to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).*

The switchyard bus and connections, transmission conductors, and transmission connectors evaluated for BBS are those credited for recovery of offsite power following a station blackout.

Wind-Induced Abrasion and Fatigue – Switchyard Bus

Switchyard buses are connected to flexible conductors that do not normally vibrate and are supported by insulators and ultimately by static, structural components such as concrete footings and structural steel. Switchyard bus is rigidly mounted and is therefore not subject to abrasion induced by wind loading. Therefore, based on BBS design and confirmed by their operating experience, wind-induced abrasion and fatigue is not applicable to BBS switchyard bus.

Corrosion – Switchyard Bus

BBS switchyards are not subject to a saline environment or industrial air pollution. It is located inland, in central Illinois, in an area where industrial airborne particle concentrations are comparatively low, since it is located in a rural area with no heavy industry nearby. Aluminum bus material does not experience any appreciable aging effects in this environment. Therefore, based on BBS design and confirmed by their operating experience, corrosion is not an applicable aging mechanism.

Oxidation or Loss of Pre-Load – Switchyard Bus

Switchyard bus connections employ good bolting practices. The connections are treated with corrosion inhibitors to avoid connections oxidations and torqued at the time of installation to avoid loss of pre-load. The switchyard bus bolted connections are designed and installed using stainless steel lock washers that provide vibration absorption and prevent loss of preload. Therefore, based on BBS design and confirmed by their operating experience, oxidation and loss of preload are not applicable aging mechanisms.

Wind-Induced Abrasion and Fatigue – Transmission Conductors

Transmission conductor vibration or sway could be caused by wind loading. Experience has shown that the transmission conductors do not normally swing significantly. When transmission conductors do swing due to a substantial wind, they do not continue to swing for very long once the wind has subsided. Wind loading that can cause a transmission line to vibrate or sway is considered in design and installation. Therefore, based on BBS design and confirmed by their operating experience, the loss of material aging effect that could result from wind-induced transmission conductor vibration or sway is not applicable and would not cause a loss of intended function for transmission conductors for the period of extended operation.

Corrosion – Transmission Conductors

The in scope transmission conductors at BBS are the tie lines between the 345-kV switchyard and the system auxiliary transformers and short connections from switchyard buswork to gas circuit breakers. The short connection cables between the gas circuit breakers and switchyard buswork at Byron only are 1113 MCM all aluminum (AA) conductors. AA transmission conductors have the same characteristics as aluminum conductor aluminum alloy reinforced (ACAR) transmission conductors. AA transmission conductors are not subject to corrosion that requires aging management.

The tie line conductors at BBS are 2156 MCM 84/19 aluminum conductor steel reinforced (ACSR). Each phase has one conductor. The 2156 MCM 84/19 ACSR transmission conductor is a large, substantial transmission conductor. It is approximately 1.8 inches in diameter and is configured with 19 steel conductors wrapped by 84 aluminum conductors. The rated or ultimate strength per American Society for Testing and Materials (ASTM) standards and National Electric Safety Code (NESC) heavy load tension requirements of 2156 MCM ACSR are 60,300 lbs and 36,180 lbs, respectively.

The ComEd Transmission and Distribution design practices follow the NESC methodologies. The NESC requires that tension on installed conductors be a maximum of 60 percent of the ultimate conductor strength. The NESC also sets the maximum tension of a conductor must be designed to withstand heavy load requirements, which include consideration of ice, wind, and temperature.

The most prevalent contribution to loss of conductor strength of an ACSR transmission conductor is corrosion, which includes corrosion of the steel core and aluminum strand pitting. For ACSR conductors, degradation begins as a loss of zinc from the galvanized steel core wires. Corrosion rates depend largely on air quality which includes suspended particles chemistry, sulfur dioxide (SO2) concentration in air, precipitation, fog chemistry, and meteorological conditions.

Ontario Hydroelectric performed a study that is documented in 1992 IEEE Transactions on Power Delivery. The papers present the methodology and results of both field and laboratory tests on ACSR conductors from Ontario Hydroelectric's older transmission lines. The field tests were performed on-line, to detect steel core galvanizing loss by using an overhead line conductor corrosion detector. Potential conductor degradation was measured by an eddy current sensor that travels along the conductor, between transmission towers. Laboratory tests were performed for fatigue, tensile strength, torsional ductility, and electrical performance. The fatigue tests simulating 50 years of service life were performed to assess existing cables as well as a new cable. The tensile strength was assessed by the individual wire method, and torsional ductility was assessed by the twist to failure method. Both the tensile strength and torsional ductility tests were performed in accordance with published standards. Additional considerations in the performance of these aging assessments included metallurgical data and analysis for potential environmental contributors. Tests performed by Ontario Hydroelectric showed a 30 percent loss of composite conductor strength of an 80-year-old ACSR conductor due to corrosion. The BBS in scope tie line transmission conductors are the same type of transmission conductors evaluated in the Ontario Hydroelectric study and in the analysis of the Ontario Hydroelectric Study and in the EPRI License Renewal

Electrical Handbook. The test methodology as published in the IEEE Transactions on Power Delivery is applicable to the in scope BBS transmission conductors.

BBS is located in an area where industrial airborne particle concentrations are comparatively low, since it is located in a rural area with no heavy industry nearby. In the Ontario Hydroelectric Study, the conductors most affected by atmospheric corrosion were located in areas subject to pollution sources and a major urban area. Therefore, the environmental impacts to the BBS transmission conductors (which are located in a rural area) are bounded by the Ontario Hydroelectric conductors (which are located in polluted and urban environments).

An example presented in the EPRI License Renewal Handbook, 1013475, compares a 4/0 conductor to the results of the Ontario Hydroelectric Study. The EPRI License Renewal Electrical Handbook evaluation documents that a 4/0 ACSR conductor (equivalent to a 211 MCM conductor size), which was included in the Ontario Hydroelectric study, has the smallest ultimate strength margin. Larger, more substantial transmission conductors (e.g., 336.4 MCM 30/7 conductors) that had a greater strength margin were bounded by the 4/0, 6/1 ACSR conductor example. The BBS transmission conductors are physically more substantial than the limiting 4/0 ACSR conductor. NESC requirements and the handbook guidance are used to evaluate the in scope transmission conductors at BBS.

Assuming a 30 percent loss of strength as demonstrated by the Ontario Hydroelectric tests, there would still be significant margin between what is required by the NESC and actual conductor strength. The margin between the NESC heavy load and the ultimate strength is 24,120 lbs. The Ontario Hydroelectric study showed a 30 percent loss of composite conductor strength in an 80 year old conductor. In the case of the 2156 MCM ACSR transmission conductors, a 30 percent loss of ultimate strength would mean that there would still be a 6,030 lbs margin between the 80-year old ultimate strength and the strength required by the NESC. Therefore the design and physical construction of the BBS in scope transmission conductors’ strength margin is bounded by the handbook analysis of the 4/0 ACSR conductor and is also bounded by the Ontario Hydroelectric study.

2156 MCM 84/19 ACSR Transmission Conductor	
Ultimate Strength, New	60,300 lbs.
Postulated Ultimate Strength at 80 Years	42,210 lbs.
NESC Design Strength, Required	36,180 lbs.
NESC Heavy Load Tension, Required	10,000 lbs.

In conclusion, the in scope BBS transmission conductors are bounded by the Ontario Hydroelectric study by test methodology, design and construction, and environment. The above evaluations demonstrate with reasonable assurance that transmission conductors will have ample strength margin through the period of extended operation. Therefore, based on BBS design and confirmed by their operating experience, the loss of transmission conductor strength is not applicable and would not cause a loss of intended function for transmission conductors for the period of extended operation.

Oxidation or Loss of Pre-Load – Transmission Connectors

Transmission connectors employ good bolting practices. The connections are treated with corrosion inhibitors to avoid connection oxidation and torqued at the time of installation to avoid loss of pre-load. The transmission connectors are designed and installed using stainless steel lock washers that provide vibration absorption and prevent loss of preload. Therefore, based on BBS design and confirmed by their operating experience, oxidation and loss of preload are not applicable aging mechanisms.

Conclusion

Aging management activities for BBS switchyard bus and connections, transmission conductors, and transmission connectors are not required for the period of extended operation.

3.6.2.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

QA provisions applicable to License Renewal are discussed in Section B.1.3.

3.6.2.3 AMR Results Not Consistent With or Not Addressed in the GALL Report

3.6.2.3.1 Fuse Holders (Not Part of Active Equipment): Metallic Clamps

The individual Fuse Holders (Not Part of Active Equipment): Metallic Clamps subject to aging management review were identified from a systematic review of plant documents, controlled drawings, and the plant equipment database (PassPort). The results of this systematic review determined sixty-eight fuse holders at Braidwood and one hundred fuse holders at Byron that require aging management review.

Braidwood Station

There are sixty-eight fuse holders in scope for license renewal that are not part of active equipment at Braidwood. These fuse holders are in two enclosed electrical panels. The potential aging effects as discussed in NUREG-1801 are not applicable to the sixty-eight fuse holders in the two in-scope fire detection 125 Vdc electrical power distribution panels (thirty-eight fuse holders in one electrical panel and thirty fuse holders in the other electrical panel) located in the Braidwood Auxiliary Building. The evaluation of aging effects is discussed below.

Chemical Contamination, Corrosion, and Oxidation

The two fire detection electrical panels in the Braidwood Auxiliary Building are located in an environment that does not subject them to environmental aging mechanisms. They are located inside the Braidwood Auxiliary Building in an electrical panel room. The fuse holders are protected from chemical contamination, and are within a mild environment inside the Braidwood Auxiliary Building during normal conditions. There are no sources of chemicals in the vicinity of the electrical panels during normal conditions. The environment inside the room is air-conditioned by a ventilation system, thus they do not experience high relative humidity during normal conditions. The fuse holders are not subject to outside weather conditions and therefore, are not subject to moisture from precipitation. A second barrier that protects the fuse holders from exposure to moisture is their location inside an enclosed electrical panel. The fuse holders are not located in or near humid areas and they are not exposed to industrial or oceanic environments.

A walkdown of these electrical panels containing the in scope fuse holders confirmed that the operating conditions for these fuse holders are clean and dry, with no evidence of moisture intrusion, chemical contamination, oxidation or corrosion. Therefore, chemical contamination, corrosion, and oxidation are not considered applicable aging mechanisms for these fuse holders.

Ohmic Heating, Thermal Cycling, and Electrical Transients

Fuse holders for circuits that carry significant current in power applications could potentially be exposed to thermal fatigue in the form of high resistance caused by thermal cycling and ohmic heating. Instrumentation and control power circuits characteristically operate at low currents where no appreciable thermal cycling or ohmic heating occurs.

The fuse holders located in the Braidwood Auxiliary Building are for fire detection instrument and control power. The loads are instrumentation and control circuits that operate at low currents where no appreciable thermal cycling or ohmic heating occurs. Therefore, electrical and thermal cycling is not considered an applicable aging mechanism for these fuse holders.

Mechanical stress due to forces associated with electrical faults and transients are mitigated by the fast action of the circuit protective devices at high currents. Also, mechanical stress due to electrical faults is not considered a credible aging mechanism since such faults are infrequent and random in nature. The corrective action program is used to document adverse conditions and provides corrective actions associated with electrical faults and transients that cause the actuation of circuit protective devices. Therefore, electrical transients is not considered an applicable aging mechanism for these fuse holders.

Frequent Manipulation and Vibration

Wear and fatigue is caused by repeated insertion and removal of fuses. The fuses in these fuse holders are not subject to frequent manipulation (i.e. removal and reinsertion) because they are neither clearance nor isolation points which support periodic testing or preventative maintenance. Additionally, if fuses are manipulated for non-routine inspection or maintenance, proceduralized good work practices would identify any abnormal condition such as loose or corroded fuse clips.

These fuse holders are located in electrical panels that are not mounted on moving or rotating equipment such as compressors, fans, or pumps. Because the electrical panels are mounted with no attached sources of vibration, vibration is not an applicable aging mechanism. Therefore, the metallic clamps of these fuse holders will not exhibit the aging effects/ mechanisms of fatigue due to frequent manipulation or vibration.

Braidwood Station Conclusion

Based on installed location, design configuration, operating service conditions, and operating experience, the sixty-eight fuse holders inside the two fire detection electrical panels located in the Braidwood Auxiliary Building are not susceptible to the aging effects and mechanisms associated with metallic clamps. Therefore, aging management activities are not required for these sixty-eight Fuse Holders (Not Part of Active Equipment): Metallic Clamps at Braidwood.

Byron Station

There are one hundred fuse holders in scope for license renewal that are not part of active equipment at Byron. These fuse holders are in twelve enclosed electrical panels. Ten enclosed electrical panels are located in the Byron Auxiliary Building. Eight of these electrical panels in the Byron Auxiliary Building contain two fuse holders each, one electrical panel contains thirty fuse holders, and the other electrical panel contains thirty-eight fuse holders. The remaining two enclosed electrical panels are located in Byron River Screen House and contain eight fuse holders each.

Byron Auxiliary Building

The potential aging effects as discussed in NUREG-1801 are not applicable to the sixteen fuse holders in the eight in-scope instrument power electrical panels (two fuse holders in each electrical panel) and the sixty-eight fuse holders in the two in-scope fire detection control power distribution panels (thirty-eight fuse holders in one panel and thirty fuse holders in the other panel) located in the Byron Auxiliary Building. The evaluation of aging effects is discussed below.

Chemical Contamination, Corrosion, and Oxidation

The ten electrical panels in the Byron Auxiliary Building are located in an environment that does not subject them to environmental aging mechanisms. They are located inside the Byron Auxiliary Building in electrical panel rooms. The fuse holders are protected from chemical contamination, and are within a mild environment inside the Byron Auxiliary Building during normal conditions. There are no sources of chemicals in the vicinity of the electrical panels during normal conditions. The environment inside the room is air-conditioned by a ventilation system, thus they do not experience high relative humidity during normal conditions. The fuse holders are not subject to outside weather conditions and therefore, are not subject to moisture from precipitation. A second barrier that protects the fuse holders from exposure to moisture is their location inside an enclosed electrical panel. The fuse holders are not located in or near humid areas and they are not exposed to industrial or oceanic environments.

A walkdown of these electrical panels containing the in-scope fuse holders confirmed that the operating conditions for these fuse holders are clean and dry, with no evidence of moisture intrusion, chemical contamination, oxidation or corrosion. Therefore, chemical contamination, corrosion, and oxidation are not considered applicable aging mechanisms for these fuse holders.

Ohmic Heating, Thermal Cycling, and Electrical Transients

Fuse holders for circuits that carry significant current in power applications could potentially be exposed to thermal fatigue in the form of high resistance caused by thermal cycling and ohmic heating. Instrumentation and control circuits characteristically operate at low currents where no appreciable thermal cycling or ohmic heating occurs.

The fuse holders located in the Byron Auxiliary Building are for process instruments or fire detection control power. The loads are instrumentation and control circuits that operate at low currents where no appreciable thermal cycling or ohmic heating occurs. Therefore, electrical and thermal cycling is not considered an applicable aging mechanism for these fuse holders.

Mechanical stress due to forces associated with electrical faults and transients are mitigated by the fast action of the circuit protective devices at high currents. Also, mechanical stress due to electrical faults is not considered a credible aging mechanism since such faults are infrequent and random in nature. The corrective action program is used to document adverse conditions and provides corrective actions associated with electrical faults and transients that cause the actuation of circuit protective devices. Therefore, electrical transients is not considered an applicable aging mechanism for these fuse holders.

Frequent Manipulation and Vibration

Wear and fatigue is caused by repeated insertion and removal of fuses. The fuses in these fuse holders are not subject to frequent manipulation (i.e. removal and reinsertion) because they are neither clearance nor isolation points which support periodic testing or preventative maintenance. Additionally, if fuses are manipulated for non-routine inspection or maintenance, proceduralized good work practices would identify any abnormal condition such as loose or corroded fuse clips.

These fuse holders are located in electrical panels that are not mounted on moving or rotating equipment such as compressors, fans, or pumps. Because the electrical panels are mounted with no attached sources of vibration, vibration is not an applicable aging mechanism. Therefore, the metallic clamps of these fuse holders will not exhibit the aging effects/ mechanisms of fatigue due to frequent manipulation or vibration.

Byron Auxiliary Building Conclusion

Based on installed location, design configuration, operating service conditions, and operating experience, the sixteen fuse holders in the eight in-scope instrument power electrical panels (two fuse holders in each electrical panel) and the sixty-eight fuse holders in the two in-scope fire detection control power distribution panels (thirty-eight fuse holders in one panel and thirty fuse holders in the other panel) located in the Byron Auxiliary Building are not susceptible to the aging effects and mechanisms associated with metallic clamps. Therefore, aging management activities are not required for these eighty-four Fuse Holders (Not Part of Active Equipment): Metallic Clamps.

Byron River Screen House

The remaining sixteen fuse holders at Byron serve the essential service water system, specifically the essential service water makeup pump battery charger fuses. They are in two enclosed electrical panels located in Byron River Screen House. Each enclosed electrical panel contains eight fuse holders. The indoor air uncontrolled environment at the River Screen House subjects the fuse holders to environmental aging mechanisms. Additionally, these fuse holders serve power circuits that can carry significant current and potentially expose the fuse holders metallic clamps to thermal fatigue in the form of high resistance caused by thermal cycling and ohmic heating. Finally, these fuses are routinely manipulated during the battery charger surveillance test, thus they are subject to fatigue caused by frequent manipulation or vibration.

Byron River Screen House Conclusion

Based on installed location, design configuration, and operating service conditions, these sixteen fuse holders are susceptible to the aging effects and mechanisms associated with metallic clamps. Therefore, aging management activities are required for these sixteen Fuse Holders (Not Part of Active

Equipment): Metallic Clamps located in the Byron River Screen House during the period of extended operation.

Byron Station Conclusion

Based on installed location, design configuration, and operating service conditions, the holders located in the Byron Auxiliary Building are not susceptible to the aging effects and mechanisms associated with metallic clamps. Therefore, aging management activities are not required for these eighty-four Fuse Holders (Not Part of Active Equipment): Metallic Clamps.

Based on installed location, design configuration, and operating service conditions, the holders located in the Byron River Screen House are susceptible to the aging effects and mechanisms associated with metallic clamps. Therefore, aging management activities are required for these sixteen Fuse Holders (Not Part of Active Equipment): Metallic Clamps at Byron during the period of extended operation.

Conclusion

The results of the aging management review of the individual Fuse Holders (Not Part of Active Equipment): Metallic Clamps determined that:

- Braidwood - aging management activities are not required for Fuse Holders (Not Part of Active Equipment): Metallic Clamps,
- Byron Auxiliary Building - aging management activities are not required for Fuse Holders (Not Part of Active Equipment): Metallic Clamps,
- Byron River Screen House - aging management activities are required for sixteen Fuse Holders (Not Part of Active Equipment): Metallic Clamps during the period of extended operation.

The Fuse Holders (Byron Only) (B.2.1.41) aging management program will manage the aging effects for sixteen Fuse Holders (Not Part of Active Equipment): Metallic Clamps located in the Byron River Screen House during the period of extended operation.

3.6.2.4 Time-Limited Aging Analysis

The time-limited aging analyses identified below are associated with Electrical Commodities:

- Section 4.4, Environmental Qualification (EQ) of Electric Components.

3.6.3 CONCLUSION

The Electrical Commodities that are subject to aging management review have been identified in accordance with the requirements of 10 CFR 54.4. The aging management programs selected to manage aging effects for the Electrical Commodities are identified in the summaries in Section 3.6.2.1 above.

A description of these aging management programs is provided in Appendix B, along with the demonstration that the identified aging effects will be managed for the period of extended operation.

Therefore, based on the conclusions provided in Appendix B, the effects of aging associated with the Electrical Commodities will be adequately managed so that there is reasonable assurance that the intended functions are maintained consistent with the current licensing basis during the period of extended operation.

Table 3.6.1 Summary of Aging Management Evaluations for Electrical Components

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.6.1-1	Electrical equipment subject to 10 CFR 50.49 EQ requirements composed of Various polymeric and metallic materials exposed to Adverse localized environment caused by heat, radiation, oxygen, moisture, or voltage	Various aging effects due to various mechanisms in accordance with 10 CFR 50.49	EQ is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.4, "Environmental Qualification (EQ) of Electrical Equipment," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1)(i) and (ii). See Chapter X.E1, "Environmental Qualification (EQ) of Electric Components," of this report for meeting the requirements of 10 CFR 54.21(c)(1)(iii).	Yes, TLAA	Environmental Qualification is a TLAA; further evaluation is documented in Subsection 3.6.2.2.1 and Section 4.4.
3.6.1-2	High-voltage insulators composed of Porcelain; malleable iron; aluminum; galvanized steel; cement exposed to Air – outdoor	Loss of material due to mechanical wear caused by wind blowing on transmission conductors	A plant-specific aging management program is to be evaluated	Yes, plant-specific	NUREG-1801 loss of material aging effects is not applicable to BBS. See subsection 3.6.2.2.2 for further evaluation.

Table 3.6.1 Summary of Aging Management Evaluations for Electrical Components

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.6.1-3	High-voltage insulators composed of Porcelain; malleable iron; aluminum; galvanized steel; cement exposed to Air – outdoor	Reduced insulation resistance due to presence of salt deposits or surface contamination	A plant-specific aging management program is to be evaluated for plants located such that the potential exists for salt deposits or surface contamination (e.g., in the vicinity of salt water bodies or industrial pollution)	Yes, plant-specific	NUREG-1801 reduced insulation resistance aging effects are not applicable to BBS. See subsection 3.6.2.2.2 for further evaluation.
3.6.1-4	Transmission conductors composed of Aluminum; steel exposed to Air – outdoor	Loss of conductor strength due to corrosion	A plant-specific aging management program is to be evaluated for ACSR	Yes, plant-specific	NUREG-1801 loss of conductor strength aging effects is not applicable to BBS. See subsection 3.6.2.2.3 for further evaluation.
3.6.1-5	Transmission connectors composed of Aluminum; steel exposed to Air – outdoor	Increased resistance of connection due to oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated	Yes, plant-specific	NUREG-1801 increased resistance of connection aging effects is not applicable to BBS. See subsection 3.6.2.2.3 for further evaluation.
3.6.1-6	Switchyard bus and connections composed of Aluminum; copper; bronze; stainless steel; galvanized steel exposed to Air – outdoor	Loss of material due to wind-induced abrasion; Increased resistance of connection due to oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated	Yes, plant-specific	NUREG-1801 loss of material and increased resistance of connection aging effects are not applicable to BBS. See subsection 3.6.2.2.3 for further evaluation.

Table 3.6.1 Summary of Aging Management Evaluations for Electrical Components

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.6.1-7	Transmission conductors composed of Aluminum; Steel exposed to Air – outdoor	Loss of material due to wind-induced abrasion	A plant-specific aging management program is to be evaluated for ACAR and ACSR	Yes, plant-specific	NUREG-1801 loss of material aging effects is not applicable to BBS. See subsection 3.6.2.2.3 for further evaluation.
3.6.1-8	Insulation material for electrical cables and connections (including terminal blocks, fuse holders, etc.) composed of Various organic polymers (e.g., EPR, SR, EPDM, XLPE) exposed to Adverse localized environment caused by heat, radiation, or moisture	Reduced insulation resistance due to thermal/ thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	Chapter XI.E1, "Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No	Consistent with NUREG-1801. The Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.2.1.37) program will be used to manage the reduced insulation resistance of the insulation material in electrical cables and connections, including terminal blocks, fuse holders, splices and electrical penetration pigtails, exposed to an adverse localized environment caused by heat, radiation, or moisture.
3.6.1-9	Insulation material for electrical cables and connections used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance (IR) composed of Various organic polymers (e.g., EPR, SR, EPDM, XLPE) exposed to Adverse localized environment caused by heat, radiation, or moisture	Reduced insulation resistance due to thermal/ thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	Chapter XI.E2, "Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits"	No	Consistent with NUREG-1801. The Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits (B.2.1.38) program will be used to manage the reduced insulation resistance of the insulation material in electrical cables and connections for in scope neutron monitoring and radiation monitoring circuits, exposed to an adverse localized environment caused by heat, radiation, or moisture.

Table 3.6.1 Summary of Aging Management Evaluations for Electrical Components

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.6.1-10	Conductor insulation for inaccessible power cables greater than or equal to 400 volts (e.g., installed in conduit or direct buried) composed of Various organic polymers (e.g., EPR, SR, EPDM, XLPE) exposed to Adverse localized environment caused by significant moisture	Reduced insulation resistance due to moisture	Chapter XI.E3, "Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No	Consistent with NUREG-1801. The Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.2.1.39) program will be used to manage the reduced insulation resistance of the conductor insulation in inaccessible power cables greater than or equal to 400 volts, exposed to an adverse localized environment caused by significant moisture.
3.6.1-11	Metal enclosed bus: enclosure assemblies composed of Elastomers exposed to Air – indoor, controlled or uncontrolled or Air – outdoor	Surface cracking, crazing, scuffing, dimensional change (e.g. “ballooning” and “necking”), shrinkage, discoloration, hardening and loss of strength due to elastomer degradation	Chapter XI.E4, "Metal Enclosed Bus," or Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	Consistent with NUREG-1801. The Metal-Enclosed Bus (B.2.1.40) program will be used to manage the surface cracking, crazing, scuffing, dimensional change, shrinkage, discoloration, hardening and loss of strength of elastomers in metal enclosed bus enclosure assemblies, exposed to air – indoor, uncontrolled or air – outdoor.
3.6.1-12	Metal enclosed bus: bus/connections composed of Various metals used for electrical bus and connections exposed to Air – indoor, controlled or uncontrolled or Air – outdoor	Increased resistance of connection due to the loosening of bolts caused by thermal cycling and ohmic heating	Chapter XI.E4, "Metal Enclosed Bus"	No	Consistent with NUREG-1801. The Metal-Enclosed Bus (B.2.1.40) program will be used to manage the increased resistance of connection of various metals in metal enclosed bus: bus/connections, exposed to air – indoor, uncontrolled or air – outdoor.

Table 3.6.1 Summary of Aging Management Evaluations for Electrical Components

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.6.1-13	Metal enclosed bus: insulation; insulators composed of Porcelain; xenoy; thermo-plastic organic polymers exposed to Air – indoor, controlled or uncontrolled or Air – outdoor	Reduced insulation resistance due to thermal/ thermoxidative degradation of organics/thermoplastics, radiation-induced oxidation, moisture/debris intrusion, and ohmic heating	Chapter XI.E4, "Metal Enclosed Bus"	No	Consistent with NUREG-1801. The Metal-Enclosed Bus (B.2.1.40) program will be used to manage the reduced insulation resistance of porcelain and various organic polymers in metal enclosed bus: insulation/insulators, exposed to air – indoor, uncontrolled or air - outdoor.
3.6.1-14	Metal enclosed bus: external surface of enclosure assemblies composed of Steel exposed to Air – indoor, uncontrolled or Air – outdoor	Loss of material due to general, pitting, and crevice corrosion	Chapter XI.E4, "Metal Enclosed Bus," or Chapter XI.S6, "Structures Monitoring"	No	Not applicable. There is no steel in metal enclosed bus, external surface enclosure assemblies that are in scope of license renewal at BBS.
3.6.1-15	Metal enclosed bus: external surface of enclosure assemblies composed of Galvanized steel; aluminum exposed to Air – outdoor	Loss of material due to pitting and crevice corrosion	Chapter XI.E4, "Metal Enclosed Bus," or Chapter XI.S6, "Structures Monitoring"	No	Consistent with NUREG-1801. The Metal Enclosed Bus (B.2.1.40) program will be used to manage the loss of material of aluminum in metal enclosed bus: external surface of enclosure assemblies, exposed to air – outdoor.

Table 3.6.1 Summary of Aging Management Evaluations for Electrical Components

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.6.1-16	Fuse holders (not part of active equipment): metallic clamps composed of Various metals used for electrical connections exposed to Air – indoor, uncontrolled	Increased resistance of connection due to chemical contamination, corrosion, and oxidation (in an air, indoor controlled environment, increased resistance of connection due to chemical contamination, corrosion and oxidation do not apply); fatigue due to ohmic heating, thermal cycling, electrical transients	Chapter XI.E5, "Fuse Holders"	No	Consistent with NUREG-1801. The Fuse Holders (Byron Only) (B.2.1.41) program will be used to manage the increased resistance of connection and fatigue of various metals used for electrical connections in the metallic portions of fuse holders that are not part of active equipment, exposed to air – indoor, uncontrolled.
3.6.1-17	Fuse holders (not part of active equipment): metallic clamps composed of Various metals used for electrical connections exposed to Air – indoor, controlled or uncontrolled	Increased resistance of connection due to fatigue caused by frequent manipulation or vibration	Chapter XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are located in an environment that does not subject them to environmental aging mechanisms or fatigue caused by frequent manipulation or vibration	No	Consistent with NUREG-1801. The Fuse Holders (Byron Only) (B.2.1.41) program will be used to manage the increased resistance of connection of various metals used for electrical connections in the metallic portions of fuse holders that are not part of active equipment, exposed to air – indoor, uncontrolled.

Table 3.6.1 Summary of Aging Management Evaluations for Electrical Components					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.6.1-18	Cable connections (metallic parts) composed of Various metals used for electrical contacts exposed to Air – indoor, controlled or uncontrolled or Air – outdoor	Increased resistance of connection due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	Chapter XI.E6, "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No	Consistent with NUREG-1801. The Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.2.1.42) program will be used to manage the increased resistance of connection of various metals used for electrical contacts in the metallic parts of cable connections, exposed to air – indoor, uncontrolled or air – outdoor.
3.6.1-19	Connector contacts for electrical connectors exposed to borated water leakage composed of Various metals used for electrical contacts exposed to Air with borated water leakage	Increased resistance of connection due to corrosion of connector contact surfaces caused by intrusion of borated water	Chapter XI.M10, “Boric Acid Corrosion”	No	Consistent with NUREG-1801. The Boric Acid Corrosion (B.2.1.4) program will be used to manage increased resistance of connection of various metals used for connector contacts for electrical connectors exposed to air with borated water leakage.
3.6.1-20	Transmission conductors composed of Aluminum exposed to Air – outdoor	Loss of conductor strength due to corrosion	None - for Aluminum Conductor Aluminum Alloy Reinforced (ACAR)	None	Consistent with NUREG-1801.

Table 3.6.1 Summary of Aging Management Evaluations for Electrical Components					
Item Number	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Discussion**
3.6.1-21	Fuse holders (not part of active equipment): insulation material, Metal enclosed bus: external surface of enclosure assemblies composed of Insulation material: bakelite; phenolic melamine or ceramic; molded polycarbonate; other, Galvanized steel; aluminum, Steel exposed to Air – indoor, controlled or uncontrolled	None	None	NA - No AEM or AMP	Consistent with NUREG-1801.

Table 3.6.2-1
Electrical Commodities
Summary of Aging Management Evaluation

Table 3.6.2-1 Electrical Commodities

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Cable Connections (Metallic Parts)	Electrical Continuity	Various Metals Used for Electrical Connections	Air - Indoor Uncontrolled (External)	Increased Resistance of Connection	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.2.1.42)	VI.A.LP-30	3.6.1-18	A
			Air - Outdoor (External)	Increased Resistance of Connection	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.2.1.42)	VI.A.LP-30	3.6.1-18	A
Conductor insulation for inaccessible power cables greater than or equal to 400 volts	Insulate (Electrical)	Various Organic Polymers	Adverse Localized Environment	Reduced Insulation Resistance	Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.2.1.39)	VI.A.LP-35	3.6.1-10	A
Connector Contacts for Electrical Connectors Exposed to Borated Water Leakage	Electrical Continuity	Various Metals Used for Electrical Contacts	Air with Borated Water Leakage (External)	Increased Resistance of Connection	Boric Acid Corrosion (B.2.1.4)	VI.A.LP-36	3.6.1-19	A
Electrical Equipment Subject to 10 CFR 50.49 EQ Requirements	Electrical Continuity	Various Metals Used for Electrical Contacts	Adverse Localized Environment	Various Aging Effects	Environmental Qualification (EQ) of Electric Components (B.3.1.3)	VI.B.L-05	3.6.1-1	A

Table 3.6.2-1 Electrical Commodities (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Electrical Equipment Subject to 10 CFR 50.49 EQ Requirements	Insulate (Electrical)	Various Organic Polymers	Adverse Localized Environment	Various Aging Effects	Environmental Qualification (EQ) of Electric Components (B.3.1.3)	VI.B.L-05	3.6.1-1	A
Fuse Holders (not part of active equipment): insulation material	Insulate (Electrical)	Insulation Material: Bakelite; Phenolic Melamine or Ceramic; Molded Polycarbonate; other	Air - Indoor Uncontrolled (External)	None	None	VI.A.LP-24	3.6.1-21	A
Fuse Holders (not part of active equipment): metallic clamps	Electrical Continuity	Various Metals Used for Electrical Connections	Air - Indoor Uncontrolled (External)	Increased Resistance of Connection	Fuse Holders (Byron Only) (B.2.1.41)	VI.A.LP-31	3.6.1-17	A, 8
				Increased Resistance of Connection; Fatigue	Fuse Holders (Byron Only) (B.2.1.41)	VI.A.LP-23	3.6.1-16	A, 8
High Voltage Insulators	Insulate (Electrical)	Porcelain; Malleable Iron; Aluminum; Galvanized Steel; Cement	Air - Outdoor (External)	None	None	VI.A.LP-32	3.6.1-2	I, 1
				None	None	VI.A.LP-28	3.6.1-3	I, 2
Insulation Material for Electrical Cables and Connections	Insulate (Electrical)	Various Organic Polymers	Adverse Localized Environment	Reduced Insulation Resistance	Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (B.2.1.37)	VI.A.LP-33	3.6.1-8	A

Table 3.6.2-1 Electrical Commodities (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Insulation Material for Electrical Cables and Connections used in Instrumentation Circuits	Insulate (Electrical)	Various Organic Polymers	Adverse Localized Environment	Reduced Insulation Resistance	Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits (B.2.1.38)	VI.A.LP-34	3.6.1-9	A
Metal Enclosed Bus: Bus/Connections	Electrical Continuity	Various Metals Used for Electrical Bus and Connections	Air - Indoor Uncontrolled (External)	Increased Resistance of Connection	Metal-Enclosed Bus (B.2.1.40)	VI.A.LP-25	3.6.1-12	A
			Air - Outdoor (External)	Increased Resistance of Connection	Metal-Enclosed Bus (B.2.1.40)	VI.A.LP-25	3.6.1-12	A
Metal Enclosed Bus: Enclosure Assemblies	Shelter, Protection	Elastomers	Air - Indoor Uncontrolled (External)	Surface Cracking, Crazing, Scuffing, Dimensional Change, Shrinkage, Discoloration, Hardening and Loss of Strength	Metal-Enclosed Bus (B.2.1.40)	VI.A.LP-29	3.6.1-11	A
			Air - Outdoor (External)	Surface Cracking, Crazing, Scuffing, Dimensional Change, Shrinkage, Discoloration, Hardening and Loss of Strength	Metal-Enclosed Bus (B.2.1.40)	VI.A.LP-29	3.6.1-11	A
Metal Enclosed Bus: External Surface of Enclosure Assemblies	Shelter, Protection	Aluminum	Air - Indoor Uncontrolled (External)	None	None	VI.A.LP-41	3.6.1-21	A
			Air - Outdoor (External)	Loss of Material	Metal-Enclosed Bus (B.2.1.40)	VI.A.LP-42	3.6.1-15	A

Table 3.6.2-1 Electrical Commodities (Continued)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Item	Table 1 Item	Notes
Metal Enclosed Bus: Insulation, Insulators	Insulate (Electrical)	Porcelain, Various Organic Polymers	Air - Indoor Uncontrolled (External)	Reduced Insulation Resistance	Metal-Enclosed Bus (B.2.1.40)	VI.A.LP-26	3.6.1-13	A
			Air - Outdoor (External)	Reduced Insulation Resistance	Metal-Enclosed Bus (B.2.1.40)	VI.A.LP-26	3.6.1-13	A
Switchyard Bus and Connections	Electrical Continuity	Aluminum, Stainless Steel	Air - Outdoor (External)	None	None	VI.A.LP-39	3.6.1-6	I, 3
Transmission Conductors	Electrical Continuity	Aluminum	Air - Outdoor (External)	Loss of Conductor Strength	None	VI.A.LP-46	3.6.1-20	A, 7
				None	None	VI.A.LP-47	3.6.1-7	I, 4
		Aluminum, Steel	Air - Outdoor (External)	None	None	VI.A.LP-38	3.6.1-4	I, 5
				None	None	VI.A.LP-47	3.6.1-7	I, 4
Transmission Connectors	Electrical Continuity	Aluminum, Steel	Air - Outdoor (External)	None	None	VI.A.LP-48	3.6.1-5	I, 6

Table 3.6.2-1 Electrical Commodities (Continued)

Notes	Definition of Note
A	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
B	Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
C	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.
D	Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.
E	Consistent with NUREG-1801 item for material, environment and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.
F	Material not in NUREG-1801 for this component.
G	Environment not in NUREG-1801 for this component and material.
H	Aging effect not in NUREG-1801 for this component, material and environment combination.
I	Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.
J	Neither the component nor the material and environment combination is evaluated in NUREG-1801.

Plant Specific Notes:

1. Based on BBS design and a review of operating experience, loss of material is not an applicable aging effect for BBS high voltage insulators. In scope high voltage insulators are not subject to mechanical wear caused by wind blowing on transmission conductors. For more information see LRA Section 3.6.2.2.2.

2. Based on BBS design and a review of operating experience, reduced insulation resistance is not an applicable aging effect for BBS high voltage insulators. In scope high voltage insulators are not subject to reduced insulation resistance due to the presence of salt deposits or surface contamination. For more information see LRA Section 3.6.2.2.2.

Table 3.6.2-1 Electrical Commodities (Continued)

Plant Specific Notes: (continued)

3. Based on BBS design and a review of operating experience, loss of material and increased resistance of connection are not applicable aging effects for BBS switchyard bus and connections. In scope switchyard bus and connections are not subject to wind induced abrasion nor oxidation or loss of pre-load. For more information see LRA Section 3.6.2.2.3.

4. Based on BBS design and a review of operating experience loss of material is not an applicable aging effect for BBS transmission conductors. In scope BBS transmission conductors are not subject to wind induced abrasion. For more information see LRA Section 3.6.2.2.3.

5. Based on BBS design and a review of operating experience loss of conductor strength is not an applicable aging effect for BBS transmission conductors. In scope BBS transmission conductors are not subject to corrosion. For more information see LRA Section 3.6.2.2.3.

6. Based on BBS design and a review of operating experience increased resistance of connection is not an applicable aging effect for BBS transmission connectors. In scope BBS transmission connectors are not subject to oxidation or loss of pre-load. For more information see LRA Section 3.6.2.2.3.

7. Based on Byron design, a portion of the in-scope transmission conductors are all-aluminum conductor (AAC). AAC transmission conductors have the same characteristics as aluminum conductor aluminum alloy reinforced (ACAR) transmission conductors.

8. Based on BBS design and a review of operating experience, increased resistance of connection is not an applicable aging effect for Braidwood Fuse Holders (not part of active equipment): metallic clamps. In scope Fuse Holders (not part of active equipment): metallic clamps at Braidwood are not subject to chemical contamination, corrosion, and oxidation nor subject to fatigue caused by ohmic heating, thermal cycling, electrical transients, frequent manipulation, or vibration. For more information see LRA Section 3.6.2.3.1.

4.0 TIME-LIMITED AGING ANALYSES

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

This section presents descriptions of the Time-Limited Aging Analyses (TLAAs) for Byron and Braidwood Stations, Units 1 and 2 (BBS) in accordance with 10 CFR 54.3(a) and 10 CFR 54.21(c). Section 4.0 is divided into Subsections 4.1 through 4.8. Subsection 4.1 describes the process used to identify TLAAs and exemptions that are based on TLAAs. Each of the Subsection 4.2 through 4.7 evaluates the TLAAs associated with a TLAA category for the period of extended operation. Table 4.1-2 lists the TLAAs in each section and provides a reference to the subsection where they are evaluated. Subsection 4.8 provides the list of references.

By letter dated June 23, 2011, Exelon requested an increase in licensed power level for Byron and Braidwood Stations, Units 1 and 2 from 3586.6 MWt to 3645 MWt based on Measurement Uncertainty Recapture (MUR). NRC approval of the MUR is anticipated in the 3rd quarter, 2013. It should be noted that any impact of MUR on engineering analyses that involve license renewal TLAAs was taken into account prior to crediting or updating the analyses for this license renewal application. As discussed in Section 1.2.1, any change to the current licensing basis that materially affects the contents of the license renewal application, including any impact due to completion of MUR review activities, will be addressed in an annual update.

4.1 IDENTIFICATION OF TIME-LIMITED AGING ANALYSES

Pursuant to 10 CFR 54.3, time-limited aging analyses (TLAAs) are defined as those licensee calculations and analyses that:

1. Involve systems, structures, and components within the scope of license renewal;
2. Consider the effects of aging;
3. Involve time-limited assumptions defined by the current operating term, for example 40 years;
4. Were determined to be relevant by the licensee in making a safety determination;
5. Involve conclusions or provide the basis for conclusions related to the capability of the system, structure, and component to perform intended functions; and
6. Are contained or incorporated by reference in the current licensing basis (CLB).

4.1.1 IDENTIFICATION OF BBS TIME-LIMITED AGING ANALYSES

TLAAs have been identified for BBS using methods consistent with those provided in NUREG-1800, Revision 2, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants” (SRP) and with 10 CFR 54, “Requirements for Renewal of Operating License for Nuclear Power Plants.”

A generic list of potential TLAAs was assembled from the SRP, industry guidance, and experience including:

- NUREG-1800, Revision 2, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants”
- NUREG-1801, Revision 2, “Generic Aging Lessons Learned (GALL) Report”
- NEI 95-10, Revision 6, “Industry Guideline for Implementing the Requirements of 10 CFR 54, the License Renewal Rule”
- The 10 CFR 54 Final Rule “Statement of Considerations”
- Prior license renewal applications, NRC Requests for Additional Information, and NRC Safety Evaluation Reports for these applications.

CLB and design basis documentation was searched to identify potential TLAAs. The document search included the following:

- Updated Final Safety Analysis Report (UFSAR)
- Technical Specifications and Bases
- Technical Requirements Manual
- Docketed licensing correspondence
- NRC Safety Evaluation Reports (SERs)
- Design Basis Documents (DBDs)
- Westinghouse design analyses and reports
- Vendor design analyses and reports
- Environmental Qualification Binders

- Design Specifications
- Engineering Changes
- Corrective Action Program Reports
- Self Assessment Reports
- 10 CFR 50.12 Exemption Requests
- Inspection Relief Requests

Each potential TLAA was reviewed against the six criteria of 10 CFR 54.3(a). Those that met all six criteria were identified as TLAAs which require evaluation for the period of extended operation. LRA Table 4.1-1 lists the example TLAAs provided in NUREG-1800, Tables 4.1-2 and 4.1-3, and specifies whether or not these have been identified as TLAAs for BBS. Those with a “Yes” entry apply to BBS and the LRA section where they are evaluated is provided. Those with a “No” entry were determined to not apply to BBS. No TLAAs were identified for these categories either because they are associated with design features not employed at BBS or because no analyses were identified in this category that meet all six TLAA criteria.

BBS also reviewed previous license renewal applications and requests for additional information to determine if a TLAA evaluated for another plant was applicable to BBS. The same process as applied to the review of CLB documentation was applied to determine if the TLAA was applicable to BBS and if applicable evaluated for the period of extended operation.

Table 4.1-1

Review of Generic TLAAs Listed in NUREG-1800, Tables 4.1-2 and 4.1-3

NUREG-1800 Example TLAA	Applies to BBS	LRA Section
NUREG-1800, Table 4.1-2 – Potential TLAAs		
Reactor vessel neutron embrittlement (Subsection 4.2)	Yes	4.2
Metal fatigue (Subsection 4.3)	Yes	4.3
Environmental qualification (EQ) of electrical components (Subsection 4.4)	Yes	4.4
Concrete containment tendon prestress (Subsection 4.5)	Yes	4.5
Inservice local metal containment corrosion analysis (Subsection 4.6)	No (1)	NA
NUREG-1800, Table 4.1-3 – Additional Examples of Plant-Specific TLAAs		
Intergranular separation in the heat-affected zone (HAZ) of reactor vessel low-alloy steel under austenitic SS cladding	No (2)	NA
Low-temperature overpressure protection (LTOP) analyses (PWR)	Yes	4.2.6
Fatigue analysis for the main steam supply lines to the turbine driven auxiliary feedwater pumps	No (3)	NA
Fatigue analysis for the reactor coolant pump flywheel	Yes	4.7.5
Fatigue analysis of polar crane	Yes	4.7.2
Flow-induced vibration endurance limit for the reactor vessel internals	No	4.3.5
Transient cycle count assumptions for the reactor vessel internals	Yes	4.3.5
Ductility reduction of fracture toughness for the reactor vessel internals	No (4)	NA
Leak-before-break	Yes	4.7.1
Fatigue analysis for the containment liner plate	Yes	4.6.1
Containment penetration pressurizations cycles	Yes	4.6.4
Metal corrosion allowance	No (5)	NA
High-energy line-break postulation base on fatigue CUF	Yes	4.3.6

Table 4.1-1

Review of Generic TLAAs Listed in NUREG-1800, Tables 4.1-2 and 4.1-3

NUREG-1800 Example TLAA	Applies to BBS	LRA Section
Inservice flaw growth analyses that demonstrate structure stability for 40 years	Yes	4.7.4, 4.7.6, 4.7.7, 4.7.8

Notes:

(1) There are no containment corrosion analyses justifying 40 years operation.

(2) No analysis performed since the cladding was installed using a qualified high heat welding process to avoid underclad cracking as an aging effect as documented in the Appendix A1.43 of the BBS UFSAR.

(3) No TLAA exists since BBS does not have steam driven auxiliary feedwater pumps.

(4) No TLAA exists since no CLB analysis was identified to address ductility reduction fracture toughness for the BBS reactor vessel internals.

(5) No metal corrosion allowance analyses applicable to 40-year operation were identified.

4.1.2 EVALUATION OF BBS TIME-LIMITED AGING ANALYSES

Each part of Section 4 evaluates one or more related TLAAs. Information is provided using the following definitions:

TLAA Description:

A description of the CLB analysis that has been identified as a TLAA, including a description of the aging effect evaluated, the time-limited variable used in the analysis, and its basis.

TLAA Evaluation:

An evaluation of the TLAA for the period of extended operation, provides information associated with 60 years of operation for comparison with the information used in the TLAA that considered 40 years of operation. This evaluation will provide the basis for the disposition, which will fall into one of the three disposition categories described below.

TLAA Disposition:

The disposition is classified in accordance with one or more of the acceptance criteria from 10 CFR 54.21(c)(1) specified below in Section 4.1.3.

4.1.3 ACCEPTANCE CRITERIA

10 CFR 54.21, Contents of application – technical information, states that an application must contain the following information:

(c) An evaluation of time-limited aging analyses.

(1) A list of time-limited aging analyses, as defined in §54.3, must be provided. The applicant shall demonstrate that:

(i) The analyses remain valid for the period of extended operation;

(ii) The analyses have been projected to the end of the period of extended operation; or

(iii) The effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

One or more of these three methods were used to disposition each TLAA identified for BBS. The disposition methods used are described in each TLAA evaluation section.

4.1.4 SUMMARY OF RESULTS

Several categories of TLAAs were identified for BBS. The TLAAs are grouped together by affected component type and aging effect analyzed, as shown in the TLAA Summary in Table 4.1-2. The table includes a reference to the applicable section of the application that evaluates each TLAA. LRA Subsection 4.1.5 evaluates exemptions to 10 CFR 50.12 in effect that are based upon TLAAs. LRA Subsections 4.2 through 4.7 provide descriptions and evaluations of the TLAAs and classify their disposition.

Table 4.1-2

SUMMARY OF RESULTS – BBS TIME-LIMITED AGING ANALYSES

TLAA DESCRIPTION	DISPOSITION	LRA SECTION
IDENTIFICATION OF TIME-LIMITED AGING ANALYSES		4.1
Identification of BBS Time-Limited Aging Analyses	NA	4.1.1
Evaluation of BBS Time-Limited Aging Analyses	NA	4.1.2
Acceptance Criteria	NA	4.1.3
Summary of Results	NA	4.1.4
Identification and Evaluation of BBS Exemptions	NA	4.1.5

Table 4.1-2

SUMMARY OF RESULTS – BBS TIME-LIMITED AGING ANALYSES

TLAA DESCRIPTION	DISPOSITION	LRA SECTION
REACTOR VESSEL NEUTRON EMBRITTLEMENT ANALYSIS		4.2
Neutron Fluence Projections	§54.21(c)(1)(ii)	4.2.1
Upper-Shelf Energy	§54.21(c)(1)(ii)	4.2.2
Pressurized Thermal Shock	§54.21(c)(1)(ii)	4.2.3
Adjusted Reference Temperature	§54.21(c)(1)(ii)	4.2.4
Pressure-Temperature Limits	§54.21(c)(1)(iii)	4.2.5
Low Temperature Overpressure Projection (LTOP) Analyses	§54.21(c)(1)(iii)	4.2.6
METAL FATIGUE		4.3
Transient Inputs to Fatigue Analyses	§54.21(c)(1)(ii)	4.3.1
ASME Section III, Class 1, Class 2, and Class 3 Fatigue Analyses	§54.21(c)(1)(iii)	4.3.2
ASME Section III, Class 2 and 3 and ANSI B31.1 Allowable Stress Analyses	§54.21(c)(1)(iii) and §54.21(c)(1)(i)	4.3.3
Class 1 Component Fatigue Analyses Supporting GSI-190 Closure	§54.21(c)(1)(iii)	4.3.4
Reactor Vessel Internals Fatigue Analyses	§54.21(c)(1)(iii)	4.3.5
High-Energy Line Break (HELB) Analyses Based on Fatigue	§54.21(c)(1)(iii)	4.3.6
NRC Bulletin 88-11 Revised Fatigue Analysis of the Pressurizer Surge Line for Thermal Cycling and Stratification	§54.21(c)(1)(iii)	4.3.7
ASME Section III, Subsection NF, Class 1 Component Supports Allowable Stress Analyses	§54.21(c)(1)(iii)	4.3.8
Fatigue Design of Spent Fuel Pool Liner and Spent Fuel Storage Racks for Seismic Events	§54.21(c)(1)(iii)	4.3.9
Pressurizer Heater Sleeve Structural Assessment	§54.21(c)(1)(iii)	4.3.10

Table 4.1-2

SUMMARY OF RESULTS – BBS TIME-LIMITED AGING ANALYSES

TLAA DESCRIPTION	DISPOSITION	LRA SECTION
ENVIRONMENTAL QUALIFICATION (EQ) OF ELECTRIC COMPONENTS	§54.21(c)(1)(iii)	4.4
CONCRETE CONTAINMENT TENDON PRESTRESS ANALYSIS	§54.21(c)(1)(iii)	4.5
CONTAINMENT LINER PLATE, METAL CONTAINMENTS, AND PENETRATIONS FATIGUE ANALYSES		4.6
Containment Liner Plates Fatigue	§54.21(c)(1)(iii)	4.6.1
Containment Airlocks and Hatches Fatigue	§54.21(c)(1)(iii)	4.6.2
Containment Electrical Penetrations Fatigue	§54.21(c)(1)(iii)	4.6.3
Containment Piping Penetrations Fatigue	§54.21(c)(1)(iii)	4.6.4
Fuel Transfer Tube Bellows Fatigue	§54.21(c)(1)(iii)	4.6.5
Recirculation Sump Guard Piping Bellows Fatigue	§54.21(c)(1)(iii)	4.6.6
OTHER PLANT-SPECIFIC TIME-LIMITED AGING ANALYSES		4.7
Leak-Before-Break	§54.21(c)(1)(i) and §54.21(c)(1)(ii)	4.7.1
Crane Load Cycle Limits	§54.21(c)(1)(i)	4.7.2
Mechanical Environmental Qualification	§54.21(c)(1)(iii)	4.7.3
Residual Heat Removal Heat Exchangers Tube Side Inlet and Outlet Nozzles Fracture Mechanics Analysis	§54.21(c)(1)(iii)	4.7.4
Reactor Coolant Pump Flywheel Crack Growth Analysis	§54.21(c)(1)(i)	4.7.5
Byron Unit 2 Pressurizer Seismic Restraint Lug Flaw Evaluation	§54.21(c)(1)(iii)	4.7.6
Braidwood Unit 2 Feedwater Pipe Elbow Crack Growth Evaluation	§54.21(c)(1)(iii)	4.7.7
Analyses Supporting Flaw Evaluations of Primary System Components	§54.21(c)(1)(i) and §54.21(c)(1)(iii)	4.7.8

4.1.5 IDENTIFICATION AND EVALUATION OF BBS EXEMPTIONS

10 CFR 54.21(c)(2) states: A list must be provided of plant-specific exemptions granted pursuant to 10 CFR 50.12 and in effect that are based on time-limited aging analyses as defined in 10 CFR 54.3. The applicant shall provide an evaluation that justifies the continuation of these exemptions for the period of extended operation. A search of docketed correspondence, the operating license, and the Updated Final Safety Analysis Report (UFSAR) identified the exemptions in effect that are based upon a time-limited aging analysis. These exemptions are shown in Table 4.1-3. All six exemptions are associated with Pressure-Temperature (P-T) limits developed using exemptions to 10 CFR 50 Appendix G.

Table 4.1-3 – BBS EXEMPTION EVALUATION TABLE

BBS Unit **Exemption Approval Date**	**Exemption Description**	**Based upon TLAA?**	**In Effect during PEO?**
Braidwood Unit 1 7/13/1995	NRC granted an exemption from 10 CFR 50.60 to use alternate methodology as proposed in ASME Code Case N-514 “Low Temperature Overpressure Protection” for calculating the maximum allowable pressure for the low temperature overpressure (LTOP) setpoint. ASME Code Case N-514 allows determination of the setpoint for LTOP events such that the maximum pressure in the reactor vessel will not exceed 110 percent of the P-T limits of the existing ASME Appendix G curves. See Section 4.2.6 for additional information.	Yes	See Note 1
Byron Units 1 & 2 11/29/1996	NRC granted an exemption from 10 CFR 50.60 to use alternate methodology as proposed in ASME Code Case N-514 “Low Temperature Overpressure Protection” for calculating the maximum allowable pressure for the low temperature overpressure (LTOP) setpoint. ASME Code Case N-514 allows determination of the setpoint for LTOP events such that the maximum pressure in the reactor vessel will not exceed 110 percent of the P-T limits of the existing ASME Appendix G curves. See Section 4.2.6 for additional information.	Yes	See Note 1

Table 4.1-3 – BBS EXEMPTION EVALUATION TABLE			
BBS Unit **Exemption Approval Date**	**Exemption Description**	**Based upon TLAA?**	**In Effect during PEO?**
Braidwood Unit 2 12/12/1997	NRC granted an exemption from 10 CFR 50.60 to use alternate methodology as proposed in ASME Code Case N-514 "Low Temperature Overpressure Protection" for calculating the maximum allowable pressure for the low temperature overpressure (LTOP) setpoint. ASME Code Case N-514 allows determination of the setpoint for LTOP events such that the maximum pressure in the reactor vessel will not exceed 110 percent of the P-T limits of the existing ASME Appendix G curves. See Section 4.2.6 for additional information.	Yes	See Note 1
Byron and Braidwood, Units 1 & 2 1/16/1998	NRC granted an exemption to use the safety margins based on the 1996 Addenda to the ASME Code in lieu of the 1989 Edition for the determination of the setpoint for mitigating low temperature overpressure (LTOP) events so that the maximum pressure in the vessel would not exceed 110 percent of the Appendix G P-T limits. It should be noted that provision to allow determination of the setpoint for mitigating low temperature overpressure (LTOP) events so that the maximum pressure in the vessel would not exceed 110 percent of the P-T limits was previously approved by exemption to 10 CFR 50.60 for Byron Units 1 and 2 on November 29, 1996, for Braidwood Unit 1 on July 13, 1995 and for Braidwood Unit 2 on December 12, 1997. See Section 4.2.6 for additional information.	Yes	See Note 1
Byron and Braidwood, Units 1 & 2 8/8/2001	NRC granted an exemption to 10 CFR 50.60(a) and 10 CFR 50 Appendix G to permit the use of Code Case N-588, "Alternative to Reference Flaw Orientation of Appendix G for Circumferential Welds in Reactor Vessels, Section XI, Division 1" and Code Case N-640, "Alternative Reference Fracture Toughness for Development of P-T Limit Curves for ASME Section XI, Division 1." Code Case N-588 permits the postulation of a circumferentially-oriented flaw (in lieu of an axially-oriented flaw) for the evaluation of circumferential reactor pressure vessel (RPV) welds. Code Case N-640 permits the use of an alternate fracture toughness curve for reactor vessel materials in determining the P-T limits. See Section 4.2.1 and Section 4.2.5 for additional information.	Yes	See Note 1

Table 4.1-3 – BBS EXEMPTION EVALUATION TABLE

BBS Unit Exemption Approval Date	Exemption Description	Based upon TLAA?	In Effect during PEO?
Byron and Braidwood Units 1 & 2 11/22/2006	NRC granted an exemption to those requirements related to the application of footnote (2) of Table 1 of 10 CFR 50, Appendix G in calculating certain reactor pressure vessel P-T limits. Footnote (2) to Table 1 of 10 CFR 50, Appendix G specifies that RPV minimum temperature requirements related to RPV closure flange considerations shall be based on the highest reference temperature of the material in the closure flange region that is highly stressed by bolt preload. See Section 4.2.1 and Section 4.2.5 for additional information.	Yes	See Note 1

Notes:

(1) All six of the above exemptions are associated with Pressure-Temperature (P-T) limits that are applicable for 32 Effective Full Power Years (EFPY). Based on EFPY projections described in LRA Section 4.2.1, it is expected that Byron Units 1 and 2 and Braidwood Units 1 and 2 will exceed 32 EFPY prior to the period of extended operation (PEO), thereby necessitating replacement of the P-T limit curves in accordance with 10 CFR 50, Appendix G, prior to the PEO. It is therefore anticipated that these exemptions will not be required to be in effect during PEO. If however, 32 EFPY is not reached prior to the PEO for any reason for any of the BBS units, continuation of these exemptions into the PEO, if necessary, is acceptable because the use of the exemptions as a basis for the 32 EFPY P-T limits was approved by the NRC without a limitation with respect to plant operation beyond the original license term. The above exemptions and their acceptability are not tied to or limited by the original license term.

4.2 REACTOR VESSEL NEUTRON EMBRITTLEMENT ANALYSIS

10 CFR 50.60 requires that all light-water reactors meet the fracture toughness, P-T limits, and materials surveillance program requirements for the reactor coolant pressure boundary as set forth in 10 CFR 50, Appendices G and H. The BBS Reactor Vessel Surveillance program is described in Section B.2.1.19. The ferritic materials of the reactor vessel are subject to embrittlement due to high energy (E > 1.0 MeV) neutron exposure. Embrittlement means the material has lower toughness (i.e., will absorb less strain energy during a crack or rupture), thus allowing a crack to propagate more easily under thermal and pressure loading. Neutron embrittlement analyses are used to account for the reduction in fracture toughness associated with the cumulative neutron fluence (total number of neutrons that intersect a square centimeter of component area during the life of the plant). Since these neutron embrittlement analyses are calculated based on plant life, they are identified as time-limited aging analyses.

Fracture toughness (indirectly measured in foot-pounds of absorbed energy in a Charpy impact test) is temperature dependent in ferritic materials. An initial nil-ductility reference temperature (RT_{NDT}) is associated with the transition from ductile to brittle behavior and is determined for vessel materials through a combination of Charpy and drop-weight testing. Toughness increases with temperature up to a maximum value called the “upper-shelf energy,” or USE. Neutron embrittlement results in the USE decrease of reactor vessel steels.

To reduce the potential for brittle fracture during reactor vessel operation, changes in material toughness as a function of neutron radiation exposure (fluence) are accounted for through the use of operating pressure-temperature (P-T) limits that are included in the unit-specific Byron and Braidwood Pressure-Temperature Limit Reports (Reference 4.8.29). The P-T limits account for the decrease in material toughness of the reactor vessel beltline materials associated with materials that are predicted to receive a cumulative neutron exposure of 1.0×10^{17} neutrons/cm^2 or more during the licensed life of the plant. Since the cumulative neutron fluence will increase during the period of extended operation, a review is required to determine if any additional components will exceed the cumulative neutron fluence threshold value and require evaluation for neutron embrittlement.

Based on the projected drop in toughness for each beltline material as a result of exposure to the predicted fluence values, Upper Shelf Energy calculations are performed to determine if the components will continue to have adequate fracture toughness at the end of the license to meet the required minimums. P-T limit curves are generated to provide minimum temperature limits that must be achieved during operations prior to applications of specified reactor vessel pressures. The P-T limit curves are based upon the RT_{NDT} and ΔRT_{NDT} values computed for the licensed operating period along with appropriate margins.

The reactor vessel material ΔRT_{NDT} and USE values, calculated on the basis of neutron fluence, are part of the current licensing basis and support safety determinations. Therefore, these calculations have been identified as TLAAs.

The following TLAAs related to neutron embrittlement are evaluated in the LRA subsections listed below:

- Neutron Fluence Projections (4.2.1)
- Upper-Shelf Energy (4.2.2)
- Pressurized Thermal Shock (4.2.3)

- Adjusted Reference Temperature (4.2.4)
- Pressure-Temperature (P-T) Limits (4.2.5)
- Low Temperature Overpressure Protection (LTOP) Analyses (4.2.6)

4.2.1 NEUTRON FLUENCE PROJECTIONS

TLAA Description:

Neutron fluence is the term used to represent the cumulative number of neutrons per square centimeter that contact the reactor vessel shell and its internal components over a given period of time. The fluence projections that quantify the number of neutrons that contact these surfaces have been used as inputs to the neutron embrittlement analyses that evaluate the loss of fracture toughness aging effect resulting from neutron fluence.

The fluence projections used as inputs to the current 40-year neutron embrittlement analyses were developed using discrete ordinates transport fluence methodology. These projections predicted the neutron fluence expected to occur during 32 Effective full Power Years (EFPY) of plant operation. At the time the projections were prepared, 32 EFPY was considered to represent the amount of power to be generated over 40 years of plant operation, assuming a 40-year average capacity factor of 80 percent. These fluence projections have been identified as a TLAA. The fluence projections are also inputs to additional TLAAs requiring evaluation for the period of extended operation.

TLAA Evaluation:

The first step in updating fluence projections for 40 years and 60 years is to update the EFPY projections that are based upon actual unit operating history and upon a conservative capacity factor estimate for future cycles through the end of the period of extended operation. The information used to develop these EFPY projections is summarized below.

EFPY Projections

EFPY Projections are the sum of the accumulated EFPYs and the future EFPYs accrued through the end of the period of extended operation at a certain capacity factor. Accumulated EFPY for each BBS unit were calculated at the completion of the latest operating cycle as of May 4, 2011. For future cycles through the end of the period of extended operation, the EFPYs were calculated using a conservative estimate for capacity factor of 100%. The summation of the two values was rounded up to the next whole year. The following are projected 60-year EFPYs for the BBS units:

- Byron Station, Unit 1 – 56 EFPY
- Byron Station, Unit 2 – 57 EFPY
- Braidwood Station, Unit 1 – 56 EFPY
- Braidwood Station, Unit 2 – 57 EFPY

To simplify the input to the required reactor vessel embrittlement analyses, a bounding EFPY at the end of the period of operation of 57 EFPY was used for BBS Units 1 and 2.

Fluence Projections

For license renewal, updated fluence projections based upon 57 EFPY were prepared for use as inputs, to provide margin, in the neutron embrittlement analyses prepared for 60 years of operation (End of License Extended (EOLE)). Since a request for a Measurement Uncertainty Recapture Power Uprate has been submitted to the NRC, the MUR flux levels were used to calculate fluence for cycles occurring after the completion of the last full operating cycle prior to November, 2012.

Fluence values applicable for 60 years of operation were calculated for each BBS reactor vessel beltline material. The analysis methods used to calculate the predicted 60-year BBS vessel fluence values satisfy the requirements set forth in Regulatory Guide 1.190, “Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence” (Reference 4.8.1). These methodologies have been approved by the U.S. Nuclear Regulatory Commission (NRC) and are described in detail in WCAP-14040-A (Reference 4.8.2) and WCAP-16083-NP-A (Reference 4.8.3).

In accordance with 10 CFR 50, Appendix H, any materials exceeding 1.0 X 10^{17} n/cm^2 (E > 1.0 MeV) must be monitored to evaluate their changes in their fracture toughness. Reactor vessel materials that are not traditionally thought of as being plant limiting were evaluated to determine their cumulative fluence values at 57 EFPY. Therefore, fluence calculations were performed for the Byron and Braidwood, Units 1 and 2 RPV inlet nozzle-to-nozzle shell welds, outlet nozzle-to-nozzle shell welds, nozzle shell forging-to-intermediate shell forging circumferential welds, intermediate shell forging-to-lower shell forging circumferential welds, and lower shell forging-to-bottom head circumferential welds to determine if they will exceed 1.0 x 10^{17} n/cm^2 (E > 1.0 MeV) at 57 EFPY. The materials that exceed this threshold are referred to as the extended beltline materials.

Table 4.2.1-1 summarizes the results of the fluence projections to 57 EFPY for Byron and Braidwood Station, Units 1 and 2 beltline and extended beltline materials.

TLAA Disposition: 10 CFR 54.21 (c)(1)(ii) – The fluence analyses have been projected to the end of the period of extended operation. They are to be used as inputs in the neutron embrittlement TLAA evaluations in the remainder of Section 4.2.

Table 4.2.1-1 Byron and Braidwood Stations, Units 1 and 2: 57 EFPY Clad/Base Metal Projected Neutron Fluence (E > 1.0 MeV) for Beltline and Extended Beltline Materials

Reactor Vessel Material	Neutron Fluence (E > 1.0 MeV)[n/cm^2]			
	Byron Unit 1	Byron Unit 2	Braidwood Unit 1	Braidwood Unit 2
Reactor Vessel Beltline Materials				
Nozzle Shell Forging(a)	1.15×10^{19}	1.10×10^{19}	1.14×10^{19}	1.11×10^{19}
Intermediate Shell Forging(b)	3.21×10^{19}	3.19×10^{19}	3.19×10^{19}	3.16×10^{19}
Lower Shell Forging(b)	3.21×10^{19}	3.19×10^{19}	3.19×10^{19}	3.16×10^{19}
Nozzle Shell Forging-to-Intermediate Shell Forging Circ. Weld Seam	1.15×10^{19}	1.10×10^{19}	1.14×10^{19}	1.11×10^{19}
Intermediate Shell Forging-to-Lower Shell Forging Circ. Weld Seam	3.08×10^{19}	3.07×10^{19}	3.06×10^{19}	3.03×10^{19}
Reactor Vessel Extended Beltline Materials				
Inlet Nozzles(c)	1.38×10^{17}	1.30×10^{17}	1.36×10^{17}	1.31×10^{17}
Outlet Nozzles(c)	1.05×10^{17}	1.00×10^{17}	1.04×10^{17}	1.00×10^{17}
Inlet Nozzle-to-Nozzle Shell Forging Weld Seams	1.38×10^{17}	1.30×10^{17}	1.36×10^{17}	1.31×10^{17}
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams	1.05×10^{17}	1.00×10^{17}(d)	1.04×10^{17}	1.00×10^{17}(d)

Notes:

(a) Nozzle shell forging fluence is conservatively assumed to be equivalent to the fluence of the nozzle shell forging-to-intermediate shell forging circumferential weld.

(b) Intermediate shell forging fluence and lower shell forging fluence is taken to be the maximum reactor vessel fluence at the clad/base metal interface.

(c) Inlet and outlet nozzle fluences are conservatively assumed to be equivalent to the fluence for the inlet and outlet nozzle-to-nozzle shell forging weld seams, respectively.

(d) The actual fluence for the outlet nozzle-to-nozzle shell forging weld seams is 9.92×10^{16} n/cm^2 and 9.95×10^{16} n/cm^2 (E > 1.0 MeV) for Byron and Braidwood Units 2, respectively. The fluence for these welds is conservatively assumed to be 1.00×10^{17}. Therefore, all the Byron and Braidwood Unit 2 outlet nozzles and outlet nozzle-to-nozzle shell forging weld seams are considered in reactor vessel integrity evaluations to be consistent with the respective Unit 1 components.

4.2.2 UPPER-SHELF ENERGY

TLAA Description:

The current licensing basis Upper Shelf Energy (USE) calculations were prepared for Byron and Braidwood reactor vessel beltline materials for 32 EFPY. Since the USE value is a function of 32 EFPY fluence, associated with the 40-year licensed operating period, these USE calculations meet the criteria of 10 CFR 54.3(a) and have been identified as TLAAs requiring evaluation for 60 years.

TLAA Evaluation:

Appendix G of 10 CFR 50, Paragraph IV.A.1.a, states that reactor vessel beltline materials must have Charpy upper-shelf energy of no less than 75 ft-lb initially, and must maintain Charpy upper-shelf energy (USE) throughout the life of the vessel of no less than 50 ft-lb, unless it is demonstrated in a manner approved by the Director, Office of Nuclear Reactor Regulation, that lower values of Charpy upper-shelf energy will provide margins of safety against fracture equivalent to those required by Appendix G of Section XI of the ASME Code.

Per Regulatory Guide 1.99, Revision 2 (Reference 4.8.4), the Charpy USE should be assumed to decrease as a function of fluence according to Figure 2 of the Regulatory Guide when credible surveillance data is not available. If credible surveillance data is available, the decrease in USE may be obtained by plotting the reduced plant surveillance data on Figure 2 of the Regulatory Guide and fitting the data with a line drawn parallel to the existing lines as the upper bound of all of the data.

The Byron and Braidwood reactor vessels were fabricated by Babcock & Wilcox (B&W) and consist of the nozzle shell forgings, intermediate shell forgings, lower shell forgings, nozzle shell forging-to-intermediate shell forging circumferential weld seams, and intermediate shell forging-to-lower shell forging circumferential weld seams. No longitudinal welds are used on the Byron and Braidwood reactor vessels. The inlet and outlet nozzles are also fabricated from forged material.

Certified Material Test Report (CMTR) data were used to determine the chemical compositions for all of the Byron and Braidwood Units 1 and 2 RPV beltline and extended beltline forging and weld materials. The chemical compositions of the beltline materials are consistent with those documented in the U.S. NRC Reactor Vessel Integrity Database (RVID), except for the weight-percent nickel (Ni) for the Nozzle Shell Forging and the weight-percent copper (Cu) of the Lower Shell Forging of Braidwood Unit 1. However, the Cu and Ni values for these materials are conservative compared to the values listed in RVID. The initial USE values for the Byron and Braidwood Units 1 and 2 beltline materials are inconsistent with those documented in RVID; however, the values used are consistent with those used in the MUR power uprate evaluation and are based on data contained in the CMTRs. The initial USE values for the extended beltline forging and weld materials were also determined based on data contained in the CMTRs.

Predictions of the Charpy USE for 57 EFPY were determined in accordance with NUREG-0800, Branch Technical Position 5-3 (Reference 4.8.5), and are summarized in Table 4.2.2-1 and Table 4.2.2-2 for Byron Station, Units 1 and 2, and in Table 4.2.2-3 and Table 4.2.2-4 for Braidwood Station, Units 1 and 2. These predictions are using the corresponding 1/4T fluence projection, the copper content of the beltline and extended beltline materials, the results of the capsules tested to-date, and where applicable, using Figure 2 in Regulatory Guide 1.99

(Reference 4.8.4). Where credible surveillance data is available, entries are included, as noted in the tables.

The USE values for the beltline and extended beltline materials are projected to remain above the 50 ft-lb minimum requirement through the period of extended operation as indicated in Table 4.2.2-1 through Table 4.2.2-4 for the BBS, Units 1 and 2. Therefore, the requirements of 10 CFR 50, Appendix G will continue to be met through the period of extended operation.

TLAA Disposition: 10 CFR 54.21 (c)(1)(ii) – The USE analyses have been projected to the end of the period of extended operation.

Table 4.2.2-1 Byron Unit 1: Predicted USE Values at 57 EFPY (EOLE)

Reactor Vessel Material	Cu[(a)] (Wt. %)	1/4T EOLE Fluence[(b)] ($x10^{19}$ n/cm^2, E > 1.0 MeV)	Initial USE[(a)] (ft-lb)	Projected USE Decrease[(c)] (%)	Projected EOLE USE (ft-lb)
Reactor Vessel Beltline Materials					
Nozzle Shell Forging	0.05	0.691	138	17.5	114
Intermediate Shell Forging	0.04	1.928	139	22	108
Using Byron Unit 1 surveillance data	0.04	1.928	139	4.8[(d)]	132
Lower Shell Forging	0.04	1.928	150	22.0	117
Nozzle Shell Forging-to Intermediate Shell Forging Circ. Weld Seam (Heat # 442011)	0.03	0.691	77	17.5	64
Intermediate Shell Forging-to-Lower Shell Forging Circ. Weld Seam (Heat # 442002)	0.04	1.850	77	22.0	60
Using Byron Unit 1 surveillance data	0.04	1.850	77	13.0[(d)]	67
Reactor Vessel Extended Beltline Materials[(e)]					
Inlet Nozzle 03-001	0.12	0.008	113	10.0	102
Inlet Nozzle 03-002	0.12	0.008	115	10.0	104
Inlet Nozzle 04-001	0.13	0.008	114	10.0	103
Inlet Nozzle 04-002	0.12	0.008	118	10.0	106
Outlet Nozzle 01-001	0.11	0.006	131	10.0	118
Outlet Nozzle 01-002	0.11	0.006	129	10.0	116
Outlet Nozzle 02-001	0.11	0.006	111	10.0	100
Outlet Nozzle 02-002	0.11	0.006	95	10.0	86
Inlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 442002)	0.15	0.008	98	12.0	86
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 1P5412)	0.178	0.006	75	14.0	65
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 504)	0.054	0.006	81	10.0	73

Notes:

(a) Copper content from Certified Material Test Reports (CMTRs). Initial USE values are based on Charpy test data taken from the CMTRs for the forging and weld materials. In accordance with Section B.1.2 of NUREG-0800 Branch Technical Position 5-3 (Reference 4.8.5), the initial USE values for the forging materials are based on Charpy test data taken from the "weak" direction only. For both the forging and weld materials, all data points that achieved 100% shear were averaged for the respective material to determine the materials' initial USE values shown above.

(b) The 1/4T fluence was calculated using the Regulatory Guide 1.99, Revision 2 correlation, and the Byron Unit 1 reactor vessel wall thickness of 8.5 inches.

(c) Unless otherwise noted, percentage USE decrease values are based on Position 1.2 of Regulatory Guide 1.99, Revision 2 (Reference 4.8.4), and were calculated by plotting the 1/4T fluence values in Figure 2 of the Regulatory Guide. The Cu weight % values for each material were conservatively rounded up to the next highest line for each forging and weld material.

(d) Percentage USE decrease is based on Position 2.2 of Regulatory Guide 1.99, Revision 2 using surveillance material test results. Credibility Criterion 3 in the Discussion section of Regulatory Guide 1.99, Revision 2, indicates that even if the surveillance data are not considered credible for determination of ΔRT_{NDT}, "they may be credible for determining decrease in upper-shelf energy if the upper shelf can be clearly determined, following the definition given in ASTM E 185-82 (Reference 4.8.8)." Regulatory Guide 1.99, Revision 2, Position 2.2 indicates that an upper-bound line drawn parallel to the existing lines (in Figure 2 of the Guide) through the surveillance data points should be used in preference to the existing graph lines for determining the decrease in USE.

(e) The minimum fluence value (2×10^{17} n/cm^2) displayed in Figure 2 of Regulatory Guide 1.99, Revision 2, was conservatively used to determine the projected USE decrease values for the inlet and outlet nozzle forgings and the inlet and outlet nozzle-to-nozzle shell forging weld seams.

Table 4.2.2-2 Byron Unit 2: Predicted USE Values at 57 EFPY (EOLE)

Reactor Vessel Material	Cu[a] (Wt. %)	1/4T EOLE Fluence[b] ($x10^{19}$ n/cm^2, E > 1.0 MeV)	Initial USE[a] (ft-lb)	Projected USE Decrease[c] (%)	Projected EOLE USE (ft-lb)
Reactor Vessel Beltline Materials					
Nozzle Shell Forging	0.05	0.661	155	17.0	129
Intermediate Shell Forging	0.01	1.916	149	22.0	116
Lower Shell Forging	0.06	1.916	127	22.0	99
Using Byron Unit 2 surveillance data	0.06	1.916	127	18.0[d]	104
Nozzle Shell Forging-to-Intermediate Shell Forging Circ. Weld Seam (Heat # 442011)	0.03	0.661	80	17.0	66
Intermediate Shell Forging-to-Lower Shell Forging Circ. Weld Seam (Heat # 442002)	0.04	1.844	80	22.0	62
Using Byron Unit 2 surveillance data	0.04	1.844	80	2.0[d, e]	78
Reactor Vessel Extended Beltline Materials[f]					
Inlet Nozzle 01-001	0.07	0.008	129	7.5	119
Inlet Nozzle 01-002	0.07	0.008	118	7.5	109
Inlet Nozzle 02-001	0.07	0.008	122	7.5	113
Inlet Nozzle 02-002	0.07	0.008	118	7.5	109
Outlet Nozzle 01-001	0.09	0.006	108	7.5	100
Outlet Nozzle 01-002	0.08	0.006	119	7.5	110
Outlet Nozzle 02-001	0.09	0.006	136	7.5	126
Outlet Nozzle 02-002	0.09	0.006	118	7.5	109
Inlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 41403)	0.15	0.008	70	12.0	62
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 442010)	0.22	0.006	79	16.0	66
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 41403)	0.15	0.006	70	12.0	62

Notes:

(a) Copper content from Certified Material Test Reports (CMTRs). Initial USE values are based on Charpy test data taken from the CMTRs for the forging and weld materials. In accordance with Section B.1.2 of NUREG-0800 Branch Technical Position 5-3 (Reference 4.8.5), the initial USE values for the forging materials are based on Charpy test data taken from the "weak" direction only. For both the forging and weld materials, all data points that achieved 100% shear were averaged for the respective material to determine the materials' initial USE values shown above.

(b) The 1/4T fluence was calculated using the Regulatory Guide 1.99, Revision 2 correlation, and the Byron Unit 2 reactor vessel wall thickness of 8.5 inches.

(c) Unless otherwise noted, percentage USE decrease values are based on Position 1.2 of Regulatory Guide 1.99, Revision 2 (Reference 4.8.4), and were calculated by plotting the 1/4T fluence values in Figure 2 of the Regulatory Guide. The Cu weight % values for each material were conservatively rounded up to the next highest line for each forging and weld material.

(d) Percentage USE decrease is based on Position 2.2 of Regulatory Guide 1.99, Revision 2 using surveillance material test results. Credibility Criterion 3 in the Discussion section of Regulatory Guide 1.99, Revision 2, indicates that even if the surveillance data are not considered credible for determination of ΔRT_{NDT}, “they may be credible for determining decrease in upper-shelf energy if the upper shelf can be clearly determined, following the definition given in ASTM E 185-82.” Regulatory Guide 1.99, Revision 2, Position 2.2 indicates that an upper-bound line drawn parallel to the existing lines (in Figure 2 of the Guide) through the surveillance data points should be used in preference to the existing graph lines for determining the decrease in USE.

(e) The most limiting surveillance data point for the intermediate shell forging–to-lower shell forging circumferential weld seam is a measured decrease of 1% at a fluence of 2.18 x 10^{19} n/cm^2 pertaining to Capsule X. A parallel line cannot be drawn in accordance with the guidelines of Position 2.2 of Regulatory Guide 1.99, Revision 2, using this limiting data point. Therefore, a Position 2.2 projected USE decrease of 2% is conservatively used.

(f) The minimum fluence value (2 x 10^{17} n/cm^2) displayed in Figure 2 of Regulatory Guide 1.99, Revision 2, was conservatively used to determine the projected USE decrease values for the inlet and outlet nozzle forgings and the inlet and outlet nozzle-to-nozzle shell forging weld seams.

Table 4.2.2-3 Braidwood Unit 1: Predicted USE Values at 57 EFPY (EOLE)

Reactor Vessel Material	Cu[a] (Wt. %)	1/4T EOLE Fluence[b] ($x10^{19}$ n/cm^2, E > 1.0 MeV)	Initial USE[a] (ft-lb)	Projected USE Decrease[c] (%)	Projected EOLE USE (ft-lb)
Reactor Vessel Beltline Materials					
Nozzle Shell Forging	0.04	0.685	155	17.5	128
Intermediate Shell Forging	0.05	1.916	122	22.0	95
Lower Shell Forging	0.05	1.916	135	22.0	105
Using Braidwood Unit 1 surveillance data	0.05	1.916	135	15.0[d]	115
Nozzle Shell Forging–to-Intermediate Shell Forging Circ. Weld Seam (Heat # H4498)	0.04	0.685	90	17.5	74
Intermediate Shell Forging-to-Lower Shell Forging Circ. Weld Seam (Heat # 442011)	0.03	1.838	80	22.0	62
Using Braidwood Unit 1 surveillance data	0.03	1.838	80	7.0[d]	74
Reactor Vessel Extended Beltline Materials[e]					
Inlet Nozzle 01-001	0.09	0.008	141	7.5	130
Inlet Nozzle 01-002	0.09	0.008	144	7.5	133
Inlet Nozzle 02-001	0.07	0.008	130	7.5	120
Inlet Nozzle 02-002	0.07	0.008	115	7.5	106
Outlet Nozzle 01-001	0.13	0.006	121	10.0	109
Outlet Nozzle 01-003	0.09	0.006	125	7.5	116
Outlet Nozzle 02-001	0.08	0.006	147	7.5	136
Outlet Nozzle 02-002	0.08	0.006	143	7.5	132
Inlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-598 (Heat # 41403)	0.29	0.008	72	18.0	59
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-598 (Heat # 41403)	0.29	0.006	72	18.0	59
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-588 (Heat # 41403)	0.29	0.006	73	18.0	60
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-579 (Heat # 442010)	0.25	0.006	85	16.0	71

Notes:

(a) Copper content from Certified Material Test Reports (CMTRs). Initial USE values are based on Charpy test data taken from the CMTRs for the forging and weld materials. In accordance with Section B.1.2 of

NUREG-0800 Branch Technical Position 5-3 (Reference 4.8.5), the initial USE values for the forging materials are based on Charpy test data taken from the “weak” direction only. For both the forging and weld materials, all data points that achieved 100% shear were averaged for the respective material to determine the materials’ initial USE values shown above.

(b) The 1/4T fluence was calculated using the Regulatory Guide 1.99, Revision 2 (Reference 4.8.4) correlation, and the Braidwood Unit 1 reactor vessel wall thickness of 8.5 inches.

(c) Unless otherwise noted, percentage USE decrease values are based on Position 1.2 of Regulatory Guide 1.99, Revision 2, and were calculated by plotting the 1/4T fluence values in Figure 2 of the Regulatory Guide. The Cu weight % values for each material were conservatively rounded up to the next highest line for each forging and weld material.

(d) Percentage USE decrease is based on Position 2.2 of Regulatory Guide 1.99, Revision 2 using surveillance material testing data. Credibility Criterion 3 in the Discussion section of Regulatory Guide 1.99, Revision 2, indicates that even if the surveillance data are not considered credible for determination of ΔRT_{NDT}, “they may be credible for determining decrease in upper-shelf energy if the upper shelf can be clearly determined, following the definition given in ASTM E 185-82.” Regulatory Guide 1.99, Revision 2, Position 2.2 indicates that an upper-bound line drawn parallel to the existing lines (in Figure 2 of the Guide) through the surveillance data points should be used in preference to the existing graph lines for determining the decrease in USE.

(e) The minimum fluence value (2×10^{17} n/cm^2) displayed in Figure 2 of Regulatory Guide 1.99, Revision 2, was conservatively used to determine the projected USE decrease values for the inlet and outlet nozzle forgings and the inlet and outlet nozzle-to-nozzle shell forging weld seams.

Table 4.2.2-4 Braidwood Unit 2: Predicted USE Values at 57 EFPY (EOLE)

Reactor Vessel Material	Cu[(a)] (Wt. %)	1/4T EOLE Fluence[(b)] ($x10^{19}$ n/cm^2, E > 1.0 MeV)	Initial USE[(a)] (ft-lb)	Projected USE Decrease[(c)] (%)	Projected EOLE USE (ft-lb)
Reactor Vessel Beltline Materials					
Nozzle Shell Forging	0.04	0.667	115	17.5	95
Intermediate Shell Forging	0.03	1.898	119	22.0	93
Lower Shell Forging	0.06	1.898	144	22.0	112
Using Braidwood Unit 2 surveillance data	0.06	1.898	144	15.0[(d)]	122
Nozzle Shell-to-Intermediate Shell Forging Circ. Weld Seam (Heat # H4498)	0.04	0.667	90	17.5	74
Intermediate Shell Forging-to-Lower Shell Forging Circ. Weld Seam (Heat # 442011)	0.03	1.820	80	22.0	62
Using Braidwood Unit 2 surveillance data	0.03	1.820	80	19.0[(d)]	65
Reactor Vessel Extended Beltline Materials[(e)]					
Inlet Nozzle 01-001	0.07	0.008	136	7.5	126
Inlet Nozzle 01-002	0.07	0.008	136	7.5	126
Inlet Nozzle 02-001	0.09	0.008	120	7.5	111
Inlet Nozzle 02-002	0.09	0.008	116	7.5	107
Outlet Nozzle 01-002	0.09	0.006	117	7.5	108
Outlet Nozzle 01-003	0.09	0.006	115	7.5	106
Outlet Nozzle 02-001	0.07	0.006	129	7.5	119
Outlet Nozzle 02-002	0.09	0.006	156	7.5	144
Inlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-654 (Heat # 41404)	0.18	0.008	73	14.0	63
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-654 (Heat # 41404)	0.18	0.006	73	14.0	63

Notes:

(a) Copper content from Certified Material Test Reports (CMTRs). Initial USE values are based on Charpy test data taken from the CMTRs for the forging and weld materials. In accordance with Section B.1.2 of NUREG-0800 Branch Technical Position 5-3 (Reference 4.8.5), the initial USE values for the forging materials are based on Charpy test data taken from the "weak" direction only. For both the forging and weld materials, all data points that achieved 100% shear were averaged for the respective material to determine the materials' initial USE values shown above.

(b) The 1/4T fluence was calculated using the Regulatory Guide 1.99, Revision 2 (Reference 4.8.4) correlation, and the Braidwood Unit 2 reactor vessel wall thickness of 8.5 inches.

(c) Unless otherwise noted, percentage USE decrease values are based on Position 1.2 of Regulatory Guide 1.99, Revision 2, and were calculated by plotting the 1/4T fluence values in Figure 2 of the Regulatory Guide. The Cu weight % values for each material were conservatively rounded up to the next highest line for each forging and weld material.

(d) Percentage USE decrease is based on Position 2.2 of Regulatory Guide 1.99, Revision 2 using surveillance material testing data. Credibility Criterion 3 in the Discussion section of Regulatory Guide 1.99, Revision 2, indicates that even if the surveillance data are not considered credible for determination of ΔRT_{NDT}, “they may be credible for determining decrease in upper-shelf energy if the upper shelf can be clearly determined, following the definition given in ASTM E 185-82.” Regulatory Guide 1.99, Revision 2, Position 2.2 indicates that an upper-bound line drawn parallel to the existing lines (in Figure 2 of the Guide) through the surveillance data points should be used in preference to the existing graph lines for determining the decrease in USE.

(e) The minimum fluence value (2×10^{17} n/cm^2) displayed in Figure 2 of Regulatory Guide 1.99, Revision 2, was conservatively used to determine the projected USE decrease values for the inlet and outlet nozzle forgings and the inlet and outlet nozzle-to-nozzle shell forging weld seams.

4.2.3 PRESSURIZED THERMAL SHOCK

TLAA Description:

10 CFR 50.61(b)(1) provides rules for protection against pressurized thermal shock (PTS) events for pressurized water reactors. Licensees are required to perform an updated assessment of the projected values of the PTS reference temperature (RT_{PTS}) whenever there is a significant change in projected values of RT_{PTS} or upon a request for a change in the expiration date for operation of the facility. The current analyses, evaluated for 32 EFPY fluence values predicted for 40 years of operation, are TLAAs requiring evaluation for 60 years.

TLAA Evaluation:

10 CFR 50.61(c) provides two methods for determining RT_{PTS}. These methods are also described as Positions 1 and 2 in Regulatory Guide 1.99 (Reference 4.8.4). Position 1 applies for material that does not have credible surveillance data available and Position 2 is used for material that does have two or more credible surveillance data sets available. The adjusted reference temperatures are calculated for both Positions 1 and 2 by following the guidance in Regulatory Guide 1.99 (Sections 1.1 and 2.1, respectively), using the copper and nickel content of Byron and Braidwood beltline materials, and the End-of-License-Extended (EOLE) fluence projections.

The Nozzle Shell Forging-to-Intermediate Shell Forging Circumferential Weld seam in both Byron Units 1 and 2 were fabricated using weld wire heat # 442011, which is the same weld material that is contained in the Braidwood Units 1 and 2 surveillance programs. The Braidwood surveillance weld material is deemed credible and also applicable to the Byron Units 1 and 2 Nozzle Shell Forging-to-Intermediate Shell Forging Circumferential Weld seams.

10 CFR 50.61(b)(2) establishes screening criteria for RT_{PTS} as 270°F for plates, forgings, and axial welds and 300°F for circumferential welds. If the RT_{PTS} does not exceed the PTS screening criteria, then only the reactor vessel is relied on to demonstrate compliance with the 10 CFR 50.61, the PTS rule.

The results of the new RT_{PTS} analyses using 57 EFPY fluence values predicted for 60 years of operation are presented in Table 4.2.3-1 and Table 4.2.3-2 for Byron Units 1 and 2, respectively, and Table 4.2.3-3 and Table 4.2.3-4 for Braidwood Units 1 and 2, respectively.

The limiting RT_{PTS} value for Byron Unit 1 forging materials at 57 EFPY is 114°F, which corresponds to the Intermediate Shell Forging using non-credible surveillance data. The limiting RT_{PTS} value for the Unit 1 circumferentially-oriented welds at 57 EFPY is 84°F, which corresponds to the Intermediate Shell Forging-to-Lower Shell Forging Circumferential Weld Seam (Heat # 442002) using credible surveillance data.

The limiting RT_{PTS} value for Byron Unit 2 forging materials at 57 EFPY is 74°F, which corresponds to the Nozzle Shell Forging. The limiting RT_{PTS} value for the Unit 2 circumferentially-oriented welds at 57 EFPY is 124°F, which corresponds to the Intermediate Shell Forging-to-Lower Shell Forging Circumferential Weld Seam (Heat # 442002) using credible surveillance data.

The limiting RT_{PTS} value for Braidwood Unit 1 forging materials at 57 EFPY is 64°F, which corresponds to the Nozzle Shell Forging. The limiting RT_{PTS} value for the Unit 1 circumferentially-oriented welds at 57 EFPY is 102°F, which corresponds to the Intermediate Shell Forging-to-Lower Shell Forging Circumferential Weld Seam (Heat # 442011) using credible surveillance data.

The limiting RT_{PTS} value for Braidwood Unit 2 forging materials at 57 EFPY is 84°F, which corresponds to the Nozzle Shell Forging. The limiting RT_{PTS} value for the Unit 2 circumferentially-oriented welds at 57 EFPY is 102°F, which corresponds to the Intermediate Shell Forging-to-Lower Shell Forging Circumferential Weld Seam (Heat # 442011) using credible surveillance data.

Each BBS Units 1 and 2 reactor vessel material that has an inside surface fluence value that exceeds 1.0×10^{17} n/cm^2 (E > 1.0 MeV) at 57 EFPY has been demonstrated to have an RT_{PTS} value less than the applicable screening criterion, which is 270 degrees F for plates, forgings, and axially-oriented welds (longitudinal welds), and 300 degrees F for circumferentially-oriented welds. Therefore, the RT_{PTS} analyses have been satisfactorily projected for 60 years of operation, and as a result, only the reactor vessel is relied on to demonstrate compliance with 10 CFR 50.61.

TLAA Disposition: 10 CFR 54.21 (c)(1)(ii) – The PTS analyses have been projected to the end of the period of extended operation.

Table 4.2.3-1 Byron Unit 1: Predicted RT_{PTS} Values for 57 EFPY (EOLE) at the Clad/Base Metal Interface

RPV Material	Cu(a) (Wt. %)	Ni(a) (Wt. %)	CF(b) (°F)	EOLE Fluence ($x10^{19}$ n/cm^2)	FF(c)	$RT_{NDT(U)}$(a) (°F)	ΔRT_{NDT}(d) (°F)	σ_U(a) (°F)	σ_Δ(e) (°F)	Margin (°F)	RT_{PTS} (°F)
Reactor Vessel Beltline Materials											
Nozzle Shell Forging	0.05	0.72	31	1.15	1.0390	30	32.2	0	16.1	32.2	94
Intermediate Shell Forging	0.04	0.74	26	3.21	1.3067	40	34.0	0	17.0	34.0	108
Using non-credible Byron Unit 1 surveillance data	---	---	30.6	3.21	1.3067	40	40.0	0	17.0	34.0	114
Lower Shell Forging	0.04	0.64	26	3.21	1.3067	10	34.0	0	17.0	34.0	78
Nozzle Shell Forging-to-Intermediate Shell Forging Circ. Weld Seam (Heat # 442011)	0.03	0.67	41	1.15	1.0390	10	42.6	0	21.3	42.6	95
Using credible Braidwood Units 1 and 2 surveillance data	---	---	26.1	1.15	1.0390	10	27.1	0	13.6	27.1	64
Intermediate Shell Forging–to-Lower Shell Forging Circ. Weld Seam (Heat # 442002)	0.04	0.63	54	3.08	1.2970	-30	70.0	0	28.0	56.0	96
Using credible Byron Units 1 and 2 surveillance data	---	---	66.5	3.08	1.2970	-30	86.2	0	14.0	28.0	84
Reactor Vessel Extended Beltline Materials											
Inlet Nozzle 03-001	0.12	0.82	86	0.0138	0.1359	-10	11.7	0	5.8	11.7	13
Inlet Nozzle 03-002	0.12	0.82	86	0.0138	0.1359	-20	11.7	0	5.8	11.7	3
Inlet Nozzle 04-001	0.13	0.79	95.8	0.0138	0.1359	-20	13.0	0	6.5	13.0	6
Inlet Nozzle 04-002	0.12	0.78	85.7	0.0138	0.1359	-20	11.6	0	5.8	11.6	3
Outlet Nozzle 01-001	0.11	0.84	77	0.0105	0.1133	0	8.7	0	4.4	8.7	17
Outlet Nozzle 01-002	0.11	0.84	77	0.0105	0.1133	-20	8.7	0	4.4	8.7	-3
Outlet Nozzle 02-001	0.11	0.85	77	0.0105	0.1133	-20	8.7	0	4.4	8.7	-3

Table 4.2.3-1 Byron Unit 1: Predicted RT_{PTS} Values for 57 EFPY (EOLE) at the Clad/Base Metal Interface											
RPV Material	**$Cu^{(a)}$ (Wt. %)**	**$Ni^{(a)}$ (Wt. %)**	**$CF^{(b)}$ (°F)**	**EOLE Fluence ($x10^{19}$ n/cm^2)**	**$FF^{(c)}$**	**$RT_{NDT(U)}^{(a)}$ (°F)**	**$\Delta RT_{NDT}^{(d)}$ (°F)**	**$\sigma_U^{(a)}$ (°F)**	**$\sigma_\Delta^{(e)}$ (°F)**	**Margin (°F)**	**RT_{PTS} (°F)**
Outlet Nozzle 02-002	0.11	0.84	77	0.0105	0.1133	-10	8.7	0	4.4	8.7	7
Inlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 442002)	0.15	0.56	139.2	0.0138	0.1359	-10	18.9	0	9.5	18.9	28
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 1P5412)	0.178	0.69	168.3	0.0105	0.1133	10	19.1	0	9.5	19.1	48
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 504)	0.054	0.80	73.6	0.0105	0.1133	10	8.3	0	4.2	8.3	27

Notes:

(a) Weight-percent copper and nickel from Certified Material Test Reports. Initial RT_{NDT} values are based on measured data for all of the materials. Note that σ_U = 0°F for measured values.

(b) Values calculated using Positions 1.1 and 2.1 of Regulatory Guide 1.99, Revision 2.

(c) FF = fluence factor = $f^{(0.28-0.10*\log(f))}$.

(d) ΔRT_{NDT} = CF * FF.

(e) The surveillance data for the forging were deemed non-credible, whereas the surveillance data for the weld materials were deemed credible. Per the guidance of 10 CFR 50.61, the base metal σ_Δ = 17°F for Position 1.1 and for Position 2.1 with non-credible surveillance data; the weld metal σ_Δ = 28°F for Position 1.1 and, with credible surveillance data, σ_Δ = 14°F for Position 2.1. However, σ_Δ need not exceed 0.5*ΔRT_{NDT}.

Table 4.2.3-2 Byron Unit 2: Predicted RT_{PTS} Values for 57 EFPY (EOLE) at the Clad/Base Metal Interface											
RPV Material	Cu[(a)] (Wt. %)	Ni[(a)] (Wt. %)	CF[(b)] (°F)	EOLE Fluence ($x10^{19}$ n/cm^2)	FF[(c)]	$RT_{NDT(U)}$[(a)] (°F)	ΔRT_{NDT}[(d)] (°F)	σ_U[(a)] (°F)	σ_Δ[(e)] (°F)	Margin (°F)	RT_{PTS} (°F)
Reactor Vessel Beltline Materials											
Nozzle Shell Forging	0.05	0.74	31	1.10	1.0266	10	31.8	0	15.9	31.8	74
Intermediate Shell Forging	0.01	0.70	20	3.19	1.3052	-20	26.1	0	13.1	26.1	32
Lower Shell Forging	0.06	0.73	37	3.19	1.3052	-20	48.3	0	17.0	34.0	62
Using Byron Unit 2 credible surveillance data	---	---	18.9	3.19	1.3052	-20	24.7	0	8.5	17.0	22
Nozzle Shell Forging-to-Intermediate Shell Forging Circ. Weld Seam (Heat # 442011)	0.03	0.67	41	1.10	1.0266	40	42.1	0	21.0	42.1	124
Using credible Braidwood Units 1 and 2 surveillance data	---	---	26.1	1.10	1.0266	40	26.8	0	13.4	26.8	94
Intermediate Shell Forging-to-Lower Shell Forging Circ. Weld Seam (Heat # 442002)	0.04	0.63	54	3.07	1.2962	10	70.0	0	28.0	56.0	136
Using credible Byron Units 1 and 2 surveillance data	---	---	66.5	3.07	1.2962	10	86.2	0	14.0	28.0	124
Reactor Vessel Extended Beltline Materials											
Inlet Nozzle 01-001	0.07	0.86	44	0.0130	0.1307	-10	5.7	0	2.9	5.7	1
Inlet Nozzle 01-002	0.07	0.86	44	0.0130	0.1307	-20	5.7	0	2.9	5.7	-9
Inlet Nozzle 02-001	0.07	0.84	44	0.0130	0.1307	0	5.7	0	2.9	5.7	11
Inlet Nozzle 02-002	0.07	0.84	44	0.0130	0.1307	0	5.7	0	2.9	5.7	11
Outlet Nozzle 01-001	0.09	0.85	58	0.0100	0.1096	-10	6.4	0	3.2	6.4	3
Outlet Nozzle 01-002	0.08	0.81	51	0.0100	0.1096	-10	5.6	0	2.8	5.6	1
Outlet Nozzle 02-001	0.09	0.78	58	0.0100	0.1096	-20	6.4	0	3.2	6.4	-7

Table 4.2.3-2 Byron Unit 2: Predicted RT_{PTS} Values for 57 EFPY (EOLE) at the Clad/Base Metal Interface											
RPV Material	$Cu^{(a)}$ (Wt. %)	$Ni^{(a)}$ (Wt. %)	$CF^{(b)}$ (°F)	EOLE Fluence ($x10^{19}$ n/cm^2)	$FF^{(c)}$	$RT_{NDT(U)}{}^{(a)}$ (°F)	$\Delta RT_{NDT}{}^{(d)}$ (°F)	$\sigma_U{}^{(a)}$ (°F)	$\sigma_\Delta{}^{(e)}$ (°F)	Margin (°F)	RT_{PTS} (°F)
Outlet Nozzle 02-002	0.09	0.81	58	0.0100	0.1096	-10	6.4	0	3.2	6.4	3
Inlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 41403)	0.15	0.59	144.3	0.0130	0.1307	40	18.9	0	9.4	18.9	78
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 442010)	0.22	0.63	172.0	0.0100	0.1096	40	18.9	0	9.4	18.9	78
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 41403)	0.15	0.59	144.3	0.0100	0.1096	40	15.8	0	7.9	15.8	72

Notes:

(a) Weight-percent copper and nickel from Certified Material Test Reports. Initial RT_{NDT} values are based on measured data for all of the materials. Note that σ_U = 0°F for measured values.

(b) Values calculated using Positions 1.1 and 2.1 of Regulatory Guide 1.99, Revision 2.

(c) FF = fluence factor = $f^{(0.28-0.10*\log(f))}$.

(d) ΔRT_{NDT} = CF * FF.

(e) The surveillance data for the forging and weld materials were deemed credible. Per the guidance of 10 CFR 50.61, the base metal σ_Δ = 17°F for Position 1.1 and, with credible surveillance data, σ_Δ = 8.5°F for Position 2.1; the weld metal σ_Δ = 28°F for Position 1.1 and, with credible surveillance data, σ_Δ = 14°F for Position 2.1. However, σ_Δ need not exceed $0.5*\Delta RT_{NDT}$.

Table 4.2.3-3 Braidwood Unit 1: Predicted RT_{PTS} Values for 57 EFPY (EOLE) at the Clad/Base Metal Interface

RPV Material	Cu[a] (Wt. %)	Ni[a] (Wt. %)	CF[b] (°F)	EOLE Fluence ($x10^{19}$ n/cm^2)	FF[c]	$RT_{NDT(U)}$[a] (°F)	ΔRT_{NDT}[d] (°F)	σ_U[a] (°F)	σ_Δ[e] (°F)	Margin (°F)	RT_{PTS} (°F)
Reactor Vessel Beltline Materials											
Nozzle Shell Forging	0.04	0.73	26	1.14	1.0366	10	27.0	0	13.5	27.0	64
Intermediate Shell Forging	0.05	0.73	31	3.19	1.3052	-30	40.5	0	17.0	34.0	44
Lower Shell Forging	0.05	0.74	31	3.19	1.3052	-20	40.5	0	17.0	34.0	54
Using credible Braidwood Unit 1 surveillance data	---	---	24.1	3.19	1.3052	-20	31.5	0	8.5	17.0	28
Nozzle Shell Forging-to-Intermediate Shell Forging Circ. Weld Seam (Heat # H4498)	0.04	0.46	54	1.14	1.0366	-25	56.0	0	28.0	56.0	87
Intermediate Shell Forging-to-Lower Shell Forging Circ. Weld Seam (Heat # 442011)	0.03	0.67	41	3.06	1.2954	40	53.1	0	26.6	53.1	146
Using credible Braidwood Units 1 and 2 surveillance data	---	---	26.1	3.06	1.2954	40	33.8	0	14.0	28.0	102
Reactor Vessel Extended Beltline Materials											
Inlet Nozzle 01-001	0.09	0.82	58	0.0136	0.1346	-20	7.8	0	3.9	7.8	-4
Inlet Nozzle 01-002	0.09	0.81	58	0.0136	0.1346	-10	7.8	0	3.9	7.8	6
Inlet Nozzle 02-001	0.07	0.78	44	0.0136	0.1346	-10	5.9	0	3.0	5.9	2
Inlet Nozzle 02-002	0.07	0.80	44	0.0136	0.1346	0	5.9	0	3.0	5.9	12
Outlet Nozzle 01-001	0.13	0.83	96	0.0104	0.1126	-10	10.8	0	5.4	10.8	12
Outlet Nozzle 01-003	0.09	0.84	58	0.0104	0.1126	-10	6.5	0	3.3	6.5	3
Outlet Nozzle 02-001	0.08	0.82	51	0.0104	0.1126	-20	5.7	0	2.9	5.7	-9

Table 4.2.3-3 Braidwood Unit 1: Predicted RT_{PTS} Values for 57 EFPY (EOLE) at the Clad/Base Metal Interface

RPV Material	$Cu^{(a)}$ (Wt. %)	$Ni^{(a)}$ (Wt. %)	$CF^{(b)}$ (°F)	EOLE Fluence ($x10^{19}$ n/cm^2)	$FF^{(c)}$	$RT_{NDT(U)}^{(a)}$ (°F)	$\Delta RT_{NDT}^{(d)}$ (°F)	$\sigma_U^{(a)}$ (°F)	$\sigma_\Delta^{(e)}$ (°F)	Margin (°F)	RT_{PTS} (°F)
Outlet Nozzle 02-002	0.08	0.81	51	0.0104	0.1126	-20	5.7	0	2.9	5.7	-9
Inlet Nozzle-to-Nozzle Shell Forging Weld Seam WF-598 (Heat # 41403)	0.29	0.56	185.6	0.0136	0.1346	40	25.0	0	12.5	25.0	90
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-598 (Heat # 41403)	0.29	0.56	185.6	0.0104	0.1126	40	20.9	0	10.4	20.9	82
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-588 (Heat # 41403)	0.29	0.63	195.7	0.0104	0.1126	40	22.0	0	11.0	22.0	84
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-579 (Heat # 442010)	0.25	0.63	181.0	0.0104	0.1126	40	20.4	0	10.2	20.4	81

Notes:

(a) Weight-percent copper and nickel from Certified Material Test Reports. Initial RT_{NDT} values are based on measured data for all of the materials. Note that σ_U = 0°F for measured values

(b) Values calculated using Positions 1.1 and 2.1 of Regulatory Guide 1.99, Revision 2.

(c) FF = fluence factor = $f^{(0.28-0.10*\log(f))}$.

(d) ΔRT_{NDT} = CF * FF.

(e) The surveillance data for the forging and weld material were deemed credible. Per the guidance of 10 CFR 50.61, the base metal σ_Δ = 17°F for Position 1.1 and, with credible surveillance data, σ_Δ = 8.5°F for Position 2.1; the weld metal σ_Δ = 28°F for Position 1.1 and, with credible surveillance data, σ_Δ = 14°F for Position 2.1. However, σ_Δ need not exceed 0.5*ΔRT_{NDT}.

Table 4.2.3-4 Braidwood Unit 2: Predicted RT_{PTS} Values for 57 EFPY (EOLE) at the Clad/Base Metal Interface

RPV Material	Cu[a] (Wt. %)	Ni[a] (Wt. %)	CF[b] (°F)	EOLE Fluence ($x10^{19}$ n/cm^2)	FF[c]	$RT_{NDT(U)}$[a] (°F)	ΔRT_{NDT}[d] (°F)	σ_U[a] (°F)	σ_Δ[e] (°F)	Margin (°F)	RT_{PTS} (°F)
Reactor Vessel Beltline Materials											
Nozzle Shell Forging	0.04	0.90	26	1.11	1.0292	30	26.8	0	13.4	26.8	84
Intermediate Shell Forging	0.03	0.71	20	3.16	1.3030	-30	26.1	0	13.0	26.1	22
Lower Shell Forging	0.06	0.76	37	3.16	1.3030	-30	48.2	0	17.0	34.0	52
Using non-credible Braidwood Unit 2 surveillance data	---	---	13.2	3.16	1.3030	-30	17.2	0	8.6	17.2	4
Nozzle Shell Forging-to-Intermediate Shell Forging Circ. Weld Seam (Heat # H4498)	0.04	0.46	54	1.11	1.0292	-25	55.6	0	27.8	55.6	86
Intermediate Shell Forging-to-Lower Shell Forging Circ. Weld Seam (Heat # 442011)	0.03	0.67	41	3.03	1.2931	40	53.0	0	26.5	53.0	146
Using credible Braidwood Units 1 and 2 surveillance data	---	---	26.1	3.03	1.2931	40	33.7	0	14.0	28.0	102
Reactor Vessel Extended Beltline Materials											
Inlet Nozzle 01-001	0.07	0.83	44	0.0131	0.1313	-10	5.8	0	2.9	5.8	2
Inlet Nozzle 01-002	0.07	0.85	44	0.0131	0.1313	-10	5.8	0	2.9	5.8	2
Inlet Nozzle 02-001	0.09	0.88	58	0.0131	0.1313	-10	7.6	0	3.8	7.6	5
Inlet Nozzle 02-002	0.09	0.89	58	0.0131	0.1313	-10	7.6	0	3.8	7.6	5
Outlet Nozzle 01-002	0.09	0.86	58	0.0100	0.1096	10	6.4	0	3.2	6.4	23
Outlet Nozzle 01-003	0.09	0.88	58	0.0100	0.1096	-10	6.4	0	3.2	6.4	3
Outlet Nozzle 02-001	0.07	0.84	44	0.0100	0.1096	-10	4.8	0	2.4	4.8	0

Table 4.2.3-4 Braidwood Unit 2: Predicted RT_{PTS} Values for 57 EFPY (EOLE) at the Clad/Base Metal Interface

RPV Material	$Cu^{(a)}$ (Wt. %)	$Ni^{(a)}$ (Wt. %)	$CF^{(b)}$ (°F)	EOLE Fluence ($x10^{19}$ n/cm^2)	$FF^{(c)}$	$RT_{NDT(U)}^{(a)}$ (°F)	$\Delta RT_{NDT}^{(d)}$ (°F)	$\sigma_U^{(a)}$ (°F)	$\sigma_\Delta^{(e)}$ (°F)	Margin (°F)	RT_{PTS} (°F)
Outlet Nozzle 02-002	0.09	0.78	58	0.0100	0.1096	-10	6.4	0	3.2	6.4	3
Inlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-654 (Heat # 41404)	0.18	0.52	141.2	0.0131	0.1313	-20	18.5	0	9.3	18.5	17
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-654 (Heat # 41404)	0.18	0.52	141.2	0.0100	0.1096	-20	15.5	0	7.7	15.5	11

Notes:

(a) Weight-percent copper and nickel from Certified Material Test Reports. Initial RT_{NDT} values are based on measured data for all of the materials. Note that σ_U = 0°F for measured values.

(b) Values calculated using Positions 1.1 and 2.1 of Regulatory Guide 1.99, Revision 2.

(c) FF = fluence factor = $f^{(0.28-0.10*\log(f))}$.

(d) ΔRT_{NDT} = CF * FF.

(e) The surveillance data for the forging were deemed non-credible, whereas the surveillance data for the weld material were deemed credible. Per the guidance of 10 CFR 50.61, the base metal σ_Δ = 17°F for Position 1.1 and for Position 2.1 with non-credible surveillance data; the weld metal σ_Δ = 28°F for Position 1.1 and, with credible surveillance data, σ_Δ = 14°F for Position 2.1. However, σ_Δ need not exceed $0.5*\Delta RT_{NDT}$.

4.2.4 ADJUSTED REFERENCE TEMPERATURE

TLAA Description:

The adjusted reference temperature (ART) of the limiting beltline material is used to adjust the beltline P-T limit curves to account for irradiation effects. Regulatory Guide 1.99, Revision 2, provides the methodology for determining the ART of the limiting material. The initial nil-ductility reference temperature, RT_{NDT}, is the temperature at which a non-irradiated metal (ferritic steel) changes in fracture characteristics from ductile to brittle behavior. RT_{NDT} is evaluated according to the procedures in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, Paragraph NB-2331. Neutron embrittlement increases the RT_{NDT} beyond its initial value.

10 CFR 50, Appendix G, defines the fracture toughness requirements for the life of the vessel. The shift in the initial RT_{NDT} (ΔRT_{NDT}) is evaluated as the difference in the 30 ft-lb index temperatures from the average Charpy curves measured before and after irradiation. This increase (ΔRT_{NDT}) means that higher temperatures are required for the material to continue to act in a ductile manner. The ART is defined as: Initial RT_{NDT} + (ΔRT_{NDT}) + Margin. Since the ΔRT_{NDT} value is a function of 32 EFPY fluence, associated with the 40-year licensed operating period, these ART calculations meet the criteria of 10 CFR 54.3(a) and have been identified as TLAAs requiring evaluation for 60 years.

TLAA Evaluation:

As described in Section 4.2.1, 57 EFPY fluence values were determined for BBS for the RPV beltline and extended beltline components. These 57 EFPY 1/4T fluence values were used to compute the ART values of BBS, Units 1 and 2, in accordance with Regulatory Guide 1.99, Revision 2 (Reference 4.8.4). Table 4.2.4-1 and Table 4.2.4-2 present the ART results for Byron Units 1 and 2, respectively. The ART results for Braidwood Units 1 and 2 are presented in Table 4.2.4-3 and Table 4.2.4-4.

The Nozzle Shell Forging-to-Intermediate Shell Forging Circumferential Weld seam in both Byron Units 1 and 2 were fabricated using weld wire heat # 442011, which is the same weld material that is contained in the Braidwood Units 1 and 2 surveillance programs. The Braidwood surveillance weld material is deemed credible and also applicable to the Byron Units 1 and 2 Nozzle Shell Forging-to-Intermediate Shell Forging Circumferential Weld seams.

The ART values of the limiting beltline materials at 57 EFPY for each unit remain below 200 degrees F, which is the Nil-Ductility Transition (RT_{NDT}) limit specified in NRC Regulatory Guide 1.99, Revision 2, Section 3. The limiting locations, taking credit for credible data, are listed below:

The limiting 57 EFPY ART values for Byron Unit 1 correspond to the Intermediate Shell Forging using non-credible surveillance data (Position 2.1) for axial flaw (forging) materials and the Intermediate Shell Forging-to-Lower Shell Forging Circumferential Weld Seam (Heat # 442002) using credible surveillance data (Position 2.1) for circumferential flaw (weld) materials.

The limiting 57 EFPY ART values for Byron Unit 2 correspond to the Nozzle Shell Forging for axial flaw (forging) materials and the Intermediate Shell Forging-to-Lower Shell Circumferential

Weld Seam (Heat # 442002) using credible surveillance data (Position 2.1) for circumferential flaw (weld) materials.

The limiting 57 EFPY ART values for Braidwood Unit 1 correspond to the Nozzle Shell Forging for axial flaw (forging) materials and the Intermediate Shell Forging-to-Lower Shell Circumferential Weld Seam (Heat # 442011) using credible surveillance data (Position 2.1) for circumferential flaw (weld) materials.

The limiting 57 EFPY ART values for Braidwood Unit 2 correspond to the Nozzle Shell Forging for axial flaw (forging) materials and the Intermediate Shell Forging-to-Lower Shell Forging Circumferential Weld Seam (Heat # 442011) using credible surveillance data (Position 2.1) for circumferential flaw (weld) materials.

TLAA Disposition: 10 CFR 54.21 (c)(1)(ii) – The ART analyses have been projected to the end of the period of extended operation. They may be used as inputs to 57 EFPY P-T limits for the period of extended operation.

Table 4.2.4-1 Byron Unit 1: Predicted ART Values at the 1/4T Location for 57 EFPY

Reactor Vessel Material	Cu(a) (Wt.%)	Ni(a) (Wt.%)	CF(b) (°F)	1/4T Fluence(c) ($x10^{19}$ n/cm^2, E > 1.0 MeV)	1/4T FF(c)	$RT_{NDT(U)}$(a) (°F)	ΔRT_{NDT} (°F)	σ_I (a) (°F)	σ_Δ (d) (°F)	Margin (°F)	ART (°F)
Reactor Vessel Beltline Materials											
Nozzle Shell Forging	0.05	0.72	31	0.691	0.8962	30	27.8	0	13.9	27.8	86
Intermediate Shell Forging	0.04	0.74	26	1.928	1.1795	40	30.7	0	15.3	30.7	101
Using non-credible Byron Unit 1 surveillance data	---	---	30.6	1.928	1.1795	40	36.1	0	17.0	34.0	110
Lower Shell Forging	0.04	0.64	26	1.928	1.1795	10	30.7	0	15.3	30.7	71
Nozzle Shell Forging-to-Intermediate Shell Forging Circ. Weld Seam (Heat # 442011)	0.03	0.67	41	0.691	0.8962	10	36.7	0	18.4	36.7	83
Using credible Braidwood Units 1 and 2 surveillance data	---	---	26.1	0.691	0.8962	10	23.4	0	11.7	23.4	57
Intermediate Shell Forging-to-Lower Shell Forging Circ. Weld Seam (Heat # 442002)	0.04	0.63	54	1.850	1.1685	-30	63.1	0	28.0	56.0	89
Using credible Byron Units 1 and 2 surveillance data	---	---	66.5	1.850	1.1685	-30	77.7	0	14.0	28.0	76
Reactor Vessel Extended Beltline Materials											
Inlet Nozzle 03-001	0.12	0.82	86	0.008	0.0963	-10	8.3	0	4.1	8.3	7
Inlet Nozzle 03-002	0.12	0.82	86	0.008	0.0963	-20	8.3	0	4.1	8.3	-3
Inlet Nozzle 04-001	0.13	0.79	95.8	0.008	0.0963	-20	9.2	0	4.6	9.2	-2

Table 4.2.4-1 Byron Unit 1: Predicted ART Values at the 1/4T Location for 57 EFPY

Reactor Vessel Material	Cu(a) (Wt.%)	Ni(a) (Wt.%)	CF(b) (°F)	1/4T Fluence(c) ($x10^{19}$ n/cm^2, E > 1.0 MeV)	1/4T FF(c)	$RT_{NDT(U)}$(a) (°F)	ΔRT_{NDT} (°F)	σ_I (a) (°F)	σ_Δ (d) (°F)	Margin (°F)	ART (°F)
Inlet Nozzle 04-002	0.12	0.78	85.7	0.008	0.0963	-20	8.3	0	4.1	8.3	-3
Outlet Nozzle 01-001	0.11	0.84	77	0.006	0.0794	0	6.1	0	3.1	6.1	12
Outlet Nozzle 01-002	0.11	0.84	77	0.006	0.0794	-20	6.1	0	3.1	6.1	-8
Outlet Nozzle 02-001	0.11	0.85	77	0.006	0.0794	-20	6.1	0	3.1	6.1	-8
Outlet Nozzle 02-002	0.11	0.84	77	0.006	0.0794	-10	6.1	0	3.1	6.1	2
Inlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 442002)	0.15	0.56	139.2	0.008	0.0963	-10	13.4	0	6.7	13.4	17
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 1P5412)	0.178	0.69	168.3	0.006	0.0794	10	13.4	0	6.7	13.4	37
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 504)	0.054	0.80	73.6	0.006	0.0794	10	5.8	0	2.9	5.8	22

Notes:

(a) Weight-percent copper and nickel from Certified Material Test Reports. Initial RT_{NDT} values are based on measured data for all of the materials. Note that σ_I = 0°F for measured values.

(b) Values calculated using Positions 1.1 and 2.1 of Regulatory Guide 1.99, Revision 2.

(c) The 1/4T fluence and FF were calculated using the Regulatory Guide 1.99, Revision 2 correlations and the Byron Unit 1 reactor vessel wall thickness of 8.5 inches.

(d) The surveillance data for the forging were deemed non-credible, whereas the surveillance data for the weld materials were deemed credible. Per the guidance of Regulatory Guide 1.99, Revision 2, the base metal σ_Δ = 17°F for Position 1.1 and for Position 2.1 with non-credible surveillance data; the weld metal σ_Δ = 28°F for Position 1.1 and, with credible surveillance data, σ_Δ = 14°F for Position 2.1. However, σ_Δ need not exceed $0.5*\Delta RT_{NDT}$.

Table 4.2.4-2 Byron Unit 2: Predicted ART Values at the 1/4T Location for 57 EFPY

Reactor Vessel Material	Cu(a) (Wt.%)	Ni(a) (Wt.%)	CF(b) (°F)	1/4T Fluence(c) ($x10^{19}$ n/cm^2, E > 1.0 MeV)	1/4T FF(c)	$RT_{NDT(U)}$(a) (°F)	ΔRT_{NDT} (°F)	σ_I (a) (°F)	σ_Δ (d) (°F)	Margin (°F)	ART (°F)
Reactor Vessel Beltline Materials											
Nozzle Shell Forging	0.05	0.74	31	0.661	0.8837	10	27.4	0	13.7	27.4	65
Intermediate Shell Forging	0.01	0.70	20	1.916	1.1778	-20	23.6	0	11.8	23.6	27
Lower Shell Forging	0.06	0.73	37	1.916	1.1778	-20	43.6	0	17.0	34.0	58
Using credible Byron Unit 2 surveillance data	---	---	18.9	1.916	1.1778	-20	22.3	0	8.5	17.0	19
Nozzle Shell Forging-to-Intermediate Shell Forging Circ. Weld Seam (Heat # 442011)	0.03	0.67	41	0.661	0.8837	40	36.2	0	18.1	36.2	112
Using credible Braidwood Units 1 and 2 surveillance data	---	---	26.1	0.661	0.8837	40	23.1	0	11.5	23.1	86
Intermediate Shell Forging-to-Lower Shell Forging Circ. Weld Seam (Heat # 442002)	0.04	0.63	54	1.844	1.1677	10	63.1	0	28.0	56.0	129
Using credible Byron Units 1 and 2 surveillance data	---	---	66.5	1.844	1.1677	10	77.7	0	14.0	28.0	116
Reactor Vessel Extended Beltline Materials											
Inlet Nozzle 01-001	0.07	0.86	44	0.008	0.0924	-10	4.1	0	2.0	4.1	-2
Inlet Nozzle 01-002	0.07	0.86	44	0.008	0.0924	-20	4.1	0	2.0	4.1	-12
Inlet Nozzle 02-001	0.07	0.84	44	0.008	0.0924	0	4.1	0	2.0	4.1	8
Inlet Nozzle 02-002	0.07	0.84	44	0.008	0.0924	0	4.1	0	2.0	4.1	8

Table 4.2.4-2 Byron Unit 2: Predicted ART Values at the 1/4T Location for 57 EFPY

Reactor Vessel Material	$Cu^{(a)}$ (Wt.%)	$Ni^{(a)}$ (Wt.%)	$CF^{(b)}$ (°F)	1/4T Fluence$^{(c)}$ ($\times 10^{19}$ n/cm^2, E > 1.0 MeV)	1/4T $FF^{(c)}$	$RT_{NDT(U)}{}^{(a)}$ (°F)	ΔRT_{NDT} (°F)	$\sigma_I{}^{(a)}$ (°F)	$\sigma_\Delta{}^{(d)}$ (°F)	Margin (°F)	ART (°F)
Outlet Nozzle 01-001	0.09	0.85	58	0.006	0.0766	-10	4.4	0	2.2	4.4	-1
Outlet Nozzle 01-002	0.08	0.81	51	0.006	0.0766	-10	3.9	0	2.0	3.9	-2
Outlet Nozzle 02-001	0.09	0.78	58	0.006	0.0766	-20	4.4	0	2.2	4.4	-11
Outlet Nozzle 02-002	0.09	0.81	58	0.006	0.0766	-10	4.4	0	2.2	4.4	-1
Inlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 41403)	0.15	0.59	144.3	0.008	0.0924	40	13.3	0	6.7	13.3	67
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 442010)	0.22	0.63	172.0	0.006	0.0766	40	13.2	0	6.6	13.2	66
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams (Heat # 41403)	0.15	0.59	144.3	0.006	0.0766	40	11.1	0	5.5	11.1	62

Notes:

(a) Weight-percent copper and nickel from Certified Material Test Reports. Initial RT_{NDT} values are based on measured data for all of the materials. Note that σ_I = 0°F for measured values.

(b) Values calculated using Positions 1.1 and 2.1 of Regulatory Guide 1.99, Revision 2.

(c) The 1/4T fluence and FF were calculated using the Regulatory Guide 1.99, Revision 2 correlations and the Byron Unit 2 reactor vessel wall thickness of 8.5 inches.

(d) The surveillance data for the forging and weld materials were deemed credible. Per the guidance of Regulatory Guide 1.99, Revision 2, the base metal σ_Δ = 17°F for Position 1.1 and, with credible surveillance data, σ_Δ = 8.5°F for Position 2.1; the weld metal σ_Δ = 28°F for Position 1.1 and, with credible surveillance data, σ_Δ = 14°F for Position 2.1. However, σ_Δ need not exceed $0.5{*}\Delta RT_{NDT}$.

Table 4.2.4-3 Braidwood Unit 1: Predicted ART Values at the 1/4T Location for 57 EFPY

RPV Material	$Cu^{(a)}$ (Wt.%)	$Ni^{(a)}$ (Wt.%)	$CF^{(b)}$ (°F)	1/4T $Fluence^{(c)}$ ($x10^{19}$ n/cm^2, E > 1.0 MeV)	1/4T $FF^{(c)}$	$RT_{NDT(U)}^{(a)}$ (°F)	ΔRT_{NDT} (°F)	$\sigma_I^{(a)}$ (°F)	$\sigma_\Delta^{(d)}$ (°F)	Margin (°F)	ART (°F)
Reactor Vessel Beltline Materials											
Nozzle Shell Forging	0.04	0.73	26	0.685	0.8937	10	23.2	0	11.6	23.2	56
Intermediate Shell Forging	0.05	0.73	31	1.916	1.1778	-30	36.5	0	17.0	34.0	41
Lower Shell Forging	0.05	0.74	31	1.916	1.1778	-20	36.5	0	17.0	34.0	51
Using credible Braidwood Unit 1 surveillance data	---	---	24.1	1.916	1.1778	-20	28.4	0	8.5	17.0	25
Nozzle Shell Forging-to-Intermediate Shell Forging Circ. Weld Seam (Heat # H4498)	0.04	0.46	54	0.685	0.8937	-25	48.3	0	24.1	48.3	72
Intermediate Shell Forging to Lower Shell Forging Circ. Weld Seam (Heat # 442011)	0.03	0.67	41	1.838	1.1668	40	47.8	0	23.9	47.8	136
Using credible Braidwood Units 1 and 2 surveillance data	---	---	26.1	1.838	1.1668	40	30.5	0	14.0	28.0	98
Reactor Vessel Extended Beltline Materials											
Inlet Nozzle 01-001	0.09	0.82	58	0.008	0.0954	-20	5.5	0	2.8	5.5	-9
Inlet Nozzle 01-002	0.09	0.81	58	0.008	0.0954	-10	5.5	0	2.8	5.5	1
Inlet Nozzle 02-001	0.07	0.78	44	0.008	0.0954	-10	4.2	0	2.1	4.2	-2
Inlet Nozzle 02-002	0.07	0.80	44	0.008	0.0954	0	4.2	0	2.1	4.2	8
Outlet Nozzle 01-001	0.13	0.83	96	0.006	0.0788	-10	7.6	0	3.8	7.6	5
Outlet Nozzle 01-003	0.09	0.84	58	0.006	0.0788	-10	4.6	0	2.3	4.6	-1

Table 4.2.4-3 Braidwood Unit 1: Predicted ART Values at the 1/4T Location for 57 EFPY

RPV Material	Cu[(a)] (Wt.%)	Ni[(a)] (Wt.%)	CF[(b)] (°F)	1/4T Fluence[(c)] ($x10^{19}$ n/cm^2, E > 1.0 MeV)	1/4T FF[(c)]	$RT_{NDT(U)}$[(a)] (°F)	ΔRT_{NDT} (°F)	σ_I [(a)] (°F)	σ_Δ [(d)] (°F)	Margin (°F)	ART (°F)
Outlet Nozzle 02-001	0.08	0.82	51	0.006	0.0788	-20	4.0	0	2.0	4.0	-12
Outlet Nozzle 02-002	0.08	0.81	51	0.006	0.0788	-20	4.0	0	2.0	4.0	-12
Inlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-598 (Heat # 41403)	0.29	0.56	185.6	0.008	0.0954	40	17.7	0	8.9	17.7	75
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-598 (Heat # 41403)	0.29	0.56	185.6	0.006	0.0788	40	14.6	0	7.3	14.6	69
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-588 (Heat # 41403)	0.29	0.63	195.7	0.006	0.0788	40	15.4	0	7.7	15.4	71
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-579 (Heat # 442010)	0.25	0.63	181.0	0.006	0.0788	40	14.3	0	7.1	14.3	69

Notes:

(a) Weight-percent copper and nickel from Certified Material Test Reports. Initial RT_{NDT} values are based on measured data for all of the materials. Note that σ_I = 0°F for measured values.

(b) Values calculated using Positions 1.1 and 2.1 of Regulatory Guide 1.99, Revision 2.

(c) The 1/4T fluence and FF were calculated using the Regulatory Guide 1.99, Revision 2 correlations and the Braidwood Unit 1 reactor vessel wall thickness of 8.5 inches.

(d) The surveillance data for the forging and weld material were deemed credible. Per the guidance of Regulatory Guide 1.99, Revision 2, the base metal σ_Δ = 17°F for Position 1.1 and, with credible surveillance data, σ_Δ = 8.5°F for Position 2.1; the weld metal σ_Δ = 28°F for Position 1.1 and, with credible surveillance data, σ_Δ = 14°F for Position 2.1. However, σ_Δ need not exceed $0.5^*\Delta RT_{NDT}$.

Table 4.2.4-4 Braidwood Unit 2: Predicted ART Values at the 1/4T Location for 57 EFPY

RPV Material	Cu[a] (Wt.%)	Ni[a] (Wt.%)	CF[b] (°F)	1/4T Fluence[c] (x10^{19} n/cm^2, E > 1.0 MeV)	1/4T FF[c]	$RT_{NDT(U)}$[a] (°F)	ΔRT_{NDT} (°F)	σ_I [a] (°F)	σ_Δ [d] (°F)	Margin (°F)	ART (°F)
Reactor Vessel Beltline Materials											
Nozzle Shell Forging	0.04	0.90	26	0.667	0.8863	30	23.0	0	11.5	23.0	76
Intermediate Shell Forging	0.03	0.71	20	1.898	1.1753	-30	23.5	0	11.8	23.5	17
Lower Shell Forging	0.06	0.76	37	1.898	1.1753	-30	43.5	0	17.0	34.0	47
Using non-credible Braidwood Unit 2 surveillance data	---	---	13.2	1.898	1.1753	-30	15.5	0	7.8	15.5	1
Nozzle Shell Forging-to-Intermediate Shell Forging Circ. Weld Seam (Heat # H4498)	0.04	0.46	54	0.667	0.8863	-25	47.9	0	23.9	47.9	71
Intermediate Shell-to-Lower Shell Forging Circ. Weld Seam (Heat # 442011)	0.03	0.67	41	1.820	1.1642	40	47.7	0	23.9	47.7	135
Using credible Braidwood Units 1 and 2 surveillance data	---	---	26.1	1.820	1.1642	40	30.4	0	14.0	28.0	98
Reactor Vessel Extended Beltline Materials											
Inlet Nozzle 01-001	0.07	0.83	44	0.008	0.0929	-10	4.1	0	2.0	4.1	-2
Inlet Nozzle 01-002	0.07	0.85	44	0.008	0.0929	-10	4.1	0	2.0	4.1	-2
Inlet Nozzle 02-001	0.09	0.88	58	0.008	0.0929	-10	5.4	0	2.7	5.4	1
Inlet Nozzle 02-002	0.09	0.89	58	0.008	0.0929	-10	5.4	0	2.7	5.4	1
Outlet Nozzle 01-002	0.09	0.86	58	0.006	0.0766	10	4.4	0	2.2	4.4	19
Outlet Nozzle 01-003	0.09	0.88	58	0.006	0.0766	-10	4.4	0	2.2	4.4	-1
Outlet Nozzle 02-001	0.07	0.84	44	0.006	0.0766	-10	3.4	0	1.7	3.4	-3
Outlet Nozzle 02-002	0.09	0.78	58	0.006	0.0766	-10	4.4	0	2.2	4.4	-1

Table 4.2.4-4 Braidwood Unit 2: Predicted ART Values at the 1/4T Location for 57 EFPY

RPV Material	Cu[(a)] (Wt.%)	Ni[(a)] (Wt.%)	CF[(b)] (°F)	1/4T Fluence[(c)] ($x10^{19}$ n/cm^2, E > 1.0 MeV)	1/4T FF[(c)]	$RT_{NDT(U)}$[(a)] (°F)	ΔRT_{NDT} (°F)	σ_I [(a)] (°F)	σ_Δ [(d)] (°F)	Margin (°F)	ART (°F)
Inlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-654 (Heat # 41404)	0.18	0.52	141.2	0.008	0.0929	-20	13.1	0	6.6	13.1	6
Outlet Nozzle-to-Nozzle Shell Forging Weld Seams WF-654 (Heat # 41404)	0.18	0.52	141.2	0.006	0.0766	-20	10.8	0	5.4	10.8	2

Notes:

(a) Weight-percent copper and nickel from Certified Material Test Reports. Initial RT_{NDT} values are based on measured data for all of the materials. Note that σ_I = 0°F for measured values.

(b) Values calculated using Positions 1.1 and 2.1 of Regulatory Guide 1.99, Revision 2.

(c) The 1/4T fluence and FF were calculated using the Regulatory Guide 1.99, Revision 2 correlations and the Braidwood Unit 2 reactor vessel wall thickness of 8.5 inches.

(d) The surveillance data for the forging was deemed non-credible, whereas the surveillance data for the weld material was deemed credible. Per the guidance of Regulatory Guide 1.99, Revision 2, the base metal σ_Δ = 17°F for Position 1.1 and for Position 2.1 with non-credible surveillance data; the weld metal σ_Δ = 28°F for Position 1.1 and, with credible surveillance data, σ_Δ = 14°F for Position 2.1. However, σ_Δ need not exceed $0.5^*\Delta RT_{NDT}$.

4.2.5 PRESSURE-TEMPERATURE LIMITS

TLAA Description:

10 CFR 50 Appendix G requires that the reactor vessel be maintained within established pressure-temperature (P-T) limits, including heatup and cooldown operations. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the reactor vessel is exposed to increased neutron irradiation, its fracture toughness is reduced. The P-T limits must account for the anticipated reactor vessel fluence.

The current P-T limits are based upon fluence projections that were considered to represent the amount of power to be generated over 40 years of plant operation, assuming a 40-year average capacity factor of 80 percent. Since they were originally based upon a 40-year assumption regarding capacity factor, the P-T limits satisfy the criteria of 10 CFR 54.3(a) and have been identified as TLAAs.

TLAA Evaluation:

In accordance with NUREG-1800, Revision 2, Section 4.2.2.1.3, the P-T limits for the period of extended operation need not be submitted as part of the LRA since the P-T limits are required to be updated through the 10 CFR 50.90 licensing process when necessary for P-T limits that are located in the Technical Specifications (TS). It further states that those plants that have approved pressure-temperature limit reports (PTLRs), the P-T limits for the period of extended operation will be updated at the appropriate time through the plant’s Administrative Section of the Technical Specifications and the plant’s PTLR process. In either case, the 10 CFR 50.90 or the PTLR processes, which constitute the current licensing basis, will ensure that the P-T limits for the period of extended operation will be updated prior to expiration of the P-T limits for the current period of operation.

The beltline or beltline region of the reactor vessel is defined 10 CFR 50, Appendix G, Section II.F, as the region of the reactor vessel (shell material including welds, heat affected zones, and plates or forgings) that directly surrounds the effective height of the active core and adjacent regions of the reactor vessel that are predicted to experience sufficient neutron radiation damage to be considered in the selection of the most limiting material with regard to radiation damage.

As listed in Table 4.2.1-1 of this License Renewal Application (LRA), the beltline materials at 40 years for Byron and Braidwood, Units 1 and 2, include the following items:

- Nozzle Shell Forging
- Intermediate Shell Forging
- Lower Shell Forging
- Nozzle Shell Forging-to-Intermediate Shell Forging Circumferential Weld Seam
- Intermediate Shell Forging-to-Lower Shell Forging Circumferential Weld Seam

Also noted in Table 4.2.1-1 of this LRA, the beltline materials for the period of extended operation include all items with 57 EFPY inside surface fluence greater than 1.0×10^{17} n/cm^2. For Byron and Braidwood Units 1 and 2, the 60-year beltline items include those listed above plus the following items predicted to incur irradiation damage above the threshold:

- Inlet Nozzles
- Outlet Nozzles
- Inlet Nozzle-to-Nozzle Shell Forging Weld Seams
- Outlet Nozzle-to-Nozzle Shell Forging Weld Seams

The current P-T limits for Byron and Braidwood Units 1 and 2 are based on the latest fluence data and are located in the unit specific PTLRs. PTLRs containing updated P-T limits for the period of extended operation will be submitted to the NRC for approval prior to exceeding the current terms of applicability. The analysis for the P-T curves will consider locations outside of the beltline such as nozzles, penetrations and other discontinuities to determine if more restrictive P-T limits are required than would be determined by considering only the reactor vessel beltline materials. Maintenance of the P-T limits during the period of extended operation will be managed using the applicable process as described above to comply with 10 CFR 50, Appendix G.

TLAA Disposition: 10 CFR 54.21 (c)(1)(iii) – The effects of aging on the intended function(s) of the reactor vessels will be adequately managed for the period of extended operation. The Reactor Vessel Surveillance (B.2.1.19) program will ensure that updated P-T limits based upon updated ART values will be submitted to the NRC for approval prior to exceeding the current terms of applicability for Byron and Braidwood, Units 1 and 2. The P-T limits will be maintained during the period of extended operation using the Administrative Section of Technical Specifications to amend the P-T limits through the PTLR process.

4.2.6 LOW TEMPERATURE OVERPRESSURE PROTECTION (LTOP) Analyses

TLAA Description:

Low temperature overpressure protection (LTOP) system at Byron and Braidwood is required by Technical Specification Limited Condition for Operation 3.4.12. Two pressurizer power-operated relief valves (PORV) are used to provide the automatic relief capability during the design basis mass input (MI) and the design basis heat input (HI) transients to automatically prevent the reactor coolant system pressure from exceeding the pressure-temperature limit curves based on 10 CFR 50, Appendix G. The residual heat removal (RHR) suction relief valves may also be used to provide low-temperature overpressure protection (two RHR suction relief valves or one PORV and one RHR suction relief valve). The design basis MI and HI transients are defined in the Updated Final Safety Analysis Report and Technical Specifications Bases.

Since LTOP system setpoints are based on the P-T limits calculation, which is a TLAA, the calculation of the LTOP setpoints and the supporting analyses have been identified as TLAAs.

TLAA Evaluation:

Since these LTOP system analyses do not depend upon any other time-dependent values beyond the ART at the critical locations and the P-T limits, changes to the reactor coolant system P-T limits also require an evaluation of the LTOP temperature and PORV pressure setpoints, and supporting safety analyses.

The LTOP system setpoints are established in the Pressure Temperature Limit Report (PTLR) and are managed consistent with the P-T limits, which will be managed through the period of extended operation as described in Section 4.2.5, Pressure-Temperature (P-T) Limits. Therefore the LTOP setpoints will be managed through the period of extended operation.

TLAA Disposition: 10 CFR 54.21 (c)(1)(iii) – The LTOP system licensing and design basis analyses will be managed through the period of extended operation by the Reactor Vessel Surveillance (B.2.1.19) program. The LTOP system setpoints are based on the P-T limits. The Reactor Vessel Surveillance (B.2.1.19) program will ensure that updated P-T limits based upon updated ART values will be submitted to the NRC for approval prior to exceeding the current terms of applicability for Byron and Braidwood, Units 1 and 2. The revision of the P-T limits to increase their applicability term through 57 EFPY will require re-evaluation of the LTOP system setpoints.

4.3 METAL FATIGUE

Fatigue analyses are required on components designed to ASME, Section III, Class 1. In addition, certain other codes such as ASME Section III, Class 2 and 3, ANSI B31.1, and ASME Section VIII Division 2, may require a fatigue analysis or assume a stated number of full-range thermal and displacement cycles. NUREG-1801, Revision 2, also provides a listing of components that are likely to have fatigue TLAAs within the current licensing basis that would require evaluation for License Renewal. Searches were performed to identify these and any other potential fatigue TLAA within the current licensing basis for Byron and Braidwood. Each of the potential TLAAs were evaluated with regard to the six TLAA screening criteria specified in 10 CFR 54.3. Those that were identified as Byron and Braidwood TLAAs are evaluated in the following subsections:

- Transient Inputs to Fatigue Analyses (4.3.1)
- ASME Section III, Class 1 Fatigue Analyses (4.3.2)
- ASME Section III, Class 2 and 3 and ANSI B31.1 Allowable Stress Analyses (4.3.3)
- Class 1 Component Fatigue Analyses Supporting GSI-190 Closure (4.3.4)
- Reactor Vessel Internals Fatigue Analyses (4.3.5)
- High-Energy Line Break (HELB) Analyses Based on Fatigue (4.3.6)
- NRC Bulletin 88-11 Revised Fatigue Analysis of the Pressurizer Surge Line for Thermal Cycling and Stratification (4.3.7)
- ASME Section III, Subsection NF, Class 1 Component Supports Allowable Stress Analyses (4.3.8)
- Fatigue Design of Spent Fuel Pool Liner and Spent Fuel Storage Racks for Seismic Events (4.3.9)
- Pressurizer Heater Sleeve Structural Assessment (4.3.10)

4.3.1 TRANSIENT INPUTS TO FATIGUE ANALYSES

ASME Section III, Class 1 fatigue analyses are based upon explicit numbers and amplitudes of thermal and pressure transients described in the design specifications. The intent of the design basis transient definitions is to bound a wide range of possible events with varying ranges of severity in temperature, pressure, and flow.

Each BBS component designed in accordance with ASME Section III requiring a fatigue analysis was analyzed and shown to have a CUF less than the allowable design limit of 1.0. Some components were exempted from a fatigue analysis based on the code exemption criteria. Since the fatigue analyses and exemptions from fatigue analysis are based upon a number of cycles postulated to bound 40 years of service, projection of the transients' cycles through the period of extended operation is required as an input to demonstrate that the analyses and exemptions remain valid.

Some ASME Section III Class 2 heat exchangers were evaluated for fatigue similar to Class 1 components using transients inputs from Tables 4.3.1-1, 4.3.1-2, 4.3.1-4, and 4.3.1-5. These analyses are discussed further in Section 4.3.2. Since the fatigue analyses are based upon a number of cycles postulated to bound 40 years of service, projection of the transients' cycles through the period of extended operation is required as an input to demonstrate that the analyses remain valid

Both Byron Unit 1 and Braidwood Unit 1 replaced steam generators with a new design in the year 1998. Some of the transient inputs to the fatigue analyses for the design of the replacement steam generators were different than those associated with the original steam generators. Those differences are noted in the discussion and tables of this section.

In order to determine that the analyses remain valid for 60 years of service, a review of fatigue monitoring data was performed to determine the number of cumulative cycles of each transient type that has occurred during past plant operation. The average rate of occurrence was determined, and predictions of future transient occurrences were made. For each transient type, the 60-year projected number of occurrences was determined by adding the number of past occurrences to the number of predicted future occurrences. These 60-year projections were then compared to the numbers of design cycles used in the fatigue analyses to see if the design cycles remain bounding for 60 years of operations. If the 60-year projected numbers of cycles is less than the numbers of cycles used in the design fatigue analyses, then the fatigue analyses based upon the design transients will remain valid for 60 years of operation, provided the design transient severity is also bounding the actual transient severity.

An evaluation was performed to determine if the severity of the actual plant transients that have occurred during past operations remains bounded by the transient severity assumed in each transient definition in the design specifications. This was to ensure that the past cycles were appropriately characterized during the fatigue monitoring activities. The administrative and operating procedures were also reviewed in order to assess the effectiveness of the design transient cycle counting program and to validate the cyclic assumptions. This evaluation determined that the actual transient severity was bounded by the design transient severity for each transient type. The cycle counting procedure was also determined to have been effective in properly characterizing actual plant transients.

The overall conclusion of these evaluations is the design transients bound the transients projected for 60 years of plant operation.

Projection Methodology

Most nuclear power plants experience a declining trend in accumulation of transients over time. This occurs because operating experience leads to more reliable operation in general. Also, Byron and Braidwood Stations, Units 1 and 2, operated in Economic Generation Control mode for the first several years. This mode of operation changed the power level of the plant more frequently in response to variations in demand from the grid. Currently, Byron and Braidwood Stations, Units 1 and 2 operate in base load, which results in a significantly lower number of load changes and associated transients.

For these reasons, a declining cyclic trend in transients is evident. A review of the data for heatups, cooldowns, load changes, and reactor trips shows also that there is a declining trend in cycle accumulation even with the base load years, particularly from about year 2000 on. Therefore, using a rate projection based on an average rate of accumulation over the period of base load operation provides an acceptable means of projecting transients into the future.

Byron Station, Units 1 and 2, have approximately 33 and 35 years of operation remaining for a 60-year life and, Braidwood Station, Units 1 and 2, have approximately 36 and 37 years of operation remaining for a 60-year life as of the year 2012. Using remaining years of operation, baseline cycle counts, and projection rates, the projected cycles for each of the transients could be determined. The equation is as follows:

(Baseline Cycles) + (Projection Rate) x (Remaining Years) = Projected Cycles for 60 Years

Some transients do not experience a generally declining cyclic trend. Two types of transients fall into this category. The first type is for transients that are generally expected to occur heavily at the beginning of plant life, but quickly taper off and then only occur at generally predictable, less frequent times. The second type is for transients with very few anticipated cycles or that are expected to occur randomly, if at all (e.g., OBE) but are included in design for conservatism. For these transients, projections are based on engineering judgment and experience. Tables 4.3.1-1 through 4.3.1-6 list the 60-year projections of transients applicable to BBS, Units 1 and 2.

TLAA Disposition: 10 CFR 54.21 (c)(1)(ii) – The transients have been projected to the end of the period of extended operation. They are to be used as inputs in the metal fatigue TLAA evaluations in the remainder of Section 4.3.

Table 4.3.1-1 Byron Station, Units 1 and 2: Baseline and 60-Year Cycle Projections for RCS Transients

Transient Number and Description	Byron Station, Unit 1		Byron Station, Unit 2		CLB Cycle Limit (2)
	Baseline Cycles (1)	Projected Cycles	Baseline Cycles (1)	Projected Cycles	
Normal Condition RCS Transients					
1. Plant Heatup at 100°F/hr	71	117	64	103	200
2. Plant Cooldown at 100°F/hr	70	117	63	103	200 (5)
3. Unit Loading Between 0% and 15% of Full Power	145	277	107	247	330 (6)
4. Unit Unloading Between 15% and 0% of Full Power	145	277	107	247	500 (7)
5. Unit Loading @ 5% of full power/min (15% to 100%)	3,422	4,445	3,146	4,441	13,200
6. Unit Unloading @ 5% of full power/min (100% to 15%)	3,422	4,445	3,146	4,441	12,240 (8)
7. 10% Step Load Increase	600	727	600	727	2,000 (9)
8. 10% Step Load Decrease	600	727	600	727	2,000 (9)
9. Large Step Load Decrease With Steam Dump	60	73	60	73	200
10. Steady State Fluctuations a. Initial	N/A	N/A	N/A	N/A	150,000 (10)
11. Steady State Fluctuations b. Random	N/A	N/A	N/A	N/A	3,000,000 (11)
12. Boron Concentration Equalization	2,631	4,677	2,484	5,074	26,400
13. Feedwater Cycling at Hot Shutdown	530 195 (4)	920 587 (4)	415	810	2,000
14. Loop Out of Service					
Normal loop shutdown	N/A	N/A	N/A	N/A	80 (12)
Normal loop startup	N/A	N/A	N/A	N/A	70 (12)
15. Refueling	18	40	16	40	80
16. Recovery of Main Feedwater Flow After Isolation (Unit 1 only)	N/A	N/A	N/A	N/A	760 (13)

Table 4.3.1-1 Byron Station, Units 1 and 2: Baseline and 60-Year Cycle Projections for RCS Transients

Transient Number and Description	Byron Station, Unit 1		Byron Station, Unit 2		CLB Cycle Limit (2)
	Baseline Cycles (1)	Projected Cycles	Baseline Cycles (1)	Projected Cycles	
17. Reactor Coolant Pump Startup/Shutdown	1,065	1,755	960	1,545	3,000 (19)
18. RCS Venting	N/A	N/A	N/A	N/A	320 (14)
19. Economic Generation Control	N/A	N/A	N/A	N/A	26,280 (15)
Upset Condition RCS Transients					
20. Loss of Load	3	6	1	4	80
21. Loss of Power	2	4	3	5	40
22. Partial Loss of Flow	0	3	0	3	80
23. Reactor Trip from Full Power: Case A – with no inadvertent cooldown	23	31	19	28	230
24. Reactor Trip from Full Power: Case B – with cooldown and no safety injection	32	38	18	24	160
25. Reactor Trip from Full Power: Case C – with cooldown and safety injection	1	2	1	2	10
26. Inadvertent RCS Depressurization	1	2	0	1	20
27. Inadvertent Startup of Inactive Loop	N/A	N/A	N/A	N/A	10 (12)
28. Control Rod Drop	8	11	3	6	80
29. Inadvertent Safety Injection (ECCS) Actuation	6	8	7	9	60
30. Excessive Feedwater Flow	1	2	0	2	30
31. Bypass Line Tempering Valve Failure	0	2	0	2	20 (16)
32. Excessive Bypass Feedwater Flow	0	2	0	2	40

Table 4.3.1-1 Byron Station, Units 1 and 2: Baseline and 60-Year Cycle Projections for RCS Transients

Transient Number and Description	Byron Station, Unit 1		Byron Station, Unit 2		CLB Cycle Limit (2)
	Baseline Cycles (1)	Projected Cycles	Baseline Cycles (1)	Projected Cycles	
33. RCS Cold Overpressurization Transient	0	1	0	1	10
34. Operating Basis Earthquake (OBE)	0	1	0	1	20 (17)
35. Thermal Stratification in Unit 1 Steam Generator Feedwater Nozzle Following a Reactor Trip Requiring Introduction of Auxiliary Feedwater Flow	6	23	N/A	N/A	120 (18)
36. Reactor Pressure Vessel Closure Stud Tensioning and Detensioning	22	48	19	47	57
RCS Test Condition Transients					
37. Turbine Roll Test	2	4	2	4	20
38. Primary Side Hydrostatic Test	3	5	2	4	10
39. Secondary Side Hydrostatic Test	3	5	2	4	10
40. Primary Side Leakage Test	18	40	16	40	200
41. Secondary Side Leakage Test (3)	18	40	16	40	80
42. Steam Generator Tube Leakage Test	18	40	16	40	720 (14)

Notes:

(1) Through March 31, 2012. The cycles to-date for the Unit 1 replacement steam generators were not calculated separately if qualification could be shown with the full set of cycles from the beginning of plant life.

(2) The CLB Transient Cycle Limit is the smallest limit from all the applicable component design and licensing basis analyses.

(3) For Byron Station, Unit 1, the steam generator equipment designer assumed the test temperature to be between 120°F and 250°F with the primary side at zero pressure. For Byron Station, Unit 2, the primary

and secondary sides of the steam generators are defined to be at ambient temperatures during these tests.

(4) The larger number of cycles is for components that were not replaced; the smaller number is for the Unit 1 replacement steam generators.

(5) Pressurizer cooldown rate is 200°F/hr.

(6) The CLB Cycle Limit chosen is conservative. The Unit 1 replacement steam generators have a limit of 330 with a cold turbine-generator and 1,130 with a hot turbine-generator. The projected cycles are such that the cycles remain within the lowest limit, regardless of turbine-generator status. Most other components have an overall limit of 500 cycles.

(7) Unit 2 steam generator has a limit of 580 cycles.

(8) Cycles limited by the Unit 1 replacement steam generators. Other affected components have a limit of 13,200 cycles.

(9) Some of the steam generator specifications subcategorize this transient based on the initial power level.

(10) These are assumed in the design to occur in the first 20 months of operation and are, therefore, not projected.

(11) The ± 0.5°F and ± 6 psi fluctuations cause negligible stress variations, and the resulting changes in stress ranges if this transient is combined with others in a fatigue evaluation are also negligible. Therefore this transient does not need to be counted. Also, the Byron UFSAR documents a limit of 3.5×10^6 cycles for the Unit 1 Steam Generators.

(12) This transient is not allowed per the BBS Technical Specifications LCO 3.4.4 and, therefore, has no cycle counts. It is not projected to occur for the remainder of the current and extended operating periods.

(13) This transient is applicable to the Unit 1 Steam Generators only. However, it was not evaluated separately because cycles associated with switching between main and auxiliary feedwater flow are implicit in the cycles counted for the other RCS transients.

(14) Cycles limited by Unit 1 replacement steam generators. Based on operating procedures this pressure transient does not occur. Therefore, baseline and 60-year transient projections for this transient are not required.

(15) This is an additional type of load following for which the plants were analyzed. The plants no longer operate this way. The load changes for this transient are smaller than the normal unit loading/unloading at 5%/minute transient, and the cycles that have occurred in the past were included in the unit loading/unloading transient cycle counts for conservatism. Therefore, baseline and 60-year projected transients for this transient were not required.

(16) Limited by Unit 2 Steam Generators.

(17) Cycles limited by steam generator specifications. Each of the 20 cycles has 20 subcycles of OBE mechanical loads that are to be superimposed upon the 100 percent power normal loads.

(18) 120 design cycles were based on assumed 30-year life remaining when the Unit 1 steam generators were replaced. Cumulative cycles were calculated based on reactor trip cycles with auxiliary feedwater flow.

(19) Cycles are limited by steam generator specifications but are not a significant contributor to fatigue. The projection of transients is made to support the TLAA evaluated in Section 4.7.5.

Table 4.3.1-2 Byron Station, Unit 1 and Unit 2: Baseline and 60-Year Cycle Projections for Auxiliary System Transients

Component and Associated Transients (3)	Byron Station, Unit 1		Byron Station, Unit 2		CLB Cycle Limit (2)
	Baseline Cycles (1)	Projected Cycles	Baseline Cycles (1)	Projected Cycles	
1. Accumulator Line Transients prior to connection to cold leg safety injection line	0	2	1	2	25
2. Cold Leg Accumulator/Safety Injection Nozzle and Associated Lines Transients (abnormal conditions)	8	14	9	14	110
3. Cold Leg Accumulator/Safety Injection and Hot Leg Safety Injection Nozzles and Associated Lines Transients (normal conditions)	70 (5) 18 (5)	117 (5) 40 (5)	63 (5) 16 (5)	103 (5) 40 (5)	200 (5) 80 (5)
4. Hot Leg Safety Injection Nozzle, Boron Injection Nozzle, Associated Lines, and Tank Transients (abnormal conditions)	8	12	8	12	110 (6)
5. Letdown Flow Shutoff Delayed Return to Service	9	14	9	13	20 (4)
6. Letdown Flow Shutoff Prompt Return to Service	185	304	242	388	200 (4)(8)
7. Charging Flow Step Decrease and Return to Normal	3,096	4,021	3,279	4,628	24,000 (4)
8. Charging Flow Step Increase and Return to Normal	2,915	3,785	2,869	4,050	24,000 (4)
9. Letdown Flow Step Decrease and Return to Normal	387	503	676	953	2,000 (4)
10. Letdown Flow Step Increase and Return to Normal	2,685	3,487	3,243	4,577	24,000 (4)
11. Charging Flow Shutoff with Prompt Return to Service	9	14	9	13	20 (4)

Table 4.3.1-2 Byron Station, Unit 1 and Unit 2: Baseline and 60-Year Cycle Projections for Auxiliary System Transients

Component and Associated Transients (3)	Byron Station, Unit 1		Byron Station, Unit 2		CLB Cycle Limit (2)
	Baseline Cycles (1)	Projected Cycles	Baseline Cycles (1)	Projected Cycles	
12. Charging Flow Shutoff with Delayed Return to Service	9	14	9	13	20 (4)
13. Charging and Letdown Flow Shutoff and Return to Service	9	14	9	13	60 (4)
14. Sampling Line and Nozzles Transients(7)	N/A	N/A	N/A	N/A	N/A
15. RCP Piping – Seal Injection Flow Temperature Change	12	19	12	19	180
16. RCP Piping – Loss of Seal Injection Flow	10	25	10	25	40
17. RCP Piping – Component Cooling Water Temperature Change	12	19	12	19	100
18. RCP Piping – Loss of Component Cooling Water Flow	10	25	10	25	200
19. Pressurizer Relief Valve and Inlet Line Transients	11	21	11	21	100
20. Pressurizer Safety Valve and Inlet Line Transients	3	6	1	4	40
21. Pressurizer Spray and Auxiliary Spray Line Piping and Nozzles Transients	0	3	1	3	10
22. Letdown Heat Exchanger Transients	10	25	10	25	200

Notes:

(1) Through March 31, 2012. The cycles to-date for the Unit 1 replacement steam generators were not calculated separately if qualification could be shown with the full set of cycles from the beginning of plant life.

(2) The CLB Cycle Limit is the most limiting value used in any of the applicable component design and licensing basis analyses.

(3) Any components adjacent to the RCS experience the applicable RCS transients, as well as line/nozzle-specific transients related to performing their particular safety function as described in this table.

(4) Baseline cycles were developed based on a review of Byron specific plant parameter data. Projections were based on heatups for flow isolation transients and load increase transients for flow change events.

(5) The first set of numbers is for Cooldowns, and the second is for Refueling.

(6) The Boron Injection Tank is not used and is not connected to the system.

(7) Chemistry samples are taken at a much lower frequency than that which was assumed in the design, resulting in fewer thermal cycles. Also, samples are no longer taken from the RCS (taken from letdown system) as had been specified in the design. Temperatures differences are much lower than those postulated in the original design which had assumed samples were taken from the RCS, resulting in lower transient severity.

(8) Although the baseline cycles (242 for Unit 2) and projected cycles (304 and 388 for Units 1 and 2, respectively) for this transient are greater than the CLB cycle limit (200), the transient has been redefined as four differential temperature range transients. Based on plant data, the number of baseline and 60-year projected cycles for each differential temperature range transient were determined and a reanalysis performed for the bounding location. The analysis confirmed the cumulative fatigue usage will continue to be within the allowable value of 1.0. The redefined transient CLB cycle limits bound the 60-year projected cycles for each differential temperature range transient. The revised transient definitions, bounding baseline transient cycles, and redefined CLB cycle limits will be used by the Fatigue Monitoring (B.3.1.1) program to maintain the cumulative fatigue usage within the allowable value of 1.0.

The following piping/components are also subjected to RCS and/or auxiliary transients and the cycles are acceptable based on Tables 4.3.1-1 and 4.3.1-2.

- Pressurizer surge line, nozzle and lower head
- RCS drain and loop fill lines
- Auxiliary piping and equipment integral to the steam generators
- Regenerative, letdown reheat, residual heat removal, excess letdown and sample heat exchangers
- Loop isolation valves and all other 6 inch and larger Class 1 valves

Table 4.3.1-3 Byron Station, Unit 1 and Unit 2: Baseline and 60-Year Cycle Projections for ASME Class 2, 3, and ANSI B31.1 Component Transients

Transient Number and Description	Byron Station, Unit 1		Byron Station, Unit 2		CLB Cycle Limit (2)
	Baseline Cycles (1)	Projected Cycles	Baseline Cycles (1)	Projected Cycles	
1. Plant Heatup at 100°F/hr	71	117	64	103	-
2. Plant Cooldown at 100°F/hr	70	117	63	103	-
3. Unit Loading Between 0% and 15% of Full Power	145	277	107	247	-
4. Unit Unloading Between 15% and 0% of Full Power	145	277	107	247	-
5. Unit Loading @ 5% of full power/min (15% to 100%)	45	60 (3)	45	60 (3)	-
6. Unit Unloading @ 5% of full power/min (100% to 15%)	45	60 (3)	45	60 (3)	-
7. 10% Step Load Increase	600	727	600	727	-
8. 10% Step Load Decrease	600	727	600	727	-
9. Large Step Load Decrease With Steam Dump	60	73	60	73	-
10. Refueling	18	40	16	40	-
11. Loss of Load	3	6	1	4	-
12. Loss of Power	2	4	3	5	-
13. Partial Loss of Flow	0	3	0	3	-
14. Reactor Trip from Full Power: Case A – with no inadvertent cooldown	23	31	19	28	-
15. Reactor Trip from Full Power: Case B – with cooldown and no safety injection	32	38	18	24	-
16. Reactor Trip from Full Power: Case C – with cooldown and safety injection	1	2	1	2	-
17. Inadvertent RCS Depressurization	1	2	0	1	-
18. Control Rod Drop	8	11	3	6	-
19. Inadvertent Safety Injection (ECCS) Actuation	6	8	7	9	-

Table 4.3.1-3 Byron Station, Unit 1 and Unit 2: Baseline and 60-Year Cycle Projections for ASME Class 2, 3, and ANSI B31.1 Component Transients

Transient Number and Description	Byron Station, Unit 1		Byron Station, Unit 2		CLB Cycle Limit (2)
	Baseline Cycles (1)	Projected Cycles	Baseline Cycles (1)	Projected Cycles	
20. Letdown Flow Shutoff Delayed Return to Service	9	14	9	13	-
21. Letdown Flow Shutoff Prompt Return to Service	185	304	242	388	-
22. Charging Flow Shutoff with Prompt Return to Service	9	14	9	13	-
23. Charging Flow Shutoff with Delayed Return to Service	9	14	9	13	-
24. Charging and Letdown Flow Shutoff and Return to Service	9	14	9	13	-
Total for all transients except 5 and 6:	-	2,820	-	2,789	-
Total for transients 5 and 6 with Note 3:	-	120	-	120	-
Total for all transients:	-	2,940	-	2,909	7,000

Notes:

(1) Through March 31, 2012. No separate reduction for the Unit 1 replacement steam generator is included.

(2) The 7000 cycles allowable is based on using a stress range reduction factor (f) of 1.0 in the Code Allowable Expansion Stress Range equation (Tables NC-3611.2(e)-1 and ND-3611.2(e)-1). Since the projected number of cycles for 60 years is less than 7000, the results also cover analyses for which an f-factor of less than 1.0 was employed.

(3) Projected cycles for load changes reflect a reduced temperature change equivalency ratio.

Table 4.3.1-4 Braidwood Station, Unit 1 and Unit 2: Baseline and 60-Year Cycle Projection for RCS Transients

Transient Number and Description	Braidwood Station, Unit 1		Braidwood Station, Unit 2		CLB Cycle Limit (2)
	Baseline Cycles (1)	Projected Cycles	Baseline Cycles (1)	Projected Cycles	
Normal Condition RCS Transients					
1. Plant Heatup at 100°F/hr	39	75	35	69	200
2. Plant Cooldown at 100°F/hr	38	75	34	69	200 (5)
3. Unit Loading Between 0% and 15% of Full Power	103	175	114	188	330 (6)
4. Unit Unloading Between 15% and 0% of Full Power	103	175	114	188	500 (7)
5. Unit Loading @ 5% of full power/min (15% to 100%)	1,530	1,998	1,726	2,207	13,200
6. Unit Unloading @ 5% of full power/min (100% to 15%)	1,530	1,998	1,726	2,207	12,240 (8)
7. 10% Step Load Increase	282	361	282	361	2,000 (9)
8. 10% Step Load Decrease	282	361	282	361	2,000 (9)
9. Large Step Load Decrease With Steam Dump	29	36	29	36	200
10. Steady State Fluctuations a. Initial	N/A	N/A	N/A	N/A	150,000 (10)
11. Steady State Fluctuations b. Random	N/A	N/A	N/A	N/A	3,000,000 (11)
12. Boron Concentration Equalization	1,180	2,116	1,973	2,935	26,400
13. Feedwater Cycling at Hot Shutdown	350 148 (4)	610 556 (4)	380	645	2,000
14. Loop Out of Service					
Normal loop shutdown	N/A	N/A	N/A	N/A	80 (12)
Normal loop startup	N/A	N/A	N/A	N/A	70 (12)
15. Refueling	15	39	15	40	80
16. Recovery of Main Feedwater Flow After Isolation (Unit 1 only)	N/A	N/A	N/A	N/A	760 (13)
17. Reactor Coolant Pump Startup/Shutdown	435	1,125	525	1,035	3,000 (19)

Table 4.3.1-4 Braidwood Station, Unit 1 and Unit 2: Baseline and 60-Year Cycle Projection for RCS Transients

Transient Number and Description	Braidwood Station, Unit 1		Braidwood Station, Unit 2		CLB Cycle Limit (2)
	Baseline Cycles (1)	Projected Cycles	Baseline Cycles (1)	Projected Cycles	
18. RCS Venting	N/A	N/A	N/A	N/A	320 (14)
19. Economic Generation Control	N/A	N/A	N/A	N/A	26,280 (15)
Upset Condition RCS Transients					
20. Loss of Load	1	4	1	6	80
21. Loss of Power	1	3	3	6	40
22. Partial Loss of Flow	2	5	1	6	80
23. Reactor Trip from Full Power: Case A – with no inadvertent cooldown	11	18	38	51	230
24. Reactor Trip from Full Power: Case B – with cooldown and no safety injection	11	16	9	18	160
25. Reactor Trip from Full Power: Case C – with cooldown and safety injection	4	5	1	2	10
26. Inadvertent RCS Depressurization	1	2	0	2	20
27. Inadvertent Startup of Inactive Loop	N/A	N/A	N/A	N/A	10 (12)
28. Control Rod Drop	4	7	6	11	80
29. Inadvertent Safety Injection (ECCS) Actuation	0	2	0	4	60
30. Excessive Feedwater Flow	0	2	0	2	30
31. Bypass Line Tempering Valve Failure	0	2	0	2	20 (16)
32. Excessive Bypass Feedwater Flow	0	2	0	2	40
33. RCS Cold Overpressurization Transient	1	2	0	1	10

Table 4.3.1-4 Braidwood Station, Unit 1 and Unit 2: Baseline and 60-Year Cycle Projection for RCS Transients

Transient Number and Description	Braidwood Station, Unit 1		Braidwood Station, Unit 2		CLB Cycle Limit (2)
	Baseline Cycles (1)	Projected Cycles	Baseline Cycles (1)	Projected Cycles	
34. Operating Basis Earthquake (OBE)	0	1	0	1	20 (17)
35. Thermal Stratification in Unit 1 Steam Generator Feedwater Nozzle Following a Reactor Trip Requiring Introduction of Auxiliary Feedwater Flow	5	23	N/A	N/A	120 (18)
36. Reactor Pressure Vessel Closure Stud Tensioning and Detensioning	19	47	19	48	57
RCS Test Condition Transients					
37. Turbine Roll Test	2	4	2	4	20
38. Primary Side Hydrostatic Test	3	5	2	4	10
39. Secondary Side Hydrostatic Test	3	5	2	4	10
40. Primary Side Leakage Test	15	39	15	40	200
41. Secondary Side Leakage Test (3)	15	39	15	40	80
42. Steam Generator Tube Leakage Test	15	39	15	40	720 (14)

Notes:

(1) Through March 31, 2012. The cycles to-date for the Unit 1 replacement steam generators were not calculated separately if qualification could be shown with the full set of cycles from the beginning of plant life.

(2) The CLB Transient Cycle Limit is the most limiting value used in any of the applicable component design and licensing basis analyses.

(3) For Braidwood Station, Unit 1, the steam generator equipment designer assumed the test temperature to be between 120°F and 250°F with the primary side at zero pressure. For Braidwood Station, Unit 2, the primary and secondary sides of the steam generators are defined to be at ambient temperatures during these tests.

(4) The larger number of cycles is for components that were not replaced; the smaller is for the replacement

steam generator.

(5) Pressurizer cooldown rate is 200°F/hr.

(6) The CLB Cycle Limit chosen is conservative. The Unit 1 replacement steam generators have a limit of 330 with a cold turbine-generator and 1,130 with a hot turbine-generator. The projected cycles are such that the cycles remain within the lowest limit, regardless of turbine-generator status. Most other components have an overall limit of 500 cycles.

(7) Unit 2 steam generator has a limit of 580 cycles.

(8) Cycles limited by the Unit 1 replacement steam generators. Other affected components have a limit of 13,200 cycles.

(9) Some of the steam generator specifications subcategorize this transient based on the initial power level.

(10) These are assumed in the design to occur in the first 20 months of operation and are therefore not projected.

(11) The ± 0.5°F and ± 6 psi fluctuations cause negligible stress variations, and the resulting changes in stress ranges if this transient is combined with others in a fatigue evaluation are also negligible. Therefore this transient does not need to be counted. Also, the Braidwood UFSAR documents a limit of 3.5×10^6 cycles for the Unit 1 replacement steam generators.

(12) This transient is not allowed per the BBS Technical Specifications LCO 3.4.4 and therefore has no cycle counts. It is not projected to occur for the remainder of the current and extended operating periods.

(13) This transient is applicable to the Unit 1 replacement steam generators only. However, it was not evaluated separately because cycles associated with switching between main and auxiliary feedwater flow are implicit in the cycles counted for the other RCS transients.

(14) Cycles limited by Unit 1 replacement steam generators. Based on operating procedures this pressure transient does not occur. Therefore, baseline and 60-year projected transients for this transient are not required.

(15) This is an additional type of load following for which the plants were analyzed. The plants no longer operate this way. The load changes for this transient are smaller than the normal unit loading/unloading at 5%/minute transient, and the cycles that have occurred in the past were included in the unit loading/unloading transient cycle counts for conservatism. Therefore, baseline and 60-year projected transients for this transient were not required.

(16) Limited by Unit 2 Steam Generators.

(17) Cycles limited by steam generator specifications. Each of the 20 cycles has 20 subcycles of OBE mechanical loads that are to be superimposed upon the 100 percent power normal loads.

(18) 120 design cycles were based on assumed 30-year life remaining when the Unit 1 steam generators were replaced. Cumulative cycles were calculated based on reactor trip cycles with auxiliary feedwater flow.

(19) Cycles are limited by steam generator specifications but are not a significant contributor to fatigue. The projection of transients is made to support the TLAA evaluated in Section 4.7.5.

Table 4.3.1-5 Braidwood Station, Unit 1 and Unit 2: Baseline and 60-Year Cycle Projections for Auxiliary System Transients

Component and Associated Transients (3)	Braidwood Station, Unit 1		Braidwood Station, Unit 2		CLB Cycle Limit (2)
	Baseline Cycles (1)	Projected Cycles	Baseline Cycles (1)	Projected Cycles	
1. Accumulator Line Transients prior to connection to cold leg safety injection line	2	3	1	2	25
2. Cold Leg Accumulator/Safety Injection Nozzle and Associated Lines Transients (abnormal conditions)	6	11	2	10	110
3. Cold Leg Accumulator/Safety Injection and Hot Leg Safety Injection Nozzles and Associated Lines Transients (normal conditions)	38 (5) 15 (5)	75 (5) 39 (5)	34 (5) 15 (5)	69 (5) 40 (5)	200 (5) 80 (5)
4. Hot Leg Safety Injection Nozzle, Boron Injection Nozzle, Associated Lines, and Tank Transients (abnormal conditions)	6	9	2	8	110 (6)
5. Letdown Flow Shutoff Delayed Return to Service	9	13	9	13	20 (4)
6. Letdown Flow Shutoff Prompt Return to Service	189	363	150	295	200 (4) (8)
7. Charging Flow Step Decrease and Return to Normal	1,916	2,501	2,229	2,850	24,000 (4)
8. Charging Flow Step Increase and Return to Normal	2,344	3,061	2,321	2,967	24,000 (4)
9. Letdown Flow Step Decrease and Return to Normal	322	420	343	438	2,000 (4)
10. Letdown Flow Step Increase and Return to Normal	1,943	2,536	2,344	2,996	24,000 (4)

Table 4.3.1-5 Braidwood Station, Unit 1 and Unit 2: Baseline and 60-Year Cycle Projections for Auxiliary System Transients

Component and Associated Transients (3)	Braidwood Station, Unit 1		Braidwood Station, Unit 2		CLB Cycle Limit (2)
	Baseline Cycles (1)	Projected Cycles	Baseline Cycles (1)	Projected Cycles	
11. Charging Flow Shutoff with Prompt Return to Service	9	13	9	13	20 (4)
12. Charging Flow Shutoff with Delayed Return to Service	9	13	9	13	20 (4)
13. Charging and Letdown Flow Shutoff and Return to Service	9	13	9	13	60 (4)
14. Sampling Line and Nozzles Transients(7)	N/A	N/A	N/A	N/A	N/A
15. RCP Piping – Seal Injection Flow Temperature Change	9	17	9	17	180
16. RCP Piping – Loss of Seal Injection Flow	10	30	10	30	40
17. RCP Piping – Component Cooling Water Temperature Change	9	17	9	17	100
18. RCP Piping – Loss of Component Cooling Water Flow	10	30	10	30	200
19. Pressurizer Relief Valve and Inlet Line Transients	4	14	4	22	100
20. Pressurizer Safety Valve and Inlet Line Transients	1	4	1	6	40
21. Pressurizer Spray and Auxiliary Spray Line Piping and Nozzles Transients	0	6	2	6	10
22. Letdown Heat Exchanger Transients	10	30	10	30	200

Notes:

(1) Through March 31, 2012. The cycles to-date for the Unit 1 replacement steam generators were not calculated separately if qualification could be shown with the full set of cycles from the beginning of plant life.

(2) The CLB Cycle Limit is the most limiting value used in any of all the applicable component design and licensing basis analyses.

(3) Any components adjacent to the RCS experience the applicable RCS transients, as well as line/nozzle-specific transients related to performing their particular safety function as described in this table.

(4) Baseline cycles were developed based on a review of Braidwood specific plant parameter data. Projections were based on heatups for flow isolation transients and load increase transients for flow change events.

(5) The first set of numbers is for Cooldowns, and the second is for Refueling.

(6) The Boron Injection Tank is not used and is not connected to the system.

(7) Chemistry samples are taken at a much lower frequency than that which was assumed in the design, resulting in fewer thermal cycles. Also, samples are no longer taken from the RCS (taken from letdown system) as had been specified in the design. Temperature differences are much lower than those postulated in the original design which had assumed samples were taken from the RCS, resulting in lower transient severity.

(8) Although the projected cycles (363 and 295 for Units 1 and 2, respectively) for this transient are greater than the CLB cycle limit (200), the transient has been redefined as four differential temperature range transients. Based on plant data, the number of baseline and 60-year projected cycles for each differential temperature range transient were determined and a reanalysis performed for the bounding location. The analysis confirmed the cumulative fatigue usage will continue to be within the allowable value of 1.0. The redefined transient CLB cycle limits bound the 60-year projected cycles for each differential temperature range transient. The revised transient definitions, bounding baseline transient cycles, and redefined CLB cycle limits will be used by the Fatigue Monitoring (B.3.1.1) program to maintain the cumulative fatigue usage within the allowable value of 1.0.

The following piping/components are also subjected to RCS and/or auxiliary transients and the cycles are acceptable based on Tables 4.3.1-4 and 4.3.1-5.

- Pressurizer surge line, nozzle and lower head
- RCS drain and loop fill lines
- Auxiliary piping and equipment integral to the steam generators
- Regenerative, letdown reheat, residual heat removal, excess letdown and sample heat exchangers
- Loop isolation valves and all other 6 inch and larger Class 1 valves

Table 4.3.1-6 Braidwood Station, Unit 1 and Unit 2: Baseline and 60-Year Cycle Projections for ASME Class 2, 3, and ANSI B31.1 Component Transients

Transient Number and Description	Braidwood Station, Unit 1		Braidwood Station, Unit 2		CLB Cycle Limit (2)
	Baseline Cycles (1)	Projected Cycles	Baseline Cycles (1)	Projected Cycles	
1. Plant Heatup at 100°F/hr	39	75	35	69	-
2. Plant Cooldown at 100°F/hr	38	75	34	69	-
3. Unit Loading Between 0% and 15% of Full Power	103	175	114	188	-
4. Unit Unloading Between 15% and 0% of Full Power	103	175	114	188	-
5. Unit Loading @ 5% of full power/min (15% to 100%)	25	35 (3)	25	35 (3)	-
6. Unit Unloading @ 5% of full power/min (100% to 15%)	25	35 (3)	25	35 (3)	-
7. 10% Step Load Increase	282	361	282	361	-
8. 10% Step Load Decrease	282	361	282	361	-
9. Large Step Load Decrease With Steam Dump	29	36	29	36	-
10. Refueling	15	39	15	40	-
11. Loss of Load	1	4	1	6	-
12. Loss of Power	1	3	3	6	-
13. Partial Loss of Flow	2	5	1	6	-
14. Reactor Trip from Full Power: Case A – with no inadvertent cooldown	11	18	38	51	
15. Reactor Trip from Full Power: Case B – with cooldown and no safety injection	11	16	9	18	-
16. Reactor Trip from Full Power: Case C – with cooldown and safety injection	4	5	1	2	-
17. Inadvertent RCS Depressurization	1	2	0	2	-
18. Control Rod Drop	4	7	6	11	-

Table 4.3.1-6 Braidwood Station, Unit 1 and Unit 2: Baseline and 60-Year Cycle Projections for ASME Class 2, 3, and ANSI B31.1 Component Transients

Transient Number and Description	Braidwood Station, Unit 1		Braidwood Station, Unit 2		CLB Cycle Limit (2)
	Baseline Cycles (1)	Projected Cycles	Baseline Cycles (1)	Projected Cycles	
19. Inadvertent Safety Injection (ECCS) Actuation	0	2	0	4	-
20. Letdown Flow Shutoff Delayed Return to Service	9	13	9	13	-
21. Letdown Flow Shutoff Prompt Return to Service	189	363	150	295	-
22. Charging Flow Shutoff with Prompt Return to Service	9	13	9	13	-
23. Charging Flow Shutoff with Delayed Return to Service	9	13	9	13	-
24. Charging and Letdown Flow Shutoff and Return to Service	9	13	9	13	-
Total for all transients except 5 and 6:	-	1,774	-	1,765	-
Total for transients 5 and 6, with Note 3:	-	60	-	60	-
Total for all transients:	-	1,834	-	1,825	7,000

Notes:

(1) Through March 31, 2012. No separate reduction for the Unit 1 replacement steam generator is included.

(2) The 7000 cycles allowable is based on using a stress range reduction factor (f) of 1.0 in the Code Allowable Expansion Stress Range equation (Tables NC-3611.2(e)-1 and ND-3611.2(e)-1). Since the projected number of cycles for 60 years is less than 7000, the results also cover analyses for which an f-factor of less than 1.0 was employed.

(3) Projected cycles for load changes reflect a reduced temperature change equivalency ratio.

4.3.2 ASME SECTION III, CLASS 1, CLASS 2, AND CLASS 3 FATIGUE ANALYSES

TLAA Description:

The Byron and Braidwood reactor vessels and reactor coolant pressure boundary piping, components, and auxiliary lines were designed in accordance with ASME Section III, Class 1 requirements. Fatigue analyses were prepared for these components to determine the effects of cyclic loadings resulting from changes in system temperature, pressure, and seismic loading cycles. These ASME Section III, Class 1 fatigue analyses are based upon explicit numbers and amplitudes of thermal and pressure transients described in the design specifications. The intent of the design basis transient definitions is to bound a wide range of possible events with varying ranges of severity in temperature, pressure, and flow. The fatigue analyses were required to demonstrate that the cumulative usage factor (CUF) will not exceed the design allowable limit of 1.0 when the equipment is exposed to all of the postulated transients. Since the calculation of fatigue usage factors is part of the current licensing basis and is used to support safety determinations and since the number of occurrences of each transient type was based upon 40-year assumptions, these Class 1 fatigue analyses have been identified as TLAAs requiring evaluation for the period of extended operation.

Some ASME Section III, Class 2 heat exchangers have fatigue analyses. The fatigue analyses were performed in a manner similar to that used for Class 1 components. The fatigue analyses were required to demonstrate that the cumulative usage factor (CUF) will not exceed the design allowable limit of 1.0 when the equipment is exposed to all of the postulated transients. Since the calculation of fatigue usage factors is part of the current licensing basis and the number of occurrences of each transient type was based upon 40-year assumptions, the fatigue analyses performed for Class 2 heat exchangers have been identified as TLAAs requiring evaluation for the period of extended operation.

The design analysis of some BBS ASME Section III, Class 1 components also used the fatigue exemption provisions of ASME Section III, Subparagraphs NB-3222.4 (d) (1) through (6). The exemption determination is also based on the 40-year design transients described in the design specifications. A review of the provisions of ASME Section III, Subparagraphs NB-3222.4(d) (1) through (6) shows that the allowance for an exemption is based upon the number of occurrences of design transient events and the severity of the occurrences. Since these fatigue exemptions are based upon the 40-year design transients, they have also been identified as TLAAs that require evaluation for the period of extended operation.

Some ASME Section III, Class 2 and 3 components at BBS were designed to ASME Section III, Paragraph NC-3219 requirements and were shown to meet the criteria for a fatigue exemption per ASME Section III, Subparagraphs NC-3219.2 and NC-3219.3. The approach taken for the fatigue exemption is similar to that taken in ASME Section III, Subparagraphs NB-3222.4(d) (1) through (6) for a fatigue exemption on Class 1 components.

TLAA Evaluation:

BBS ASME Section III Class 1 vessel, piping, and components have fatigue analyses and fatigue exemptions that are based on the transient cycles listed in design specifications, as shown in Tables 4.3.1-1, 4.3.1-2, 4.3.1-4, and 4.3.1-5. As demonstrated in Section 4.3.1, the 40-year design transient cycle numbers and severity remain bounding for 60 years of plant operation. Therefore, the fatigue analyses and fatigue exemptions for BBS Class 1 vessels, piping, and components remain valid for the period of extended operation. However, in order to ensure the numbers of transients remain bounding of those used in the Class 1 fatigue analyses and fatigue exemptions, the Fatigue Monitoring (B.3.1.1) program will be used to monitor transients and ensure corrective action is taken prior to exceeding any design cycle limit.

Several Class 2 heat exchangers have fatigue analyses that are based on the transient cycles listed in design specifications, as shown in Tables 4.3.1-1, 4.3.1-2, 4.3.1-4, and 4.3.1-5. As demonstrated in Section 4.3.1, the 40-year design transient cycle numbers and severity remain bounding for 60 years of plant operation. Therefore, the fatigue analyses for BBS Class 2 heat exchangers remain valid for the period of extended operation. However, in order to ensure the numbers of transients remain bounding of those used in the Class 2 heat exchanger fatigue analyses, the Fatigue Monitoring (B.3.1.1) program will be used to monitor transients and ensure corrective action is taken prior to exceeding any design cycle limit.

To demonstrate acceptability from a fatigue exemption basis for 60 years of operation for Class 1, 2, and 3 components, the transients considered are based on the transients in Tables 4.3.1-1, 4.3.1-2, 4.3.1-4 and 4.3.1-5. Section 4.3.1 demonstrates the projected numbers of transients cycles for 60 years of operation are less than the 40-year design transient cycles. The ASME Section III, Class 1 components fatigue exemptions based on ASME Section III, Subparagraphs NB-3222.4 (d) (1) through (6), and the ASME Section III, Class 2 and 3 components fatigue exemptions based on ASME Section III, Subparagraphs NC-3219.2 and NC-3219.3 remain valid because the 60-year cycle projections are less than those assumed in developing the exemptions. The Fatigue Monitoring (B.3.1.1) program will be used to ensure these cycles will not be exceeded during the period of extended operation.

TLAA Disposition: 10 CFR 54.21(c)(1)(iii) – The Fatigue Monitoring (B.3.1.1) program will be used to monitor transient cycles and ensure the numbers of transients analyzed in the ASME Section III, Class 1 fatigue analyses and the ASME Section III, Class 2 heat exchangers fatigue analyses, and the ASME Section III, Class 1, Class 2, and Class 3 fatigue exemptions will not be exceeded through the period of extended operation.

4.3.3 ASME SECTION III, CLASS 2 AND 3 AND ANSI B31.1 ALLOWABLE STRESS ANALYSES

TLAA Description:

Piping and components designed in accordance with ASME Section III, Class 2 and 3, and ANSI B31.1 design rules are not required to have an explicit analysis of cumulative fatigue usage, but cyclic loading is considered in a simplified manner in the design process. These codes first require prediction of the overall number of thermal and pressure cycles expected during the 40-year lifetime of these components. Then a stress range reduction factor is determined for that number of cycles using a table from the applicable design code, similar to Table 4.3.3-1 below. If the total number of cycles is 7,000 or less, the stress range reductions factor of 1.0 is applied that would not reduce the allowable stress value. For high numbers of cycles, a stress range reduction factor of less than 1.0 is applied that limits the allowable stresses applied to the piping, which reduces the likelihood of failure due to cyclic loading. These are considered to be implicit fatigue analyses since they are based upon cycles anticipated for the life of the component, and are therefore, TLAAs requiring evaluation for the period of extended operation.

<u>Piping and Components Designed in Accordance with ASME Section III, Class 2 and 3, and ANSI B31.1 associated with the RCS and Auxiliary Systems Transients</u>

TLAA Evaluation:

ASME Section III, Class 2 and 3 piping at BBS was designed to ASME Section III, Paragraph NC-3611, and ASME Section III, Paragraph ND-3611, and ANSI B31.1 requirements. The cyclic qualification of the piping is based on the number of equivalent full temperature cycles as listed in Table 4.3.3-1.

Table 4.3.3-1
Stress Range Reduction Factors for ASME Section III, Class 2, 3 and ANSI B31.1

Number of Equivalent Full Temperature Cycles	Stress Range Reduction Factor
7,000 and less	1.0
7,000 to 14,000	0.9
14,000 to 22,000	0.8
22,000 to 45,000	0.7
45,000 to 100,000	0.6
100,000 and over	0.5

The number of allowable temperature cycles is increased if a stress range reduction factor is applied. It is most conservative to use a factor of 1.0 and associated number of cycles of 7,000. Table 4.3.1-3 and Table 4.3.1-6 lists the transients and their 60-year projections for the Class 2, and 3 and ANSI B31.1 piping considered to experience transients associated with the RCS and Auxiliary Systems. This transient set is a subset of the transients found in Tables 4.3.1-1, 4.3.1-2, 4.3.1-4, and 4.3.1-5. These transients were summed to verify that they were less than 7,000 cycles. As demonstrated by Table 4.3.1-3 and Table 4.3.1-6, the number of projected cycles is less than 7,000. Therefore, fatigue of Class 2, 3, and ANSI B31.1 piping will remain valid through the period of extended operation.

TLAA Disposition: 10 CFR 54.21 (c)(1)(iii) – The Fatigue Monitoring (B.3.1.1) program will be used to ensure that the numbers of cycles analyzed in the ASME Section III, Class 2 and 3 and ANSI B31.1 analyses will not be exceeded during the period of extended operation. The Fatigue Monitoring (B.3.1.1) program will monitor transient cycles and severities and require action prior to exceeding design limits that would invalidate these conclusions.

Auxiliary Feedwater, Emergency Diesel Generator, Fire Protection, Heating Water and Heating Steam, and Service Water System ANSI B31.1 Piping and Components

TLAA Evaluation:

For the remaining systems that are affected by different thermal and pressure cycles, an operational review was performed that concluded that the total number of cycles projected for 60 years are significantly less 7,000 cycles. This includes the Auxiliary Feedwater, Emergency Diesel Generator, Fire Protection, Heating Water and Heating Steam System, and Service Water Systems. Therefore, since the projected number of transient cycles does not exceed the number of equivalent full temperature cycles assumed in the implicit stress analysis, the stress range reduction factors originally selected for the components in all of these systems remain applicable. Therefore, the TLAAs remain valid for the period of extended operation.

TLAA Disposition: 10 CFR 54.21(c)(1)(i) – The ASME Section III, Class 2 and 3 and ANSI B31.1 allowable stress calculations for the Auxiliary Feedwater, Emergency Diesel Generator, Fire Protection, Heating Water and Heating Steam, and Service Water System remain valid for the period of extended operation.

4.3.4 CLASS 1 COMPONENT FATIGUE ANALYSES SUPPORTING GSI-190 CLOSURE

Description:

Although not part of the current license basis, NUREG-1800, Revision 2 (Reference 4.8.30), provides a recommendation for evaluating the effects of the reactor water environment on the fatigue life of ASME Section III Class 1 components that contact reactor coolant to support closure of Generic Safety Issue 190. One method acceptable to the NRC for satisfying this recommendation is to assess the impact of the reactor coolant environment on a sample of critical components. These critical components should include those selected in NUREG/CR-6260, “Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components” (Reference 4.8.6). The components that are applicable to Byron and Braidwood Units 1 and 2 are the ones listed for a newer vintage Westinghouse plant. BBS considered adding additional component locations if they are considered to be more limiting than those considered in NUREG/CR-6260.

This sample of components can be evaluated by applying environmental life correction factors to the existing ASME Code fatigue analyses using formulae contained in NUREG/CR-6583, “Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low Alloy Steels” (Reference 4.8.9), NUREG/CR-5704, “Effects of LWR Coolant Environments on Fatigue Design Curves of Austenitic Stainless Steels” (Reference 4.8.7) and NUREG/CR-6909, “Effects of the LWR Coolant Environments on the Fatigue Life of Reactor Materials” (Reference 4.8.10). Demonstrating that these components have an environmentally adjusted cumulative usage factor less than or equal to the design limit of 1.0 is an acceptable option for managing metal fatigue for the reactor coolant pressure boundary.

NUREG/CR-6260 identifies six sample locations for newer vintage Westinghouse plants which need to consider the effects of reactor coolant environment on component fatigue life for license renewal:

1. Reactor Vessel Shell and Lower Head
2. Reactor Vessel Inlet and Outlet Nozzles
3. Surge Line
4. Charging Nozzles
5. Safety Injection Nozzle
6. Residual Heat Removal (RHR System Class 1 Piping)

The RHR system Class 1 piping includes the suction side (from the RCS hot leg via the 12-inch RHR nozzles) and the return line (to the RCS cold leg via the 10-inch accumulator nozzles). According to the environmental fatigue screening evaluation methodology described later in this subsection, the accumulator nozzles were more limiting than any component in the RHR suction piping. Therefore, the accumulator nozzles were analyzed for environmental fatigue as the NUREG/CR-6260 RHR system class 1 piping location.

Preparation of Environmental Fatigue Analyses

60-year fatigue calculations were performed for the component locations identified above. Applicable environmental fatigue multipliers (F_{en}) for the selected locations were determined in accordance with NUREG/CR-5704 (Reference 4.8.7) for austenitic stainless steel components, NUREG/CR-6583 (Reference 4.8.9) for carbon/low alloy steel components, and NUREG/CR-6909 (Reference 4.8.10) for nickel alloy components to obtain an adjusted cumulative fatigue usage, CUF_{en}, which included the effects of reactor water environment. The applicable 60-year projected numbers of transients in Section 4.3.1 were used in the evaluations when necessary. When the reduced numbers of cycles were used, they are considered to be limits in the Fatigue Monitoring (B.3.1.1) program. If these limits are approached, corrective action will be taken to review the environmental fatigue analyses and take appropriate actions to prevent exceeding the allowable CUF_{en} value of 1.0.

The existing ASME Section III fatigue analyses of the reactor vessel locations contained enough margin in the usage factor calculation to accept the appropriate maximum F_{en} penalty factors for each location.

The BBS Units 1 and 2 piping systems investigated were previously evaluated to ASME Section III, design specifications and full fatigue evaluations (either to NB-3200 or NB-3600) existed for each component that was analyzed for Environmentally Assisted Fatigue (EAF). Therefore, for the EAF evaluations, the transients defined in the design specifications and the corresponding fatigue analyses of record were reviewed to determine the applicable transient set to be analyzed for each component. Where plant specific data was available, it was incorporated into the analysis to reduce conservatism on an as needed basis for qualification. The piping locations selected for evaluation were based on the NUREG/CR-6260 locations for a newer vintage Westinghouse plant as well as one additional component identified by the EAF screening evaluation as potentially being more limiting than the NUREG/CR-6260 locations. For some piping systems, more investigation was required to select one limiting component corresponding to the NUREG/CR-6260 location (i.e., the entire surge line was investigated since NUREG/CR-6260 does not explicitly list a certain portion of the line that should be evaluated for EAF).

The objective of the EAF evaluation methodology was to reduce conservatism in the stress analyses as needed to accommodate the additional environmental penalty factor on the cumulative fatigue usage values. For the components where detailed fatigue evaluations were required, stress inputs to the fatigue analyses were developed using component-specific finite-element analysis (FEA) models. The FEA was performed to create unit load transfer functions (which included up to six components of stress) for each type of mechanical and thermal transient load case applicable to the component under consideration. In addition, piping mechanical load relationships were developed to produce time history moment loads as a function of piping system temperature and pressure parameters during a transient. The transfer functions and load functions were used in the WESTEMS™ program to determine detailed stress histories for each applicable transient, considering all applicable mechanical and thermal transient loads during each transient, and to calculate fatigue usage. This provided the most appropriate method of stress combination to obtain total stresses for the fatigue analyses and allow margin for the added reactor water environmental effects on fatigue.

The stress histories from the component analyses were used to determine the stress peaks and valleys for the fatigue evaluation, as well as the corresponding strain rates and temperature information needed for the F_{en} calculations. The stress peaks and valleys and applicable F_{en} factors were used to determine the environmental fatigue usage for the limiting locations. The F_{en} factors were determined using the most detailed method required, consistent with methods in the appropriate NUREGs. This included, as necessary, an integrated approach incorporating the strain rate characteristics of the component response for the tensile portion of each transient pair.

The WESTEMS™ fatigue calculation methodology employs a conservative algorithm for selection of the stress peaks and valleys for use in the ASME fatigue evaluation. In some cases, conservatism may be removed by the analyst using optional program tools, to produce a more accurate final result. For any ASME component fatigue evaluation in which the analyst removed conservatism in the peak and valley selection, full documentation of the justification of peak removal was included in the supporting calculations. Otherwise, the conservatism inherent to the WESTEMS™ software was retained for the ASME fatigue evaluations.

All of the fatigue analyses performed meet the ASME Section III, Subarticle NB-3200 requirements. The concerns expressed in NRC Regulatory Issue Summary 2008-30 (Reference 4.8.11) and 2011-14 (Reference 4.8.12) have been addressed and applied as needed to the evaluations.

The environmental fatigue analyses prepared for the BBS, Units 1 and 2 limiting components, equivalent to the locations evaluated in NUREG/CR-6260 for newer vintage Westinghouse plants, demonstrate that cumulative environmental fatigue usage values do not exceed the ASME allowable cumulative fatigue usage value of 1.0. Since the analyses are based on design cycles and 60-year cycle projections, monitoring of usage through the period of extended operation is required to ensure these conclusions remain valid. Where reduced numbers of cycles were used, they are considered to be the new CLB cycle limits in the Fatigue Monitoring (B.3.1.1) program. The reduced numbers of cycles are equal to or greater than the 60-year projected cycles in Tables 4.3.1-1, 4.3.1-2, 4.3.1-4, and 4.3.1-5. See Table 4.3.4-1 for a summary of the cumulative fatigue usage of NUREG/CR-6260 locations for BBS Units 1 and 2.

Screening for Limiting Locations for Environmentally Assisted Fatigue

To ensure that the limiting plant-specific EAF locations have been identified, BBS performed a systematic review. The BBS environmentally assisted fatigue (EAF) screening process considers all Safety Class 1 reactor coolant pressure boundary components in major equipment and piping systems with a fatigue analysis that are susceptible to EAF, including those locations listed in NUREG/CR-6260. In order to perform the EAF screening process on each plant, all of the Safety Class 1 reactor coolant pressure boundary components that are susceptible to EAF were reviewed and categorized into common groups for the purpose of identifying leading locations for EAF consideration. These leading locations are meant to supplement those identified in NUREG/CR-6260, resulting in a comprehensive list of plant-specific lead indicator locations for EAF consideration. Tables 4.3.4-2 and 4.3.4-3 identify the leading locations.

First, the Class 1 components were grouped into transient sections. A transient section is defined as a group of sub-components/locations that experience the same transients. Components that reside in the same transient section can easily be compared with each other to determine the most limiting component (or leading location) which is the location with the highest CUF value. The differences in stresses experienced by each component in a transient section are generally the result of the material and geometry differences; which can be quantified for common analysis methods. The transient sections for the piping systems were defined previously for use in the design fatigue analyses.

Components that reside in different transient sections, but are within a common system or piece of major equipment, were also compared to determine leading locations to represent their respective system/equipment. Often, it is the transients themselves that control which components have the highest usage factors in a given system. So within a particular system, those transient sections with the most severe system transients will usually have the components with the highest usage factors. However, the comparison of components in different transient sections must be performed after the appropriate F_{en} correction factor is applied to the component usage factor. This is because the F_{en} correction factor is dependent on temperature and strain rate and, therefore, can vary for each transient section.

A stress basis comparison is performed to identify the leading transient section locations. Westinghouse has developed an approach that was applied to BBS Units 1 and 2 for performing a stress basis comparison for the components included in the screening process. First, the context surrounding the stress basis comparison is that, in general, one or two limiting locations per transient section can be determined qualitatively based on experience with typical nuclear power plant component fatigue evaluations. Furthermore, the limiting locations for each of the transient sections within a system/equipment will initially be compared against each other only and will not be compared against other components of different piping systems or pieces of equipment. This puts the emphasis of the stress-based comparison on components within the same piping system or piece of equipment; thus reducing the need to perform a plant-wide stress basis comparison of all components.

The following stress analysis characteristics were considered in determining the limiting locations within a given transient section:

1. Qualification Criteria (ASME Section III, NB-3200, NB-3600, etc.)
2. Stress Analysis Technique
    a. Interaction Analysis
    b. Simplified or One-Dimensional Analysis (NB-3600 formula, etc.)
    c. Finite Element Analysis
        i. Thermal
        ii. Mechanical
    d. Elastic/Plastic Analysis

In order to perform these stress basis comparisons, a hierarchy of stress analysis techniques was developed based on fatigue analysis experience to define the relative complexity of the various techniques. In general, fatigue analysis performed to ASME Section III, NB-3200 criteria are regarded as more complex than those performed to ASME Section III, NB-3600 criteria. The hierarchy used is presented below; ordered from the least complex to the most complex techniques within NB-3200 and NB-3600 analyses.

1) Standard NB-3600 analysis

2) NB-3600 with non-standard mechanical stress indices or stress quantities used in stress formulas
3) NB-3600 with non-standard thermal stress indices or stress quantities used in stress formulas
4) Combination of 2) and 3)
5) NB-3200 Fatigue Analysis:
    a. NB-3200 with interaction analysis
    b. NB-3200 with elastic FE analysis
    c. NB-3228 Elastic/Plastic analysis

Generally, within a transient section there only exists one or two components where more advanced stress analysis techniques were used relative to the other components of the same transient section. Therefore, determining the most limiting location within a transient section is usually not a difficult task, since the component where the most technical rigor was applied is often times the limiting location within a transient section. Components in a common transient section will have similar F_{en} correction factors applied since they experience the same transients. Therefore, one or two leading locations per transient section can be found prior to the consideration of the F_{en} correction factors. However, comparisons made between components in the same system/equipment, but different transient sections, must consider the potential differences in the F_{en} correction factors. These comparisons must also consider the stress basis comparison characteristics in determining the ultimate leading location for each system/equipment.

Once the stress basis comparison has been performed and the leading transient section locations have been identified, screening environmental correction factors (F_{en}) are developed for each component so that cumulative usage factors including environmental fatigue, CUF_{en}, can be calculated. Note that the F_{en} correction factors calculated for screening are not meant to be used for component qualification. They are conservatively calculated for screening purposes only. However, those components with a screening CUF_{en} of less than 1.0 were removed from the list because they have been calculated using the design basis fatigue usage factors with a maximum F_{en} based on material.

When performing an EAF evaluation, a plant can either use guidance from NUREG/CR-5704 for austenitic stainless steels, NUREG/CR-6583 for carbon and low alloy steels, and NUREG/CR-6909 for nickel alloy steels, or they can use guidance from NUREG/CR-6909 for all materials. Note that if NUREG/CR-6909 is used, the corresponding fatigue curves therein must be considered. This difference must be addressed as part of the EAF screening process.

For the BBS EAF screening, NUREG/CR-5704 is used for austenitic stainless steels, NUREG/CR-6583 is used for carbon and low alloy steels, and NUREG/CR-6909 is used for nickel alloy steels. This is consistent with the evaluations that are being performed on the NUREG/CR-6260 locations as a part of License Renewal. In addition, the dissolved oxygen content is 0.005 ppm for the calculation of the F_{en}, which reflects actual plant conditions in a PWR environment.

A similar methodology as that used for BBS, Units 1 and 2 has also been proposed by the Electric Power Research Institute (EPRI) in Report Number 1024995, "Environmentally-Assisted Fatigue Screening, Process and Technical Bases for Identifying EAF Limiting Locations," August 2012 (Reference 4.8.13) for performing an EAF screening evaluation. The overall method is similar to that method used at BBS, Units 1 and 2. The fundamental difference between the proposed EPRI method and the Westinghouse method is in the application of the step to compare component fatigue usage on a common basis with respect to the stress analysis techniques used for their qualification. The Westinghouse approach utilizes Westinghouse's large database of component fatigue evaluations and related experience to establish the common analysis basis of comparison, as opposed to an approach utilizing a combination of new analysis and approximations suggested by the EPRI report methodology. The limiting locations to be considered other than the sample of locations identified in NUREG/CR-6260 for BBS, Units 1 and 2 are provided in Tables 4.3.4-2, and 4.3.4-3.

For those systems where the NUREG/CR-6260 locations have the highest screening CUF_{en}, no additional locations need be considered for EAF. For those systems where the NUREG/CR-6260 locations do not have the highest screening CUF_{en} or a NUREG/CR-6260 location does not exist, the locations within that system that have the highest screening CUF_{en} should be considered leading locations.

A review of the screening CUF_{en} for the equipment and piping locations in Tables 4.3.4-2 and 4.3.4-3 identifies the Pressurizer Spray Nozzle as the most limiting plant specific component location based on the value of the screening CUF_{en}. Consistent with the methods utilized for the NUREG/CR-6260 locations, the Pressurizer Spray Nozzle was successfully evaluated for EAF to show the CUF_{en} to be less than the allowable of 1.0. The result of the evaluation is presented in Table 4.3.4-1. Additional locations from the list of limiting locations presented in Tables 4.3.4-2 and 4.3.4-3, determined to be potentially limiting will be evaluated prior to the period of extended operation. Based on industry experience, the methodology used to determine the limiting locations for BBS Units 1 and 2, and completion of the evaluation of the Pressurizer Spray Nozzle showing a CUF_{en} less than 1.0, BBS is confident the evaluation of additional locations are expected to yield similar successful results. To ensure the aging effects of environmentally assisted fatigue are managed, the results of the evaluation of other locations from Tables 4.3.4-2 and 4.3.4-3 determined to be potentially limiting will be incorporated into the Fatigue Monitoring (B.3.1.1) program prior to the period of extended operation.

Table 4.3.4-1 Byron and Braidwood Stations, Units 1 and 2: 60-Year Environmental Fatigue Results for NUREG/CR-6260 Locations

Description (1)	Cumulative Fatigue Usage on the Inside Surface		
	CUF	F_{en} Correction Factor	CUF_{en}
Reactor Vessel Shell to Lower Head to Shell Juncture	0.013	2.532	0.0329
Reactor Vessel Inlet Nozzles	0.302	2.532	0.7647
Reactor Vessel Outlet Nozzles	0.320	2.532	0.8102
Byron Units 1 and 2 RCS Hot Leg Surge Nozzles	0.0771	12.4617	0.9608
Braidwood Units 1 and 2 RCS Hot Leg Surge Nozzles	0.0773	11.89	0.9191
Byron Units 1 and 2 Pressurizer Surge Nozzles	0.0620	15.348	0.9516
Braidwood Units 1 and 2 Pressurizer Surge Nozzles	0.0588	15.348	0.9025
Reactor Coolant Loop Charging System Nozzles	0.2216	4.458	0.988
Reactor Coolant Loop Safety Injection Nozzles	0.0996	8.5653	0.8531
Reactor Coolant Loop Accumulator Nozzles (2)	0.1158	5.77	0.6682
Pressurizer Spray Nozzle (3)	0.1572	6.081	0.956

Notes:

(1) Descriptions include all four BBS units unless specifically noted otherwise.

(2) NUREG/CR-6260 Residual Heat Removal (RHR) System Class 1 piping location.

(3) Identified as the most limiting plant specific component location from the EAF screening evaluation and is not a NUREG/CR-6260 location.

Table 4.3.4-2 Byron and Braidwood Stations, Units 1 and 2: EAF Screening Leading Locations – Equipment

Equipment	**Component**	**Material**	**CUF (2)**	**Screening CUF_{en}**
Reactor Vessel	Outlet Nozzle (safe end)	SS	0.11	1.688
Pressurizer	Pressurizer Surge Nozzle(1)	SS	0.9336	14.33
Steam Generator	OSG – Primary Manway Drain Hole	CS	0.99	1.72
	OSG – Primary Chamber Drain	NI	0.594	2.687
	RSG – Primary Head/Tubesheet Juncture	LAS	0.88	2.16
Reactor Coolant Pump	Casing Suction Nozzle	SS	0.581	8.92
	Thermal Barrier	SS	0.4463	6.85

Notes:

(1) NUREG/CR-6260 location

(2) The CUF's shown in this table are from the fatigue analyses of record for each respective component. The NUREG/CR-6260 location was re-evaluated for fatigue with environmental effects included. The new results are shown in Table 4.3.4-1.

CS – Carbon Steel
LAS – Low Alloy Steel
SS – Stainless Steel
NI – Nickel Alloy
OSG- Original Steam Generator
RSG- Replacement Steam Generator

Table 4.3.4-3 Byron and Braidwood Stations, Units 1 and 2: EAF Screening Leading Locations – Piping

System	Subsystem	Component	Material	CUF (2)	Screening CUF_{en}
Reactor Coolant	Reactor Coolant Loop	Main Loop Stop Valve	SS	0.654	10.04
	Sample	3/4" RCL Nozzle	SS	0.98	15.04
Safety Injection	Safety Injection Accumulator	10" RCL Nozzle(1)	SS	0.95	14.58
	Boron Injection	3" RCL Nozzle(1)	SS	0.98	15.04
Chemical and Volume Control	Normal/Alternate Charging	3" RCL Nozzle(1)	SS	0.96	14.28
	Excess Letdown/Drain Line	2" Socket Weld	SS	0.935	14.35
Pressurizer (Reactor Coolant System)	Pressurizer Surge	14" Pressurizer Surge Nozzle(1)	SS	0.9336	14.33
		14" RCL Nozzle(1)	SS	0.83	12.74
	Pressurizer Spray	4" Pressurizer Spray Nozzle	SS	0.99	15.20
	Pressurizer Safety and Relief Valve	3/4" Branch (safety line)	SS	0.954	14.64

Notes:

(1) NUREG/CR-6260 location

(2) The CUF's shown in this table are from the fatigue analyses of record for each respective component. The NUREG/CR-6260 locations and the pressurizer spray nozzle were re-evaluated for fatigue with environmental effects included. The new results are shown in Table 4.3.4-1.

SS – Stainless Steel

Disposition: 10 CFR 54.21 (c)(1)(iii) – The Fatigue Monitoring (B.3.1.1) program will be used to ensure that the numbers of cycles used for the environmental fatigue analyses will not be exceeded during the period of extended operation. Additional locations determined to be potentially limiting based on transient section differences will be evaluated. The Fatigue Monitoring (B.3.1.1) program will monitor transient cycles and severities and require action prior to exceeding environmental fatigue usage limit of 1.0. The program will also ensure additional component locations which may be more limiting than the NUREG/CR-6260 component locations will be evaluated prior to the period of extended operation.

4.3.5 REACTOR VESSEL INTERNALS FATIGUE ANALYSES

TLAA Description:

BBS reactor internals were designed and procured prior to the issuance of ASME Section III, Subsection NG. The intent of the code is applied with load combinations and allowable stresses which is consistent with the requirements of ASME Section III, Subsection NG. The reactor vessel internals were designed to withstand stress originating from the same operating conditions as the reactor vessel. Using the reactor vessel internals stress reports, cumulative usage factors (CUF) less than 1.0 were determined for the maximum alternating stresses using the design transient cycles from each transient and the design ASME Code fatigue curve. Since the calculation of CUF is based on the number of occurrences of each transient type and 40-year assumptions, these analyses have been identified as TLAA requiring evaluation for the period of extended operation.

TLAA Evaluation:

For the BBS Measurement Uncertainty Recapture (MUR) power uprate project, the bounding CUFs for the reactor vessel internals were evaluated. The evaluation determined that the MUR power uprate did not affect the bounding CUFs. Therefore, no new CUFs were calculated for the MUR power uprate project.

The analyses performed for the reactor vessel internals components are based upon a subset of the RCS design transients used in the fatigue analyses for the reactor vessel shown in Tables 4.3.1-1 and 4.3.1-4.

As previously shown in Table 4.3.1-1 and Table 4.3.1-4, these transient cycle projections demonstrate these design transient cycle limits will not be exceeded for 60 years of operation. Therefore, the analyses will remain valid through the period of extended operation and the cumulative usage factors will remain within the allowable limit of 1.0.

TLAA Disposition: 10 CFR 54.21 (c)(1)(iii) – The reactor vessel internals analyses remain valid for the period of extended operation. The Fatigue Monitoring (B.3.1.1) program will monitor transient cycles and severities and require action prior to exceeding design limits that would invalidate these conclusions.

Flow-Induced Vibration in the Reactor Vessel Internals (Not a TLAA)

Analyses associated with flow-induced vibration of the reactor vessel internals are not based on time-dependent assumptions to be considered a TLAA in accordance with 10 CFR 54.3(a), Criterion 3. These analyses concluded that the component stress ranges remained below the endurance limit of 10^{11} cycles on the applicable ASME fatigue curves. The endurance limit is the stress range below that which the material will not experience fatigue failure. Since the stress ranges remain below the endurance limit, the number of these stress range cycles is not limited over the current operating life. Therefore, the analyses are not based on time-dependent assumptions defined by the current operating terms and are not classified as TLAAs in accordance with 10 CFR 54.3(a), Criterion 3.

4.3.6 HIGH-ENERGY LINE BREAK (HELB) ANALYSES BASED ON FATIGUE

TLAA Description:

Locations of postulated high-energy line breaks (HELB) are based on two limiting stress criteria and a cumulative usage factor criterion as noted in Section 3.6 of the BBS UFSAR (Reference 4.8.20). Meeting any one of the criteria results in a break being postulated. The postulations of break locations based on the fatigue criterion at BBS have been identified as TLAAs.

TLAA Evaluation:

One of the criteria used to determine whether a high energy line break must be postulated at a given location is that the fatigue usage calculated for the component is greater than 0.1. The fatigue usage is affected by the applicable operating transients to which the components are subject. The 60-year transient projections in Section 4.3.1 demonstrate that the operating transients for which the plant components are designed are projected to remain within their 40-year CLB design limits for 60 years. Therefore, additional break locations do not need to be postulated.

TLAA Disposition: 10 CFR 54.21 (c)(1)(iii) – The Fatigue Monitoring (B.3.1.1) program will monitor transient cycles used as inputs for the determination of postulated break locations, and ensure that the numbers of analyzed cycles will not be exceeded. If a limit is approached, corrective action will be required prior to exceeding design limits.

4.3.7 NRC BULLETIN 88-11 REVISED FATIGUE ANALYSIS OF THE PRESSURIZER SURGE LINE FOR THERMAL CYCLING AND STRATIFICATION

TLAA Description:

NRC Bulletin 88-11, issued in December 1988, requested utilities to establish and implement a program to confirm the integrity of the pressurizer surge line. The program required both visual inspection of the surge line and demonstration that the design requirements of the surge line are satisfied, including the consideration of stratification effects. The demonstration was an ASME Section III fatigue analysis to account for thermal stratification. The analysis uses time-limited assumptions such as thermal and pressure transients, operating cycles, and the licensed life of the plant. Therefore, the analyses required by NRC Bulletin 88-11 meet the criteria of 10 CFR 54.3(a) and have been identified as TLAAs requiring evaluation for 60 years.

TLAA Evaluation:

The original analyses performed to demonstrate compliance with design requirements considered ASME Code requirements and utilized the design set of NSSS transients. Pressurizer surge line stratification sub-transients were developed based on plant operating procedures, surge line monitoring data from similar units and historical records for each BBS unit. The ASME Code stress limits and cumulative usage factor requirements were shown to be acceptable for the current licensed life of BBS.

The original analyses were evaluated for impact due a power uprate project in 2000 and a measurement uncertainty recapture uprate in 2010. The evaluations determined that the original analyses were not impacted by the uprate projects.

The fatigue evaluations for the components affected by this bulletin were revised to consider the baseline and projected transients listed in Tables 4.3.1-1, 4.3.1-2 and 4.3.1-4, and 4.3.1-5. The conclusion from the analyses is the components will continue to meet the design allowable fatigue usage of 1.0 with consideration of stratification effects during the period of extended operation.

TLAA Disposition: 10 CFR 54.21 (c)(1)(iii) – The Fatigue Monitoring (B.3.1.1) program will monitor the transient cycles and severities which are the inputs to these analyses and require action prior to exceeding design limits that would invalidate these conclusions.

4.3.8 ASME SECTION III, SUBSECTION NF, CLASS 1 COMPONENT SUPPORTS ALLOWABLE STRESS ANALYSES

TLAA Description:

BBS Class 1 component supports which includes supports for the reactor vessel, steam generator, reactor coolant pump, and pressurizer are designed in accordance with ASME Section III, Subsection NF, and are inherently designed for a minimum of 20,000 stress cycles. For component supports subject to greater loading cycles, which is not the case at BBS, stress range reduction factors would be applied that limit allowable stresses; which reduces the likelihood of failure due to cyclic loading. The analyses of stress using the governing stress allowables are considered to include implicit fatigue analyses, since they are based upon cycle limits anticipated for the life of the component, and are therefore, TLAAs requiring evaluation for the period of extended operation.

TLAA Evaluation:

Westinghouse Report WCAP-14422 (Reference 4.8.17) performed a technical evaluation of cumulative fatigue aging effects, for the period of extended operation, on Class 1 component supports in Westinghouse Reactors for the period of extended operation. The report concludes that the number of actual loading transients that affect Class 1 component supports is projected to be significantly less than 20,000 loading cycles for 60 years. The fatigue usage for 60 years of operation is estimated to be less than 0.15 where the allowable limit is 1.0. The numbers of transients analyzed in the report are bounded by the transient limits shown in Section 4.3.1.

The NRC documented its review of WCAP-14422 in an SER contained in a November 17, 2000 letter. With respect to fatigue, the staff agreed with the assessment in WCAP-14422 provided that each license renewal applicant justify the use of installed materials not listed in Table 2-4 of WCAP-14422. This requirement is the result of a concern that the WCAP Table 2-4 only contains higher strength materials with a presumed limit of 20,000 loading cycles while the design of some Class 1 supports at older Westinghouse plants may have used the 1963 AISC manual, which specifies a limit of 10,000 loading cycles. Even though BBS Class 1 component supports were designed to ASME Section III, Subsection NF 1974 through the 1975 Summer Addenda requirements and not the AISC 1963 Edition, design documents were reviewed and the majority of installed Class 1 component support materials were found in the WCAP Table 2-4. Several materials were identified that were not documented in the table. Evaluation of these different materials showed that their yield strength and fatigue resistance properties are consistent with materials in WCAP-14422, Table 2-4 or the materials are used in bearing plates which do not experience cyclical tensile stresses.

TLAA Disposition: 10 CFR 54.21 (c)(1)(iii) – The Fatigue Monitoring (B.3.1.1) program will monitor transient cycles and require action prior to exceeding design limits that would invalidate these conclusions.

4.3.9 FATIGUE DESIGN OF SPENT FUEL POOL LINER AND SPENT FUEL STORAGE RACKS FOR SEISMIC EVENTS

TLAA Description:

The replacement spent fuel storage racks are designed to the stress limits of, and analyzed in accordance with ASME Section III, Division 1, Subsection NF. These analyses are described in UFSAR Section 9.1.2, "Spent Fuel Storage." The BBS spent fuel storage racks were replaced in 2000 and 2001 and both the spent fuel storage rack and the spent fuel pool liner were analyzed for fatigue due to seismic events using methods similar to those for ASME Section III, Subsection NB, Class 1 components. Therefore, these design analyses are a TLAA requiring evaluation for the period of extended operation.

TLAA Evaluation:

The analyses include a fatigue evaluation of the replacement spent fuel storage racks and the spent fuel pool liner for the cyclic loads imposed by twenty (20) OBE events plus one (1) SSE event. The analyses calculated a cumulative usage factor (CUF) of 0.950 for the spent fuel storage racks. The analyses also includes a fatigue evaluation of the spent fuel pool liner for the loads imposed by the new racks, and uses the same input of twenty (20) OBE events plus one (1) SSE event. The analyses calculated a CUF of 0.00052 for the spent fuel pool liner. Both are less than the CUF allowable of 1.0.

OBE events are monitored by the Fatigue Monitoring (B.3.1.1) program. No OBE events have occurred to date. SSE events are more severe than OBE events, and since no OBE events have occurred, no SSE events have occurred to-date. The Fatigue Monitoring (B.3.1.1) program will continue to be used to manage fatigue of these components through the period of extended operation by monitoring OBE and SSE events.

TLAA Disposition: 10 CFR 54.21(c)(1)(iii) – The Fatigue Monitoring (B.3.1.1) program will manage fatigue of these components through the period of extended operation.

4.3.10 PRESSURIZER HEATER SLEEVE STRUCTURAL ASSESSMENT

TLAA Description:

During the Braidwood Unit 1 refueling outage in May 2006 a leak was discovered in Reactor Coolant Pressurizer heating element penetration sleeve number 52. The sleeve was repaired in accordance with ASME Section III, Subsection NB. The design analysis for the repair evaluated fatigue in accordance with ASME Section III, Subparagraph NB-3222.4. The fatigue evaluation assumed 200 RCS heatup and cooldown transients and is therefore a TLAA requiring evaluation for the period of extended operation.

TLAA Evaluation:

The failed sleeve was repaired, in accordance with ASME Section III Subsection NB, by cutting the leaking sleeve out and installing a permanent plug in its place. The design analysis for this permanent repair evaluated fatigue in accordance with ASME Section III, Subparagraph NB-3222.4. Based on a transient design limit of 200 RCS heatup and cooldowns, a CUF of a maximum 0.003 was calculated which is below the allowable CUF value of 1.0. The 60-year projections of the design transients in Section 4.3.1 for heatups and cooldowns are less than those used in this analysis.

TLAA Disposition: 10 CFR 54.21 (c)(1)(iii) – The Fatigue Monitoring (B.3.1.1) program will monitor the transient cycles and require action prior to exceeding the design limits that would invalidate this analysis.

4.4 ENVIRONMENTAL QUALIFICATION (EQ) OF ELECTRIC COMPONENTS

TLAA Description:

Thermal, radiation, and cyclical aging analyses of plant electrical and instrumentation components, developed to meet 10 CFR 50.49 requirements, has been identified as time-limited aging analyses (TLAAs) for BBS. The NRC has established nuclear station environmental qualification (EQ) requirements in 10 CFR 50.49 and 10 CFR 50, Appendix A, Criterion 4. 10 CFR 50.49 specifically requires that an EQ program be established to demonstrate that certain electrical components located in harsh plant environments are qualified to perform their safety function in those harsh environments after the effects of in-service aging. Harsh environments are defined as those areas of the plant that could be subject to the harsh environmental effects of a loss-of-coolant accident (LOCA), high energy line break (HELB), or post-LOCA radiation. 10 CFR 50.49 requires that the effects of significant aging mechanisms be addressed as part of environmental qualification. Aging evaluations for electrical components in the BBS EQ Program that specify a qualification of at least 40 years have been identified as TLAAs for license renewal because the criteria contained in 10 CFR 54.3 are met.

Environmental Qualification Program Background

The BBS EQ Program meets the requirements of 10 CFR 50.49 for the applicable electrical components important to safety. 10 CFR 50.49 defines the scope of components to be included, requires the preparation and maintenance of a list of components within the scope of the EQ Program, and requires the preparation and maintenance of a qualification file that includes component performance specifications, electrical characteristics and the environmental conditions to which the components could be subjected during their service life.

10 CFR 50.49(e)(5) contains provisions for aging that require, in part, consideration of all significant types of aging degradation that can affect component functional capability. 10 CFR 50.49(e)(5) also requires replacement or refurbishment of components not qualified for the current license term prior to the end of designated life, unless additional life is established through ongoing qualification. 10 CFR 50.49(f) establishes four methods of demonstrating qualification for aging and accident conditions. 10 CFR 50.49(k) and (l) permit different qualification criteria to apply based on plant and component vintage. Supplemental EQ regulatory guidance for compliance with these different qualification criteria is provided in NUREG-0588 (Reference 4.8.18), and Regulatory Guide 1.89, (Reference 4.8.19).

Compliance with 10 CFR 50.49 provides reasonable assurance that the component can perform its intended functions during accident conditions after experiencing the effects of in-service aging. The BBS EQ Program manages component thermal, radiation, and cyclical aging, as applicable, through the use of aging evaluations based on 10 CFR 50.49(f) qualification methods. As required by 10 CFR 50.49, EQ components not qualified for the current license term are to be refurbished, replaced, or have their qualification extended prior to reaching the aging limits established in the evaluation.

TLAA Evaluation:

The BBS EQ Program, which implements the requirements of 10 CFR 50.49, as further defined and clarified by NUREG-0588 and Regulatory Guide 1.89 is viewed as an aging management program for license renewal under 10 CFR 54.21(c)(1)(iii). Reanalysis of an aging evaluation to extend the qualifications of components is performed on a routine basis as part of the BBS EQ Program. Important attributes for the reanalysis of an aging evaluation include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions (if acceptance criteria are not met). The disposition of the TLAA in accordance with 10 CFR 54.21(c)(1)(iii), which states that the effects of aging will be adequately managed for the period of extended operation, is chosen based on the fact the BBS EQ Program will manage the aging effects of the electrical and instrumentation components associated with the environmental qualification TLAA.

NUREG-1800 states that the staff evaluated the EQ program (10 CFR 50.49) and determined that it is an acceptable aging management program to address environmental qualification according to 10 CFR 54.21(c)(1)(iii). The evaluation referred to in the Standard Review Plan for License Renewal contains sections on “EQ Component Reanalysis Attributes, Evaluation, and Technical Basis” is the basis of the description provided below.

Component Reanalysis Attributes

The reanalysis of an aging evaluation is normally performed to extend the qualification by reducing conservatism incorporated in the prior evaluation. Reanalysis of an aging evaluation to extend the qualification of a component is performed on a routine basis pursuant to 10 CFR 50.49(e) as part of the BBS EQ Program. While a component life-limiting condition may be due to thermal, radiation, or cyclical aging, the majority of component aging limits are based on thermal conditions. Conservatism may exist in aging evaluation parameters, such as the assumed ambient temperature of the component, unrealistically low activation energy, or in the application of a component (de-energized versus energized). The reanalysis of an aging evaluation is documented according to BBS quality assurance program requirements, which require the verification of assumptions and conclusions. As previously noted, important attributes of a reanalysis include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions (if acceptance criteria are not met). These attributes are discussed below.

Analytical Methods:

The BBS EQ Program uses the same analytical models in the reanalysis of an aging evaluation as those previously applied during the prior evaluation. The Arrhenius methodology is an acceptable thermal model for performing a thermal aging evaluation. The analytical method used for a radiation aging evaluation is to demonstrate qualification for the total integrated dose, which is the normal radiation dose for the projected installed life plus accident radiation dose. For license renewal, one acceptable method of establishing the 60-year normal radiation dose is to multiply the 40-year normal radiation dose by 1.5 (that is, 60 years/40 years). The result is added to the accident radiation dose to obtain the total integrated dose for the component. For cyclical aging, a similar approach may be used. Other models may be justified on a case-by-case basis.

Data Collection and Reduction Methods:

The primary method used for a reanalysis per the BBS EQ Program is reduction of conservatism in the component service conditions used in the prior aging evaluation, including temperature, radiation, and cycles. Temperature data used in an aging evaluation is conservative and based on plant design temperatures or on actual plant temperature data. When used, plant temperature data can be obtained in several ways, including monitors used for technical specification compliance, other installed monitors, measurements made by plant operators during rounds, and temperature sensors on large motors. A representative number of temperature measurements are evaluated to establish the temperatures used in an aging evaluation. Plant temperature data may be used in an aging evaluation in different ways, such as: (a) directly applying the plant temperature data in the evaluation or (b) using the plant temperature data to demonstrate conservatism when using plant design temperatures for an evaluation. Any changes to material activation energy values as part of a reanalysis must be justified. Similar methods of reducing conservatism in the component service conditions used in prior aging evaluations can be used for radiation and cyclical aging.

Underlying Assumptions:

BBS EQ Program component aging evaluations contain sufficient conservatism to account for most environmental changes occurring due to plant modifications and events. When unexpected adverse conditions are identified during operational or maintenance activities that affect the normal operating environment of a qualified component, the affected EQ component is evaluated and appropriate corrective actions are taken, which may include changes to the qualification bases and conclusions.

Acceptance Criteria and Corrective Action:

Per the BBS EQ Program, the reanalysis of an aging evaluation could extend the qualification of the component. If the qualification cannot be extended by reanalysis, the component is refurbished, replaced, or re-qualified prior to exceeding the period for which the current qualification remains valid. A reanalysis is to be performed in a timely manner such that sufficient time is available to refurbish, replace, or re-qualify the component if the reanalysis is unsuccessful.

TLAA Disposition: 10 CFR 54.21(c)(1)(iii) – The effects of aging on the intended function(s) will be adequately managed for the period of extended operation. The BBS Environmental Qualification (EQ) of Electric Components (B.3.1.3) program has been demonstrated to be capable of programmatically managing the qualified lives of the electrical and instrumentation components falling within the scope of the program for license renewal. The continued implementation of the BBS EQ program provides reasonable assurance that the aging effects will be managed and that EQ components will continue to perform their intended functions for the period of extended operation. This result meets the requirements of 10 CFR 54.21(c)(1)(iii).

4.5 CONCRETE CONTAINMENT TENDON PRESTRESS ANALYSIS

TLAA Description:

The Containment Structures at Byron and Braidwood Stations are prestressed concrete shell structures made up of a cylinder with a shallow dome roof and flat foundation slab. The cylindrical portion is prestressed by a post-tensioning system consisting of 201 horizontal and 162 vertical tendons. There are three buttresses equally spaced around the containment and each horizontal tendon is anchored at buttresses 240 degrees apart, bypassing the intermediate buttress. The dome post-tensioning system is made up of 120 tendons (119 for Braidwood Unit 1), which are arranged in three groups oriented 120 degrees to each other and anchored at the vertical face of the dome ring. The base foundation slab is conventionally reinforced concrete with high strength reinforcing steel. The tendons are ungrouted, but enclosed in galvanized steel conduits filled with a corrosion protection medium. Each tendon consists of 170 high strength steel wires, each ¼ inch in diameter.

Over time, the containment prestressing forces decrease due to relaxation of the steel tendons and due to creep and shrinkage of the concrete. The containment tendon prestressing forces were calculated during the original design considering the magnitude of the tendon relaxation and concrete creep and shrinkage over the 40-year life of the plant. The ASME Section XI, Subsection IWL (B.2.1.30) program performs periodic surveillances of individual tendon prestressing values. Predicted lower limit (PLL) force values are calculated for each tendon prior to the surveillances to estimate the magnitude of the tendon relaxation and concrete creep and shrinkage for the given surveillance year. The prestressing forces are measured and plotted, and trend lines are developed, to ensure the average tendon group prestressing values remain above the respective minimum required values (MRVs) until the next scheduled surveillance, and potentially for the 40-year period. The predicted lower limit force values and regression analyses, utilizing actual measured tendon forces, are used to evaluate the acceptability of the containment structure to perform its intended function over the current 40-year life of the plant, and therefore, are TLAAs requiring evaluation for the period of extended operation.

TLAA Evaluation:

<u>Predicted Lower Limit (PLL)</u>

The containment tendon prestressing force values were calculated during the original design of the containment structure to determine the initial prestressing force required for each tendon group such that the prestressing force would remain above the respective MRVs over the 40-year life of the plant. The initial tendon prestressing force was calculated for each tendon type to compensate for the steel tendon relaxation losses and concrete creep and shrinkage so that the estimated final effective tendon prestressing force at the end of the 40 years would be higher than the minimum required values (MRVs).

As part of the ASME Section XI, Subsection IWL inspections related to tendon examinations, PLL force values are calculated for each individual tendon scheduled for examination, for the given surveillance year. The PLL force values are developed consistent with the guidance presented in Regulatory Guide 1.35.1 (Reference 4.8.21). Actual measured values for each tendon are compared to their respective PLL values, with acceptance criteria consistent with ASME Section XI, Subsection IWL requirements.

Regression Analysis

A regression analysis is developed for each of the three tendon groups to determine the trend over time in prestressing values of individual tendons within each tendon group. The regression analysis consists of a trend line utilizing actual individual tendon prestressing forces measured during successive ASME Section XI, Subsection IWL surveillances, consistent with NRC Information Notice 99-10, Attachment 3 (Reference 4.8.22). The trend lines are periodically updated with new tendon prestressing force data following each surveillance. The trend lines are used to demonstrate that the average group prestressing forces will remain above the group MRV until the next scheduled surveillance, and potentially for the life of the plant.

Assessment

The regression analyses associated with the vertical, hoop, and dome tendons at Byron and Braidwood Stations, Units 1 and 2, have been reanalyzed to extend the trend lines from 40 years to 60 years. The extended trend lines have been calculated using individual tendon prestressing force values based on data incorporating the 20th year surveillances for BBS Units 1 and 25th year surveillances for BBS Units 2. In all cases, the regression analyses predict the prestressing forces will remain above the respective group MRVs through the period of extended operation.

Figures 4.5-1 through 4.5-12 contain the reanalyzed regression analyses for each tendon group at Byron and Braidwood Stations, Units 1 and 2. Extended trend lines have been developed for both the group control tendons, as well as for all tendons within the respective group, including the control tendons, and plotted with the MRVs over the 60 year period.

The Concrete Containment Tendon Prestress (B.3.1.2) program will monitor and manage the TLAAs and the associated loss of tendon prestressing forces during the period of extended operation. The regression analyses are periodically updated following successive surveillances to ensure that estimated values remain above the MRVs until the next scheduled surveillance, and potentially for the life of the plant. Individual measured tendon prestressing forces will be compared to predicted PLL values and trend lines developed for the period of extended operation.

TLAA Disposition: 10 CFR 54.21(c)(1)(iii) – The Concrete Containment Tendon Prestress (B.3.1.2) program will manage TLAAs and the associated effects of loss of prestress forces on the containment tendon prestressing system in accordance with 10 CFR 54.21(c)(1)(iii).

Figure 4.5-1
Byron Station - Unit 1
Vertical Containment Tendons Best-Fitting Line

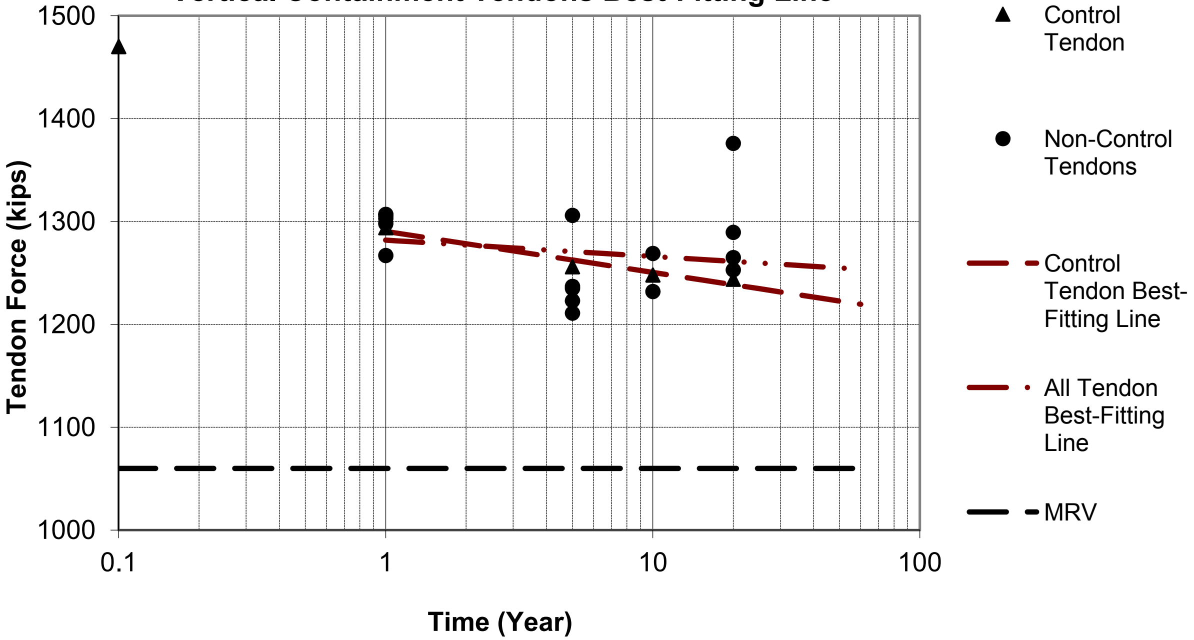


Figure 4.5-2
Byron Station - Unit 2
Vertical Containment Tendons Best-Fitting Line

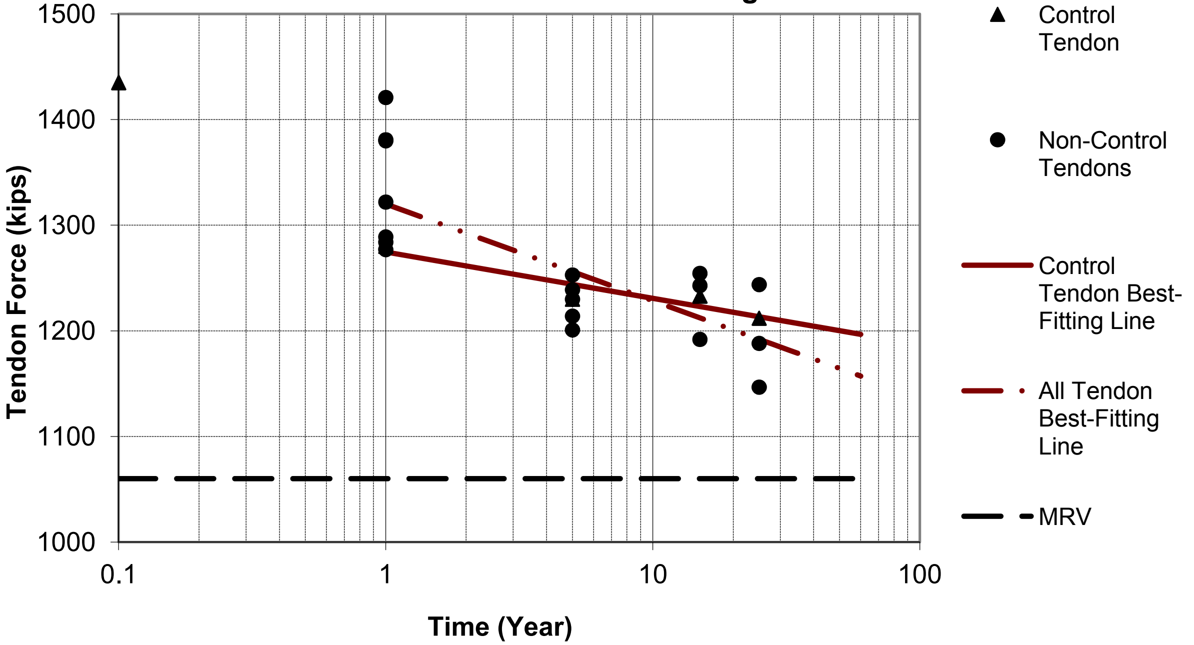


Figure 4.5-3
Byron Station - Unit 1
Hoop Containment Tendons Best-Fitting Line

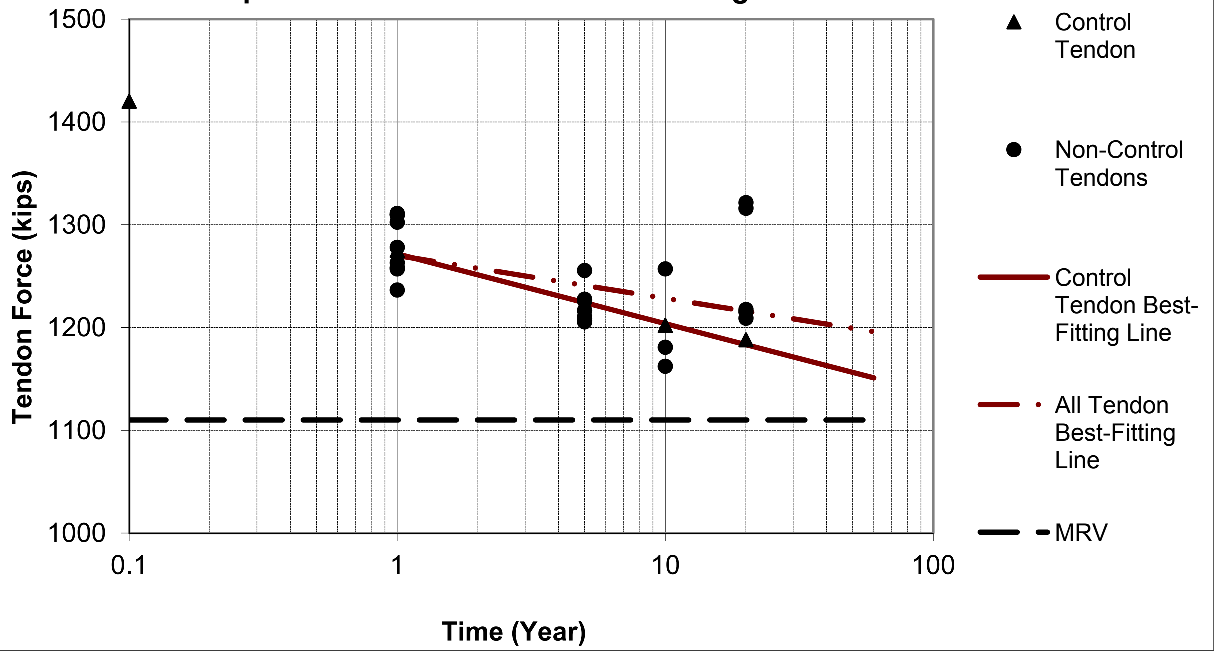


Figure 4.5-4
Byron Station - Unit 2
Hoop Containment Tendons Best-Fitting Line

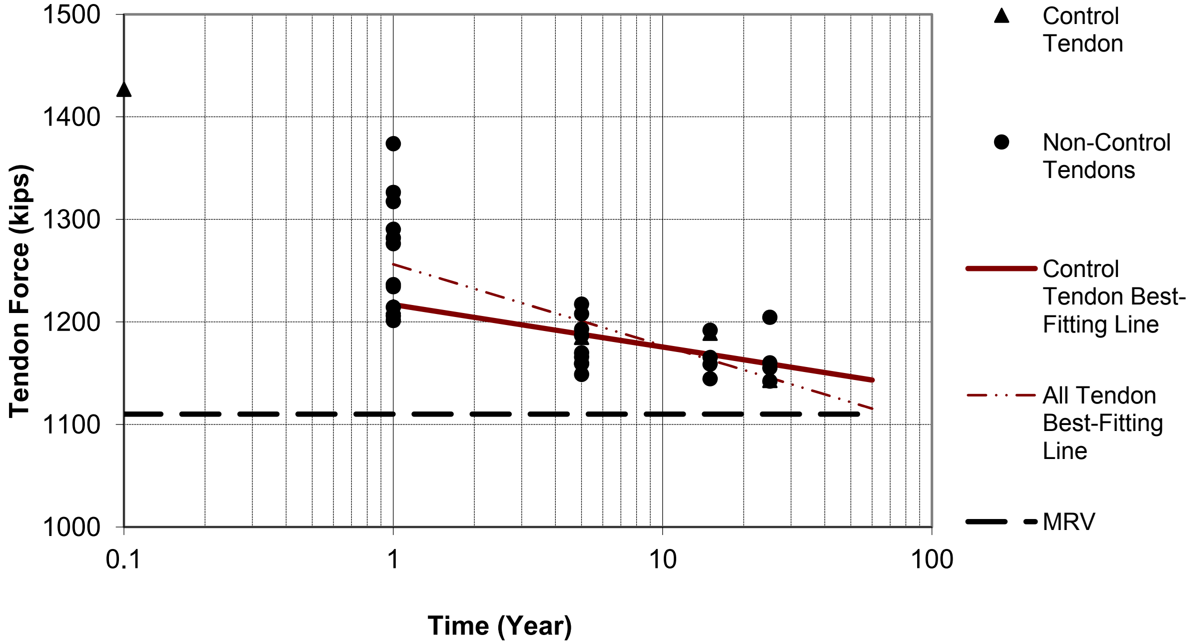


Figure 4.5-5
Byron Station - Unit 1
Dome Containment Tendons Best-Fitting Line

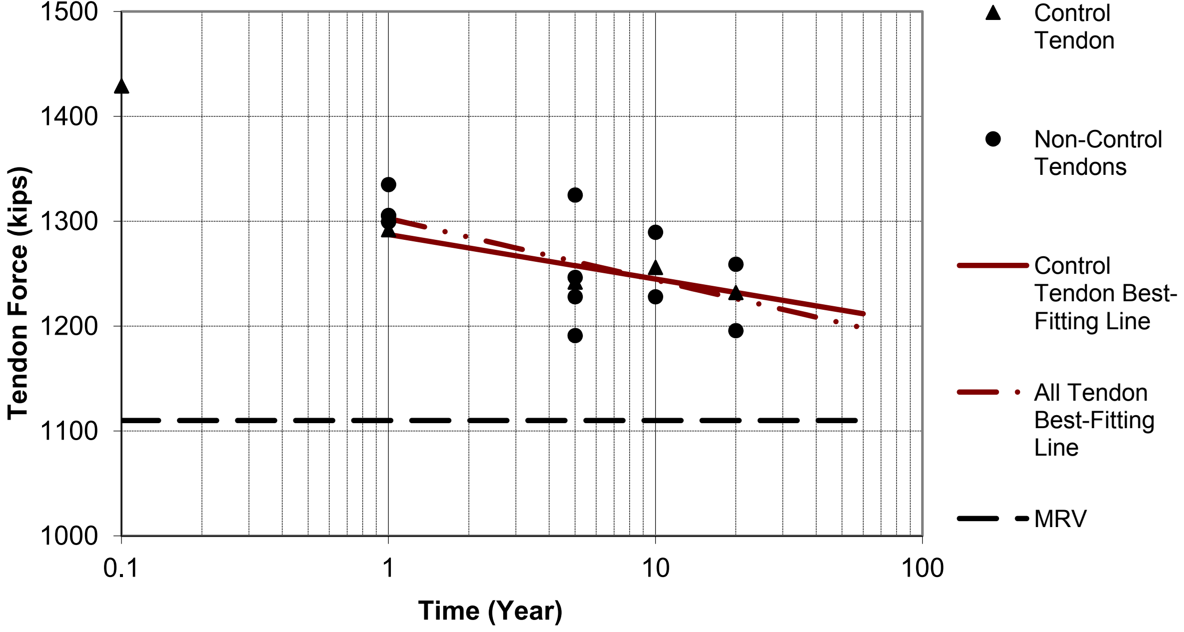


Figure 4.5-6
Byron Station - Unit 2
Dome Containment Tendons Best-Fitting Line

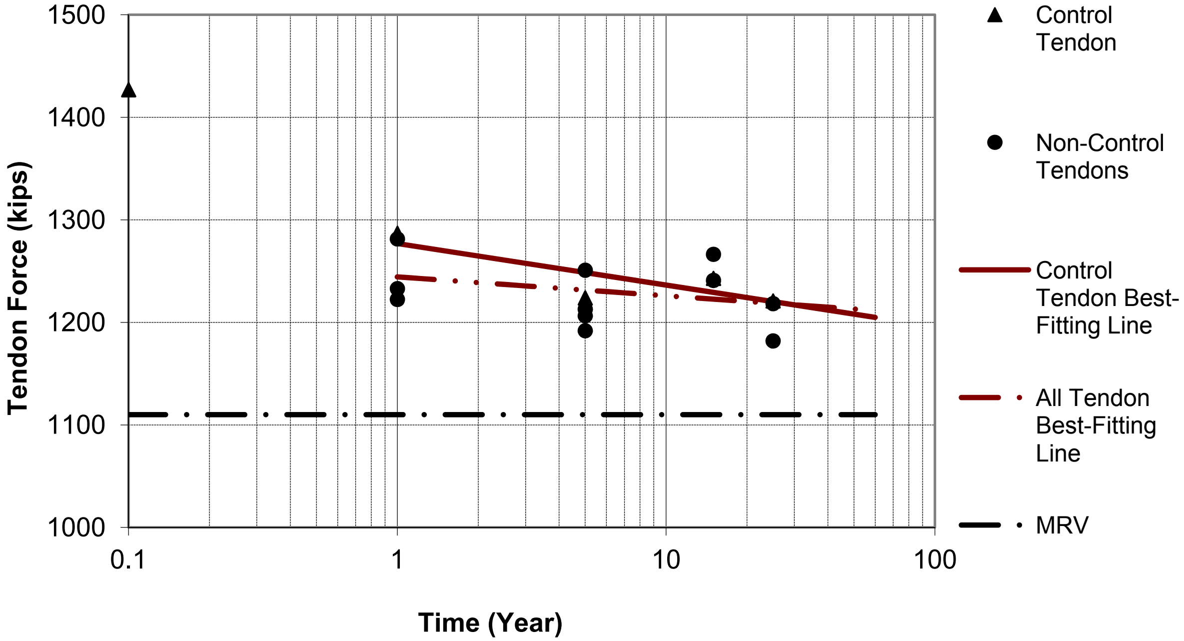


Figure 4.5-7
Braidwood Station - Unit 1
Vertical Containment Tendons Best-Fitting Line

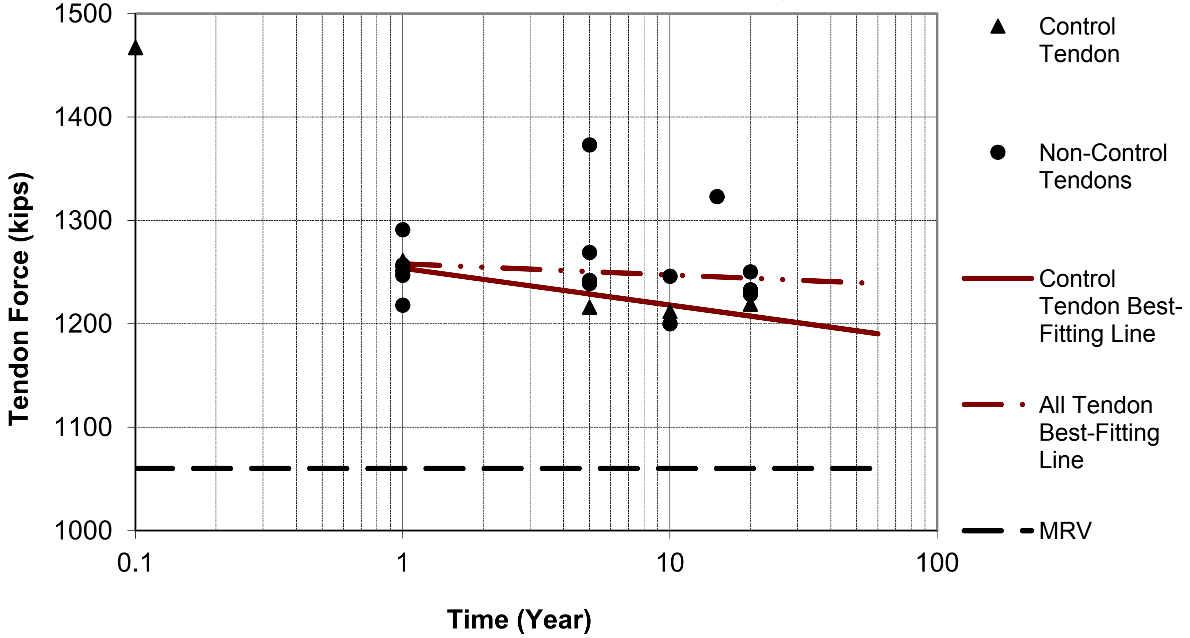


Figure 4.5-8
Braidwood Station - Unit 2
Vertical Containment Tendons Best-Fitting Line

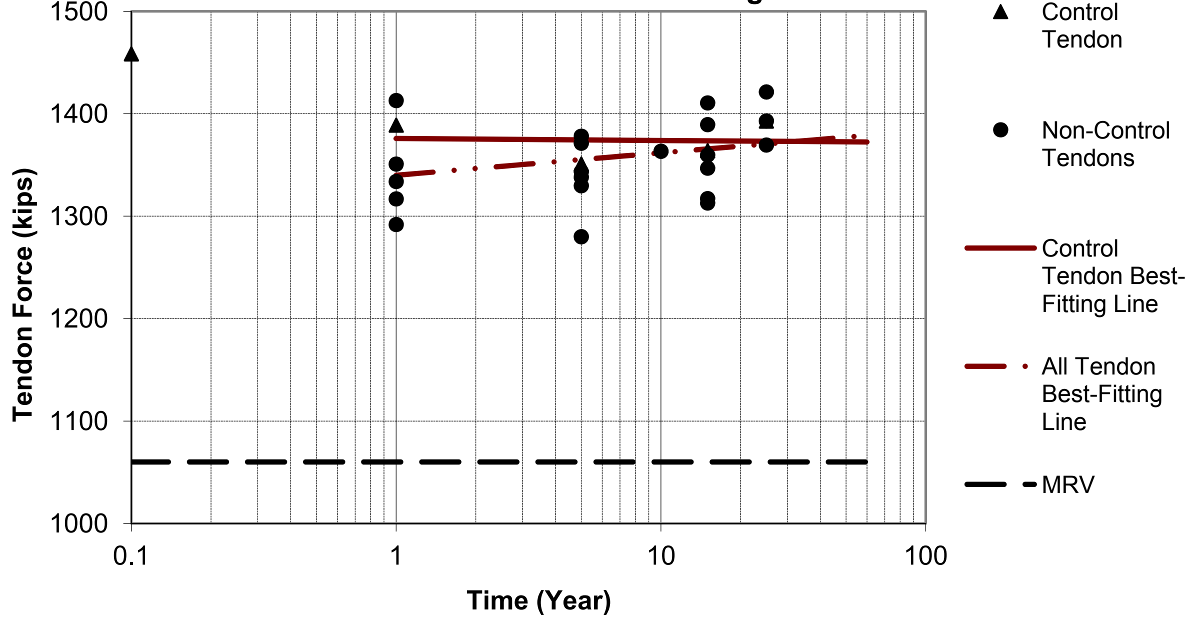


Figure 4.5-9
Braidwood Station - Unit 1
Hoop Containment Tendons Best-Fitting Line

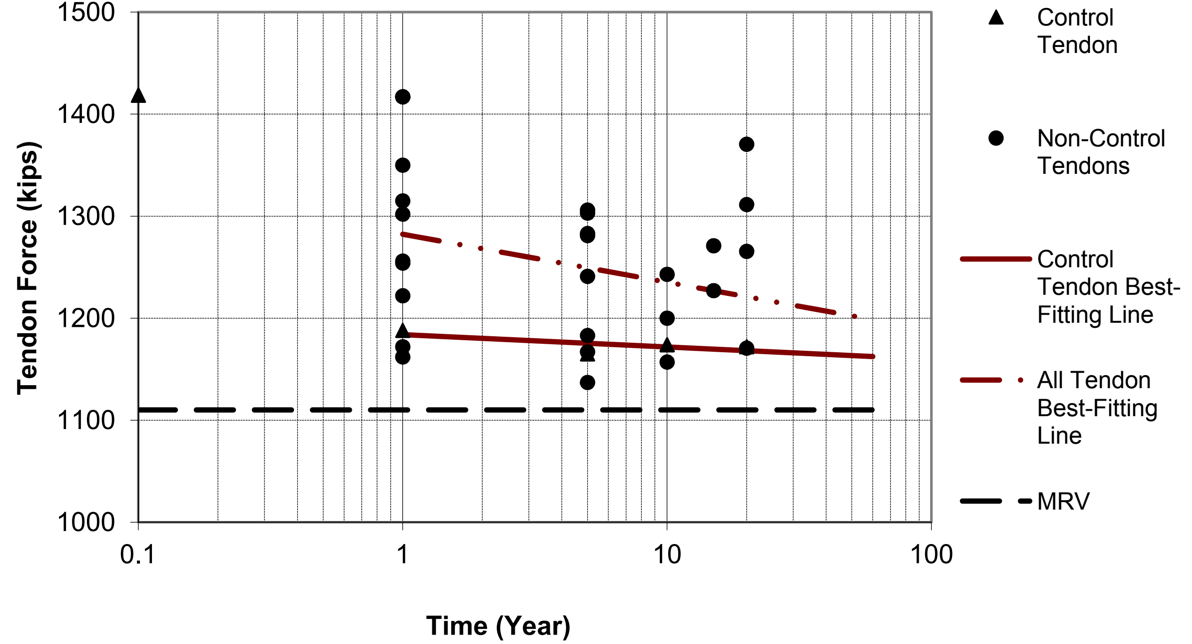


Figure 4.5-10
Braidwood Station - Unit 2
Hoop Containment Tendons Best-Fitting Line

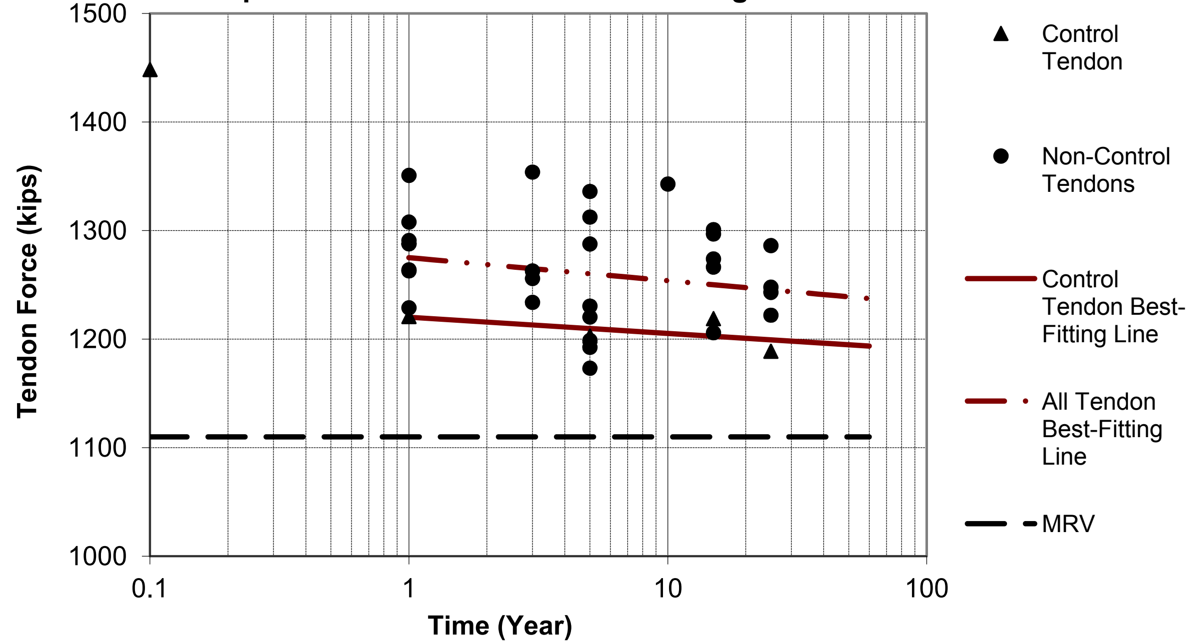


Figure 4.5-11
Braidwood Station - Unit 1
Dome Containment Tendons Best-Fitting Line

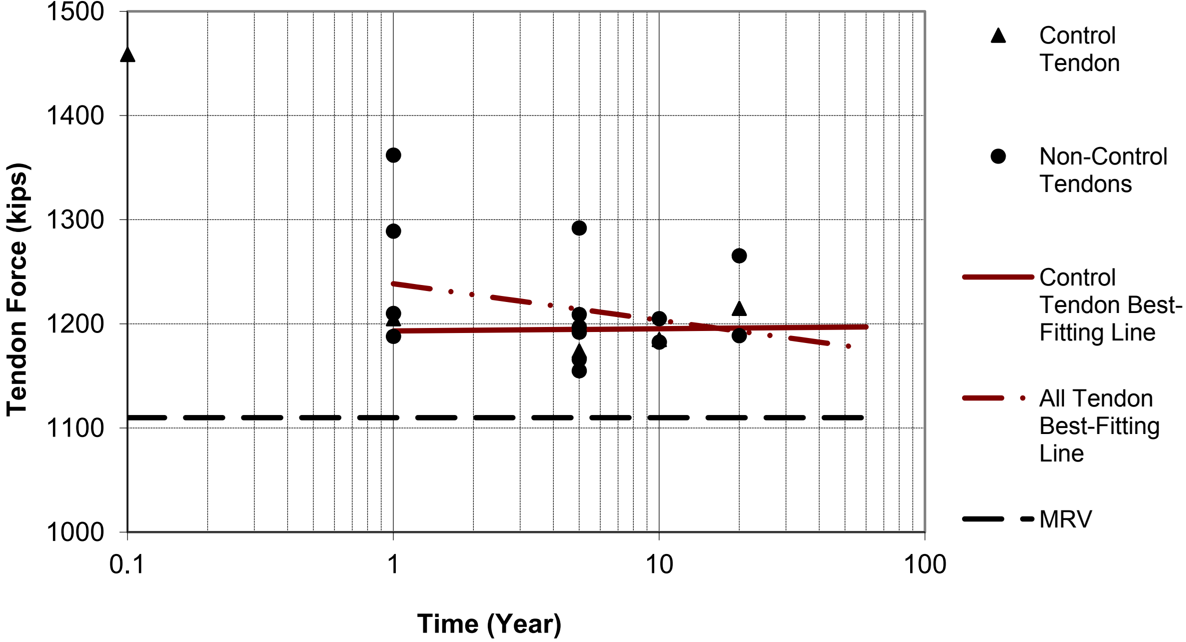
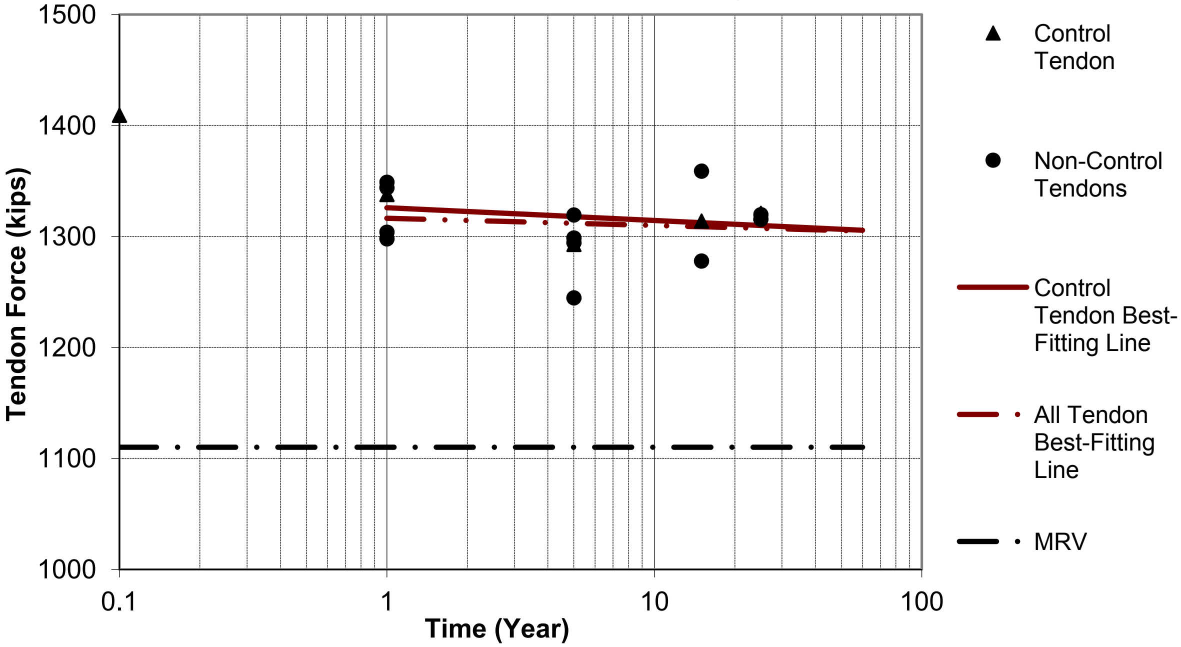


Figure 4.5-12
Braidwood Station - Unit 2
Dome Containment Tendons Best-Fitting Line



4.6 CONTAINMENT LINER PLATE, METAL CONTAINMENTS, AND PENETRATIONS FATIGUE ANALYSES

The Byron and Braidwood prestressed concrete Containment Structures are designed to contain the radioactive material that would be released in the unlikely event of a design basis accident. Each Containment Structure includes a liner made from welded carbon steel plates attached to the entire inside surface of the concrete Containment Structure. The liner provides a leak-tight membrane. The prestressed concrete Containment Structure and the portion of the carbon steel liner that is backed by concrete, were designed to conform to the ASME Section III, Division 2 requirements to withstand design basis accident pressures corresponding to design basis accidents.

The Containment Structure design also includes emergency personnel airlocks, equipment access hatches and integral personnel airlocks, and all associated penetrations and nozzles. These features, which are not backed by concrete, are defined as Class MC components, which are designed in accordance with ASME Section III, Division 1 requirements to withstand accident pressures corresponding to design basis accidents.

The analyses associated with the Containment Structure that have been identified as TLAAs are evaluated in the following sections:

4.6.1 – Containment Liner Plates Fatigue

4.6.2 – Containment Airlocks and Hatches Fatigue

4.6.3 – Containment Electrical Penetrations Fatigue

4.6.4 – Containment Piping Penetrations Fatigue

4.6.5 – Fuel Transfer Tube Bellows Fatigue

4.6.6 – Recirculation Sump Guard Piping Bellows Fatigue

4.6.1 CONTAINMENT LINER PLATES FATIGUE

TLAA Description:

Each Containment Structure includes a liner attached to the entire inside surface that provides a leak-tight membrane. The portion of the liner that is backed by concrete was designed in accordance with the requirements of the 1973 Edition of ASME Section III, Division 2, Subarticles CC-2500, CC-4500, and CC-5500. The design specification also required the liner to be analyzed for the effects of cyclic loading to satisfy the requirements of the 1973 Edition of ASME Section III, Division 1, Subsection NE. Since the original design analysis for the containment liner is based upon 40-year design inputs, it has been identified as a TLAA requiring evaluation for the period of extended operation.

TLAA Evaluation:

The original design analysis justified that the liner meets the exemption criteria specified in ASME Section III, Subparagraph NE-3222.4(d) and that no fatigue analysis was required. The six criteria address the following design inputs:

1) Atmospheric-to-Operating Pressure Cycles
2) Normal Operation Pressure Fluctuations
3) Temperature Difference – Startup and Shutdown
4) Temperature Difference – Normal Operation
5) Temperature Difference – Dissimilar Materials
6) Mechanical Loads

In order to evaluate this TLAA for the period of extended operation, a re-evaluation of the design inputs was performed relative to the six criteria and it determined that the original inputs remain valid. The temperature differences have not changed because the design transients have not been redefined. The 60-year transient projections provided in Section 4.3.1 show that the transient limits will not be exceeded during the period of operation. Therefore, the numbers of temperature and pressure cycles considered in determining the components were exempt from fatigue analysis will not be exceeded. The Fatigue Monitoring (B.3.1.1) program will be used to monitor the applicable cycles and ensure that the transient limits will not be exceeded during the period of extended operation.

TLAA Disposition: 10 CFR 54.21(c)(1)(iii) – The effects of aging on the intended function(s) of the liner will be adequately managed for the period of extended operation by the Fatigue Monitoring (B.3.1.1) program, which monitors transient cycles to ensure the transient limits are not exceeded during the period of extended operation, validating the assumptions used in these evaluations.

4.6.2 CONTAINMENT AIRLOCKS AND HATCHES FATIGUE

TLAA Description:

Byron and Braidwood emergency personnel airlock, personnel airlock with equipment hatch, and all penetrations and nozzles associated with personnel airlocks are required to contain the radioactive material that would be released in the unlikely event of a design basis accident inside the Containment Structure. These components were designed as Class "MC" components in accordance with the 1971 Edition of ASME Section III, Subsection NE through the Summer 1973 Addenda. Since the original design analysis for these components is based upon 40-year design inputs, it has been identified as a TLAA requiring evaluation for the period of extended operation.

TLAA Evaluation:

The original design analysis for the Byron and Braidwood Containment Structure Class MC components justified that these components meet the six exemption criteria specified in ASME Section III, Subparagraph NE-3222.4(d) and that no fatigue analysis is required. These criteria address the following design inputs:

1) Atmospheric-to-Operating Pressure Cycles
2) Normal Operation Pressure Fluctuations
3) Temperature Difference – Startup and Shutdown
4) Temperature Difference – Normal Operation
5) Temperature Difference – Dissimilar Materials
6) Mechanical Loads

In order to evaluate this TLAA for the period of extended operation, a re-evaluation of the design inputs was performed relative to these criteria from ASME Section III, Subparagraph NE-3222.4(d). The results of the re-evaluation determined that the original inputs remain valid. The temperature differences have not changed because the design transients have not been redefined. The 60-year transient projections provided in Section 4.3.1 show that the transient limits will not be exceeded during the period of extended operation. Therefore, the number of temperature and pressure cycles considered in determining the components, which were exempt from fatigue analysis, will not be exceeded. The Fatigue Monitoring (B.3.1.1) program will be used to monitor the applicable cycles and ensure that the transient limits will not be exceeded during the period of extended operation.

TLAA Disposition: 10 CFR 54.21(c)(1)(iii) – The effects of aging on the intended function(s) of the Class MC components will be adequately managed for the period of extended operation by the Fatigue Monitoring (B.3.1.1) program, which monitors transient cycles to ensure the transient design limits will not be exceeded during the period of extended operation, validating the assumptions used in this analysis.

4.6.3 CONTAINMENT ELECTRICAL PENETRATIONS FATIGUE

TLAA Description:

The Byron and Braidwood prestressed concrete Containment Structures are designed to contain the radioactive material that would be released in the unlikely event of a design basis accident. The Containment Structure includes electrical penetrations that were designed in accordance with ASME Section III, Division 1, Subsection NE, 1977 Edition through Summer 1978 Addenda requirements. Since the original design analysis involved 40-year design inputs, it has been identified as a TLAA requiring evaluation for the period of extended operation

TLAA Evaluation:

The original design analysis for the Byron and Braidwood Containment Structure electrical penetrations determined that the design inputs met the exemption criteria of ASME Section III, Subparagraph NE-3222.4(d) and that no fatigue analysis was required. The six criteria address the following design inputs:

1) Atmospheric-to-Operating Pressure Cycles
2) Normal Operation Pressure Fluctuations
3) Temperature Difference – Startup and Shutdown
4) Temperature Difference – Normal Operation
5) Temperature Difference – Dissimilar Materials
6) Mechanical Loads

In order to evaluate this TLAA for the period of extended operation, a re-evaluation of the design inputs was performed relative to the six criteria and it determined that the original inputs remain valid. The temperature differences have not changed because the design transients have not been redefined. The 60-year transient projections provided in Section 4.3.1 show that the transient limits will not be exceeded during the period of extended operation. Therefore, the number of temperature and pressure cycles considered in determining the components, which were exempt from fatigue analysis, will not be exceeded. The Fatigue Monitoring (B.3.1.1) program will be used to monitor the applicable cycles and ensure that the transient limits will not be exceeded during the period of extended operation.

TLAA Disposition: 10 CFR 54.21(c)(1)(iii) – The effects of aging on the intended function(s) of the Containment Structure electrical penetrations will be adequately managed for the period of extended operation by the Fatigue Monitoring (B.3.1.1) program, which monitors transient cycles to ensure they do not exceed their design limits, validating the assumptions used in these evaluations.

4.6.4 CONTAINMENT PIPING PENETRATIONS FATIGUE

TLAA Description:

The Byron and Braidwood Containment Structure penetrations conform to the requirements of ASME Section III, Subsection NE 1971 Edition through the Summer 1973 Addenda. The Containment Structure instrument and process pipe penetrations were analyzed in accordance with design specifications which required fatigue evaluations of each Containment Structure penetration, in accordance with the requirements set forth in subparagraph NB-3222.4(e) or NE-3222.4(e) of the ASME Section III. Therefore, the resulting piping penetration stress analyses contain fatigue evaluations which have been identified as TLAAs.

TLAA Evaluation:

The design specifications for the containment piping penetrations define the transients applicable to penetration stress analysis. These same transients are listed in Section 4.3.1, along with the 60-year projections. The numbers of some load/unload cycles were originally underestimated in the Main Steam and Feedwater containment piping penetration analyses and were not consistent with the governing Westinghouse transient design specification. Review of these analyses show that there is sufficient margin to accommodate the greater number of transients in the Westinghouse specification. Corrective action will be taken to revise the analyses to increase the numbers of load/unload cycles to the original CLB cycle limits presented in Tables 4.3.1-1, 4.3.1-2, 4.3.1-4, and 4.3.1-5 for the load/unload cycles. The Fatigue Monitoring (B.3.1.1) program is used to monitor the applicable transients and ensure that transient limits are not exceeded. The program also ensures that, if a transient limit is approached, corrective action is taken to reanalyze components prior to exceeding a transient limit.

TLAA Disposition: 10 CFR 54.21(c)(1)(iii) – The effects of aging on the intended function(s) of the containment penetrations will be adequately managed for the period of extended operation by the Fatigue Monitoring (B.3.1.1) program, which monitors transient cycles to ensure they do not exceed their design limits, validating the assumptions used in these evaluations. The analyses for the Main Steam and Feedwater penetrations will be revised using the applicable CLB cycle limits.

4.6.5 FUEL TRANSFER TUBE BELLOWS FATIGUE

TLAA Description:

The fuel transfer tubes connect the refueling cavity (inside the Containment Structure) to the fuel transfer canal (inside the Fuel Handling Building). The fuel transfer tubes pass through the Containment Structure wall and through the wall of the Fuel Handling Building. Guard pipe assemblies, which also function as penetration sleeves, were utilized for the fuel transfer tubes. There are three expansion bellows in the penetration sleeve around each fuel transfer tube. The guard pipes for the fuel transfer tubes are comprised of 24-inch diameter penetration sleeves that penetrate through the refueling cavity, Containment Structure, and the Fuel Handling Building walls. They also include three (3) sets of expansion joints (bellows). The design specification for the bellows includes design load cycles equal to 100 and the design is based on ASME Section III, Subsection NE, 1974 Edition through Summer 1974. The specification of 100 design load cycles along with the maximum displacements intended to envelope all postulated design basis conditions, including 1 SSE transient event, for fatigue consideration. The bellows were qualified in accordance with ASME Section III, Subparagraph NE-3365.2(e)(2). Therefore, the transfer tube bellows design load cycles have been identified as a TLAA requiring evaluation for the period of extended operation.

TLAA Evaluation:

These bellows are affected by seismic transients (1 SSE event) that would cause deflection of the bellows. These transients are listed in Section 4.3.1 and have 60-year projections that are less than the numbers of cycles which form the basis for the design requirement of 100 design load cycles and used for the qualification of the bellows. Therefore, the qualification of the bellows is acceptable for the period of extended operation. The Fatigue Monitoring (B.3.1.1) program monitors SSE transient events.

TLAA Disposition: 10 CFR 54.21(c)(1)(iii) – The effects of aging on the intended function(s) of the Fuel Transfer Tube Bellows will be adequately managed for the period of extended operation by the Fatigue Monitoring (B.3.1.1) program, which monitors transient events to ensure the CLB limits are not exceeded through the period of extended operation.

4.6.6 RECIRCULATION SUMP GUARD PIPING BELLOWS FATIGUE

TLAA Description:

The guard pipe for the containment recirculation sump effluent piping extends from the recirculation sump, inside the Containment Structure, to the sump suction valve protection chamber inside the Auxiliary Building. The guard pipe is comprised of a 28-inch diameter sleeve that penetrates through the Containment Structure and Auxiliary Building walls. The guard pipe also includes two (2) sets of expansion joints (bellows), with one bellows sealing between the containment sump piping and the guard pipe located inside the Containment Structure; and the other bellows sealing between the containment recirculation sump effluent piping and the sump suction valve protection chamber inside the Auxiliary Building. The bellows were analyzed for fatigue in accordance with Expansion Joint Manufacturers Association, 4th Edition, 1975 and substantiated per ASME Section III, Subparagraph NE-3365.2(e)(1) 1977 Edition through Summer of 1977 addenda. The required design cycles are 7000. Therefore, the design analysis for these bellows has been identified as a TLAA requiring evaluation for the period of extended operation.

TLAA Evaluation:

These bellows are affected by plant heatup and cooldown transients and other transient associated with accident conditions that would fill the containment recirculation sump, including OBE transients. These transients are listed in Section 4.3.1 and have 60-year projections that are less than the numbers of cycles analyzed for the bellows. Therefore, the design analysis of the bellows is acceptable for the period of extended operation. The BBS Fatigue Monitoring (B.3.1.1.) program monitors plant heatup and cooldown transients, as well as upset, emergency, and faulted conditions, including OBE and SSE events.

TLAA Disposition: 10 CFR 54.21(c)(1)(iii) – The effects of aging on the intended function(s) of the recirculation sump guard pipe bellows will be adequately managed for the period of extended operation by the Fatigue Monitoring (B.3.1.1) program, which monitors transient cycles and events to ensure they do not exceed their CLB cycle limits, validating the assumptions used in the analysis.

4.7 OTHER PLANT-SPECIFIC TIME-LIMITED AGING ANALYSES

4.7.1 LEAK-BEFORE-BREAK

TLAA Description:

Appendix A, Criterion 4, of 10 CFR 50 allows for the use of leak-before-break (LBB) methodology for excluding the dynamic effects of postulated ruptures in reactor coolant system piping. The fundamental premise of the LBB methodology is that the materials used in nuclear power plant piping are sufficiently tough that even a large through-wall crack would remain stable and would not result in a double-ended pipe rupture. Application of the LBB methodology is limited to those high-energy fluid systems not considered to be overly susceptible to failure from such mechanisms as corrosion, water hammer, fatigue, thermal aging or indirectly from such causes as missile damage or the failure of nearby components. LBB analyses performed for Byron and Braidwood Stations, Units 1 and 2 to demonstrate that postulated breaks can be eliminated from the structural design basis in the reactor coolant primary loop piping, safety injection accumulator piping, safety injection accumulator piping and cold leg nozzles, and reactor coolant bypass piping. These analyses associated with LBB have been identified as TLAAs that require evaluation for the period of extended operation.

Reactor Coolant Primary Loop Piping

TLAA Evaluation:

An LBB analysis (Reference 4.8.14) was initially performed for Byron and Braidwood Stations (BBS), Units 1 and 2, primary loop piping and was accepted by the NRC in 1996 (Reference 4.8.15). This analysis was subsequently reviewed and determined to remain valid during the steam generator replacements at Byron Unit 1 and Braidwood Unit 1, Measurement Uncertainty Recapture (MUR) uprate program, and Mechanical Stress Improvement Process (MSIP) application at the Reactor Vessel inlet and outlet nozzles at BBS Units 1 and 2.

For license renewal, the initial analysis was updated to demonstrate compliance with LBB methodology for BBS Units 1 and 2 for the period of extended operation. The updated LBB analysis for license renewal used input from the steam generator replacements at Byron Unit 1 and Braidwood Unit 1, Measurement Uncertainty Recapture uprate program at Byron and Braidwood Units 1 and 2, and Mechanical Stress Improvement Process (MSIP) application at BBS Units 1 and 2 at the Reactor Vessel inlet and outlet nozzles. MSIP has been implemented at Byron Unit 1 and Braidwood Units 1 and 2, and is planned at Byron Unit 2 for the year 2013. Plant specific geometry, operating parameters, loading and materials properties were used in the fracture mechanics evaluation. Mechanical properties were determined at operating temperatures. Since the piping systems include cast austenitic stainless steel (CASS), facture toughness considering thermal aging was determined for each heat of material for the fully aged condition (applicable to the license renewal period). An updated LBB analysis was performed considering the effects of thermal aging through the period of extended operation on the fracture toughness in accordance with the methodology provided in NUREG/CR-4513 (Reference 4.8.23).

Based on loading, pipe geometry, and fracture toughness considerations, enveloping critical (governing) locations were determined at which leak-before-break crack stability evaluations were made. Through-wall flaw sizes were found which would cause a leak at a rate of ten (10) times the leakage detection system capability of the plant. Large margins for such flaw sizes were demonstrated against flaw instability. Finally, a fatigue crack growth analyses using the design transients and cycles presented in Section 4.3.1 for the license renewal period was shown to be acceptable for the reactor coolant primary loop piping.

The effects of the steam generator replacement at Byron Unit 1 and Braidwood Unit 1, the MUR uprate program at BBS Units 1 and 2, MSIP application at BBS Units 1 and 2, and license renewal on the LBB analysis for the reactor coolant primary loop piping at BBS Units 1 and 2 have been evaluated. The recent LBB analysis demonstrates that the dynamic effects of the pipe rupture resulting from postulated breaks in the reactor coolant primary loop piping need not be considered in the structural design basis for BBS Units 1 and 2 for the license renewal period.

TLAA Disposition: 10 CFR 54.21(c)(1)(ii) – The Reactor Coolant Primary Loop piping LBB analyses for BBS Units 1 and 2 has been projected to the end of the period of extended operation.

Safety Injection Accumulator Piping and Reactor Coolant Bypass Piping

TLAA Evaluation:

Leak-Before-Break (LBB) analyses of Byron and Braidwood Units, 1 and 2 safety injection (SI) accumulator piping and reactor coolant bypass piping were performed in 1989. The results of these analyses were documented and accepted by the NRC (Reference 4.8.16).

A review of the current calculation packages of record for Byron and Braidwood, Units 1 and 2 was performed to obtain the latest piping loads on these piping systems. Based on the reviews, it was determined that the loads used in the original analysis are still governing. Therefore, LBB analysis results for the Byron and Braidwood, Units 1 and 2 safety injection accumulator piping and reactor coolant bypass piping remain valid for the period of extended operation.

TLAA Disposition: 10 CFR 54.21(c)(1)(i) – The Safety Injection Accumulator Piping and Reactor Coolant Bypass Piping LBB analyses for BBS Units 1 and 2 remain valid for the period of extended operation.

Safety Injection Accumulator Piping Cold Leg Nozzles

TLAA Evaluation:

The safety injection accumulator piping cold leg nozzles are made of cast stainless steel material. Cast stainless steel materials are subject to thermal aging and the affect of thermal aging over time on fracture toughness need to be considered in the LBB analysis for the nozzles and is a time-limited aging analysis. An updated LBB analysis was performed for the nozzles that considers the effects of thermal aging through the period of extended operation on the fracture toughness.

Plant specific geometry, operating parameters, loading and materials properties were used for the fracture mechanics evaluation. Mechanical properties were determined at operating temperatures. Since the piping systems include cast austenitic stainless steel (CASS), fracture toughness considering thermal aging was determined for each heat of material for the fully aged condition (applicable to the license renewal period).

Based on loading, pipe geometry and fracture toughness considerations, LBB crack stability evaluations were made. A through-wall flaw size was postulated which would cause a leak at a rate of ten times the leakage detection system capability of the plant. Large margin for such flaw size was demonstrated against flaw instability.

The LBB analysis demonstrates that the dynamic effects of the pipe rupture resulting from postulated breaks in the safety injection accumulator piping cold leg nozzles need not be considered in the structural design basis for BBS Units 1 and 2 for the license renewal period.

TLAA Disposition: 10 CFR 54.21(c)(1)(ii) – The safety injection accumulator piping cold leg nozzles LBB analysis for BBS Units 1 and 2 has been projected to the end of the period of extended operation.

4.7.2 CRANE LOAD CYCLE LIMITS

TLAA Description:

A review of design specifications for cranes within the scope of license renewal at Byron and Braidwood Stations was performed to identify those which were designed in accordance with the Crane Manufacturers Association of America Specification 70 (CMAA-70). Cranes designed in accordance with CMAA-70 include considerations for frequency of operation and expected size of loads, relative to their maximum load capacity. Based upon these considerations, cranes are designated a given service classification with an expected maximum number of design cycles over their life, which also correlates to a number of cycles on structural members. The service class is used to define the allowable stress range limits for structural members and fasteners to consider the cyclic operation over the life of the crane. Since the maximum number of design load cycles over the 40-year life of the crane provides the basis for acceptability of the design for cyclic operation over the life of the cranes, these cyclic analyses are considered TLAAs. Therefore, the load cycles experienced over the period of extended operation need to be evaluated.

TLAA Evaluation:

The following table provides a listing of those cranes within the scope of license renewal that were designed in accordance with CMAA-70, including their service class, maximum number of design load cycles, and projected number of load cycles over the 60-year life of the plant based upon past and future use.

Table 4.7.2-1

Evaluation Summary of Crane Cyclic Operation

Crane	CMAA Service Class	Maximum Number of Design Load Cycles	Projected Number of Load Cycles Over 60-Years	Valid for 60-Years
Containment Polar Crane	Class A	100,000	1,900	Yes
Fuel Handling Building Crane	Class A	100,000	7,200	Yes
Manipulator Crane	Class C	500,000	16,000	Yes
Spent Fuel Pool Bridge Crane	Class A	100,000	76,900	Yes
Turbine Building Crane	Class A	100,000	5,100	Yes

Containment Polar Crane:

The containment polar crane was designed in accordance with CMAA Specification 70 for Class A service. The containment polar crane includes a 230 ton capacity main hoist, 40 ton capacity auxiliary hoist, with a bridge rated for 460 tons. The CMAA-70 Class A service design includes consideration of 100,000 load cycles during the life of the crane. Normal loads associated with polar crane use include reactor vessel head, reactor vessel internals, movement of equipment access hatch, and reactor coolant pump maintenance. Based upon review of polar crane operation, the estimated number of cycles of loads five tons or greater from each refueling outage is approximately 44. Assuming 40 refueling outages, based on 18-month operating cycles, over the 60-year life of the plant, the total projected number of these load cycles is approximately 1,760. The containment polar crane was also used during original construction, as well as for steam generator replacement at Byron and Braidwood Stations, Unit 1. The estimated number of load cycles for these major evolutions is 100 per unit. Load cycles performed by all four containment polar cranes are assumed to be similar, with the load cycles associated with the Unit 1 steam generator replacement being the only significant difference. Therefore, the Byron and Braidwood Unit 1 containment polar cranes are considered bounding of the Unit 2 containment polar cranes, since no steam generators have been replaced on either Byron or Braidwood, Unit 2.

Based upon the above, the projected number of load cycles of five tons or greater for the Unit 1 containment polar crane over the course of the 60-year life of the plant is approximately 1,900. Since the total number of expected load cycles over the 60-year life of the plant is considerably less than the maximum number of design load cycles of 100,000 specified for Class A cranes in CMAA-70, the containment polar crane cyclic analysis for Byron and Braidwood Stations, Units 1 and 2, remains valid for the period of extended operation.

Fuel Handing Building Crane:

The fuel handling building crane was designed in accordance with CMAA Specification 70 for Class A service. The fuel handling building crane has a 125 ton rated load capacity. The CMAA-70 Class A service design includes consideration of 100,000 load cycles during the life of the crane. The single fuel handling building crane at Byron and Braidwood Stations supports operations at each of the respective units. Normal loads of five tons or greater include loads associated with reactor coolant pump motor replacement and refurbishment, dry cask storage campaigns, and outage equipment staging. A normal dry cask storage campaign involves an equivalent of six casks every 18 months and 25 load cycles of five tons or greater per cask, or 150 per operating cycle. Applying this schedule over the course of 60 years, results in an estimated 6,000 load cycles. This is considered a conservative approximation given that Byron and Braidwood Stations began dry cask storage campaigns in 2010 and 2011, respectively. The estimated number of load cycles of five tons or greater, and associated with activities other than dry cask storage, is approximately 1,200 over the 60-year life of the plant.

Based upon the above, the total number of projected load cycles of five tons or greater for the fuel handling building crane over the course of the 60-year life of the plant is 7,200. Since the total number of projected load cycles over the 60-year life of plant is considerably less than the maximum number of design load cycles of 100,000 specified for Class A cranes in CMAA-70, the fuel handling building crane load cyclic analysis for Byron and Braidwood Stations remains valid for the period of extended operation.

Manipulator Crane:

The manipulator crane is a rectilinear bridge and trolley system that spans the refueling cavity inside each containment structure, and is used for movement of fuel into and out of the reactor vessel. The manipulator crane was designed in accordance with CMAA Specification 70 for Class C service. The CMAA-70 Class C service design includes consideration of 500,000 load cycles during the life of the crane. There are 193 fuel assemblies contained within each reactor at Byron and Braidwood Stations. During each outage, the manipulator crane is used to support a full core offload and reload of all 193 assemblies, including two pull tests at >150% of the weight of assembly, as well as two source assembly moves. Therefore, the total number of load cycles during each refueling outage is approximately 400. Assuming 40 refueling outages based on 18-month operating cycles over the 60-year life of the plant, the total estimated number of these load cycles is approximately 16,000.

Since the 16,000 total number of projected load cycles over the 60-year life of the plant is considerably less than the maximum number of design load cycles of 500,000 specified for Class C cranes in CMAA-70, the manipulator crane load cyclic analysis for Byron and Braidwood Stations, Units 1 and 2, remain valid for the period of extended operation.

Spent Fuel Pool Bridge Crane

The spent fuel pool bridge was designed in accordance with CMAA Specification 70 for Class A service. The CMAA-70 Class A service design includes consideration of 100,000 load cycles during the life of the crane. Spent fuel pool bridge crane operation involves movement of fuel during new fuel receipt, transport of fuel to and from spent fuel storage racks and the fuel elevator during refueling outages, reshuffling of spent fuel in storage racks, and movement of fuel to dry cask storage casks. The spent fuel pool at Byron and Braidwood Stations is common between each of the respective units. Therefore, a single spent fuel pool bridge crane exists at each station and handles fuel moves associated with both units. The following is a summary of the load cycles to be considered for the Spent Fuel Pool Bridge Crane:

Load Cycles to Support Operating Cycle

The estimated number of load cycles over the course of each 18-month operating cycle is as follows:

- Off load – 386 load cycles
- Reload – 386 load cycles
- New fuel receipt – 180 load cycles
- Miscellaneous fuel assembly moves – 40 load cycles
- Miscellaneous fuel insert moves – 40 load cycles

Assuming 40 operating cycles over the 60-year life of the plant, the total estimated number of load cycles is approximately 41,500.

Load Cycles to Support Dry Cask Storage Campaigns

The spent fuel pool bridge crane is also used to support dry cask storage campaigns. As of Spring 2013, Byron Station has loaded 14 dry casks with 32 fuel assemblies in each, and Braidwood Station has loaded 3 dry casks. Since Byron Station has performed more cask campaigns, the 448 assemblies moved to date is considered conservative and bounding of Braidwood Station. 21 future campaigns at Byron Station, normally consisting of six casks each, are estimated to be performed for a total of approximately 4,500 load cycles. Additionally, 32 fuel assembly insert moves are performed for each cask. Therefore, the total number of load cycles associated with dry cask storage campaigns over the course the 60-year life of the plant is approximately 9,000.

Load Cycles Associated with Miscellaneous Activities

Based on a review of each spent fuel pool bridge crane operation, the following miscellaneous bounding lifts are also included for analysis:

- Two spent fuel pool rerack projects – 3,500 load cycles
- Fuel assembly moves for checker-boarding – 1,500 load cycles
- Fuel assembly moves for gamma heating – 245 load cycles
- Fuel assembly insert moves (through 2004) – 2,200 load cycles
- Fuel assembly insert moves (2005 through PEO) – 10,400 load cycles
- B.5.b moves (2006-2010) – 600 load cycles
- B.5.b moves (2010 through PEO) – 7,920 load cycles

The total of these miscellaneous load cycles over the 60-year life of the plant is approximately 26,400.

The total load cycles projected over the 60-year life of the plant for the Spent Fuel Pool Bridge Crane are approximately 76,900. Since the total number of projected load cycles is less than the maximum number of design load cycles of 100,000 specified for Class A cranes in CMAA-70, the spent fuel pool bridge crane load cyclic analysis for Byron and Braidwood Stations remains valid for the period of extended operation.

Turbine Building Crane

The turbine building crane was designed in accordance with CMAA Specification 70 for Class A service. The turbine building crane includes a 150 ton capacity main hoist and 25 ton capacity auxiliary hoist. The CMAA-70 Class A service design includes consideration of 100,000 design load cycles during the life of the crane. There is one turbine building crane at each unit at Byron and Braidwood Stations and the load cycles performed by all four cranes is assumed to be similar. Normal loads associated with turbine building crane use include turbine casings, blade rings, rotors, generator rotors, turbine valve assemblies and tooling used during outages. Based upon review of turbine building crane operation, the estimated number of load cycles over the 60-year life of the plant associated with normal maintenance activities is less than 4,800. The turbine building crane was used during original construction for a variety of equipment installations, and is also planned to be used for potential future upgrades to equipment and systems beyond the normal maintenance activities. Therefore, 200 initial load cycles during construction and 100 load cycles associated with potential future equipment and system upgrades beyond normal maintenance are conservatively included in this analysis. The total estimated number of load cycles of loads five tons or greater over the 60-year life of the plant is estimated to be less than 5,100.

Since the total number of projected load cycles over the 60-year life of the plant is considerably less than the maximum number of design load cycles of 100,000 specified for Class A cranes in CMAA-70, the turbine building crane load cyclic analysis for Byron and Braidwood Stations, Units 1 and 2, remain valid for the period of extended operation.

TLAA Disposition: 10 CFR 54.21(c)(1)(i) – Based on the above information, the projected number of load cycles associated with Containment Polar Crane, Fuel Handling Building Crane, Manipulator Crane, Spent Fuel Pool Bridge Crane, and Turbine Building Crane are considerably less than the design load cycles used in the cyclic analyses, and therefore the TLAAs remain valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

4.7.3 MECHANICAL ENVIRONMENTAL QUALIFICATION

TLAA Description:

Qualified lives and replacement intervals are established for safety-related mechanical components located in harsh environments based on aging concerns. Section 3.11 of the BBS UFSAR presents information on the design basis and qualification verifications for mechanical, instrumentation, and electrical equipment in the engineered safety features and the reactor protection system at BBS. Qualified lives for safety-related mechanical components located in harsh environments are established based on aging concerns in accordance with the provisions of Criterion 4 of Appendix A to 10 CFR Part 50. As part of the qualification, replacement intervals were identified as required either on the basis of aging performed during an IEEE 323-1974 (Reference 4.8.24) qualification test program or on the basis of published material aging data. The results of qualification tests or other published material aging data have been documented in individual mechanical component Environmental Qualification Binders. Since some of the variables analyzed are based upon 40-year assumptions, these qualifications have been identified as TLAAs that require evaluation for the period of extended operation.

TLAA Evaluation:

The design basis conditions during the period of extended operation will remain the same as those in the current license period. The individual mechanical components Environmental Qualification Binders will be revised to address the 60-year component service requirements in accordance with the BBS EQ Program. This ensures the effects of aging on the intended function(s) of mechanical components included under Environmental Qualification requirements will be adequately addressed for the period of extended operation. Therefore, the aging effects on the mechanical components included under Environmental Qualification requirements will be managed for the period of extended operation.

TLAA Disposition: 10 CFR 54.21(c)(1)(iii) – The Environmental Qualification Binders are managed in accordance with the BBS EQ Program requirements and will address the effects of aging on the intended function(s) of the mechanical components assuring the analyses will be adequately managed for the period of extended operation.

4.7.4 RESIDUAL HEAT REMOVAL HEAT EXCHANGERS TUBE SIDE INLET AND OUTLET NOZZLES FRACTURE MECHANICS ANALYSIS

TLAA Description:

During ultrasonic (UT) examinations in 1991, indications were found in the residual heat removal heat (RHR) exchanger tube side nozzles of both the Braidwood 2A and 2B RHR heat exchangers. Some of the indications exceeded the acceptance standards of ASME Section XI, Subarticle IWB-3500 1983 Edition, through Summer 1983 Addenda, and were subjected to further evaluation in accordance with ASME Section XI, Subarticle IWB-3600, 1983 Edition, through Summer 1983 Addenda. Even though this component is an ASME Class 2 component, a Class 1 fracture mechanics analysis was performed that met the ASME Section XI, Subarticle IWB-3600 requirements and, which was used to disposition the indications that did not meet the Subarticle IWB-3500 acceptance standards. This fracture mechanics analysis supporting the flaw evaluation for Braidwood Unit 2 was submitted to the NRC for review (Reference 4.8.25). The NRC reviewed and approved the analysis. (Reference 4.8.26)

Subsequently, UT examinations were performed of all the residual heat removal (RHR) heat exchanger tube side inlet and outlet nozzles at Byron and Braidwood and any additional indications exceeding the Subarticle IWB-3500 acceptance standards were dispositioned with the results of the fracture mechanics analysis. WCAP-13454 and WCAP-13455 (Reference 4.8.34) were submitted to the NRC on August 25, 1992 to present the original fracture mechanics methodology for dispositioning the indications found at Byron and Braidwood Units 1 and 2.

Relief from the requirement of UT examination became available when the NRC endorsed ASME Code Case N-706-1 (Reference 4.8.31) and became effective on January 18, 2008. This code case has been included as part of the ISI Programs for both Byron and Braidwood for the purpose of defining inspection requirements. The code case invokes a VT-2 method as acceptable in lieu of the UT examination. Note (2) in Table 1 of the code case requires the welds to have received at least one volumetric examination. The volumetric examinations performed to satisfy this requirement rely on the disposition of indications using the fracture mechanics analysis, and therefore the fracture mechanics analysis continues to be part of the current licensing basis.

To develop the maximum allowable indication size and determine crack growth rates, the analysis uses the startup and shutdowns of the RHR system coincident with the number of plant heatup and cooldowns based on the current licensed operation period as inputs. Therefore, the fracture mechanics analysis has been identified as a TLAA that requires evaluation for the period of extended operation.

TLAA Evaluation:

The analysis considers the numbers of RHR system startups and shutdowns to be coincident with the 200 RCS heatup and cooldown transients. Since the 60-year projections of heatup and cooldown transients provided in Section 4.3.1 have been demonstrated to be lower than the applicable transient design limits, the transient inputs to the analysis also remain bounded by the transient design limits in Section 4.3.1. The Fatigue Monitoring Program will be used to ensure these limits are not exceeded.

TLAA Disposition: 10 CFR 54.21(c)(1)(iii) – The Fatigue Monitoring (B.3.1.1) program will monitor transient cycles to ensure the transient inputs used in the fracture mechanics analysis supporting the flaw evaluations will not be exceeded during the period of extended operation.

4.7.5 REACTOR COOLANT PUMP FLYWHEEL FATIGUE CRACK GROWTH ANALYSIS

TLAA Description:

NUREG-1800 identifies “Fatigue analysis of the reactor coolant pump flywheel” as a potential plant-specific TLAA. At BBS, fatigue in the flywheels is a recognized and analyzed aging effect.

Due to industry operating experience, the possibility of reactor coolant pump overspeed or reactor coolant pump vibration prompted concerns regarding the potential effects of missiles that might result from the failure of the reactor coolant pump motor flywheel including damage to reactor coolant pump seals or other pressure boundary components.

The reactor coolant pump flywheel inspection program is specified in Technical Specifications 5.5.7. Compliance with Regulatory Guide 1.14, "Reactor Coolant Pump Flywheel Integrity," is set forth in Appendix A, including a description of the inservice inspection program for pump flywheels.

For two reactor coolant pump motors, a qualified in-place UT examination over the volume from the inner bore of the flywheel to the circle of one-half the outer radius or a surface examination (MT and/or PT) of exposed surfaces of the removed flywheel may be conducted at approximately 10-year intervals coinciding with the Inservice Inspection schedule as required by ASME Section XI. The basis for the 10-year inspection interval for these two flywheels is supported by a fatigue crack growth analysis contained in WCAP-14535A.(Reference 4.8.32) The fatigue crack growth analysis assumes 6000 starts and stops during a 60-year life of the flywheel.

For all other reactor coolant pump motors, a qualified in-place UT examination over the volume from the inner bore of the flywheel to the circle of one-half the outer radius or a surface examination (MT and/or PT) of exposed surfaces of the removed flywheel may be conducted at an interval not to exceed 20 years. The basis for the 20-year inspection interval for these remaining flywheels is supported by the fatigue crack growth analysis contained in WCAP-15666-A (Reference 4.8.33). The fatigue crack growth analysis assumes 6000 starts and stops during the 60-year life of the flywheel.

Since the inspection frequencies for the reactor coolant flywheels depend on fatigue crack growth analyses using the time dependent input of 6000 starts and stops during the 60 year life of the flywheels these have been identified as TLAAs.

TLAA Evaluation:

Based on the 60-year projections of reactor coolant pump starts and stops provided in Table 4.3.1-1 and Table 4.3.1-4, the maximum number of projected cycles for any of the reactor coolant pumps to occur in 60 years is 1,755. RCP flywheels are also maintained as spares and may be changed out as part of RCP motor maintenance activities, which would result in additional conservatism with respect to the projected cycles in 60 years. Therefore, since the number of analyzed start-stop cycles significantly exceeds the number of projected start-stop cycles, the RCP flywheel fatigue analysis has been demonstrated to remain valid through the period of extended operation.

TLAA Disposition: 10 CFR 54.21(c)(1)(i – Based on the above information, the RCP flywheel fatigue analysis remains valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

4.7.6 BYRON UNIT 2 PRESSURIZER SEISMIC RESTRAINT LUG FLAW EVALUATION

TLAA Description:

In September 2005, an indication exceeding the acceptance standards of ASME Section XI, Subarticle IWB-3500, 1989 Edition was found on a Byron Unit 2 pressurizer seismic lug. Investigation concluded that the indication was not service-induced, but rather was due to lack of fusion in the original weld. A flaw growth analysis was performed in accordance with ASME Section XI, Subarticle IWB-3600, 1989 Edition, which concluded that the indication size will remain within acceptable limits for the current remaining licensed operating period. The analysis assumed input transients for the current licensed operating period based on 40-year operation, and has therefore been identified as a TLAA requiring evaluation for the period of extended operation.

TLAA Evaluation:

The number of transients assumed in the analysis bound the numbers of transients projected for the period of extended operation provided in Section 4.3.1. The BBS Fatigue Monitoring (B.3.1.1) program includes corrective action requirements, if a transient approaches a cycle limit. Since the Fatigue Monitoring program will be used to validate the transient projection assumptions, the program will be credited for managing this TLAA for the period of extended operation.

TLAA Disposition: 10 CFR 54.21 (c)(1)(iii) – The ASME Section XI flaw growth analysis will be managed by the Fatigue Monitoring (B.3.1.1) program, which will monitor transient cycles and require corrective action prior to exceeding assumed input transient cycles which support the flaw evaluation.

4.7.7 BRAIDWOOD UNIT 2 FEEDWATER PIPE ELBOW FATIGUE CRACK GROWTH EVALUATION

TLAA Description:

In October 2009, an axial indication was identified on a Braidwood Unit 2, 16-inch main feedwater line elbow downstream of the feedwater regulating valves. A crack growth analysis performed in accordance with ASME Section XI, Subarticle IWB-3600, concluded that the crack size will remain within acceptable limits during the 40-year life of the plant. The analysis assumed various transients over 40 years and has therefore been identified as a TLAA requiring evaluation for the period of extended operation.

TLAA Evaluation:

The crack growth analysis assumed:

- Six (6) RCS heatup transients per year over a 40 year period for a total of 240.
- Five (5) RCS cooldown transients per year over a 40 year period for a total of 200.
- Six (6) reactor trip transients per year over a 40 year period for a total of 240.
- Four (4) reactor trips with RCS cooldown transients per year over a 40 year period for a total of 160.

The number of transients assumed in the analysis bound the number of transients projected to occur through the period of extended operation that were provided in Section 4.3.1.

TLAA Disposition: 10 CFR 54.21 (c)(1)(iii) – The ASME Section XI crack growth analysis will be managed by the Fatigue Monitoring (B.3.1.1) program, which will monitor transient cycles and require corrective action prior to exceeding the number of transient cycles assumed in the analysis which support the evaluation.

4.7.8 ANALYSES SUPPORTING FLAW EVALUATIONS OF PRIMARY SYSTEM COMPONENTS

Fatigue Crack Growth Analyses

TLAA Description:
BBS Units 1and 2 have performed pre-emptive flaw evaluations on reactor vessel, pressurizer, primary steam generator sub-components, and primary coolant components (i.e. primary system components) consistent with ASME Section XI, Subarticle IWB-3600. The flaw evaluations were performed consistently with the methodologies in WCAP-11063, "Handbook on Flaw Evaluations For Byron Unit 1 and 2 Steam Generators and Pressurizers" (Reference 4.8.27), earlier in plant life, and now with those in WCAP-12046, "Handbook on Flaw Evaluations for the Byron and Braidwood Units 1 and 2 Reactor Vessels" (Reference 4.8.28). The handbooks for flaw evaluation methodology are based on crack growth rate analyses using the design based transients as inputs for each of the evaluated components to provide crack growth rate reference curves. Since the flaw evaluation handbooks are based on analyses which have time-limited inputs, e.g., number of design transients cycles assumed over 40 years, these analyses supporting flaw evaluations of primary system components have been identified as TLAAs.

TLAA Evaluation:

The methodology in WCAP-11063 and WCAP-12046 uses inputs such as: flaw location, initial size, and the final acceptable size; the base material; and the number of design transient cycles to calculate conservative flaw growth on reactor vessel, pressurizer, primary steam generator sub-components and primary coolant components. To aid in the analyses and disposition of actual flaws found on these sub-components the WCAPs provide crack growth rate reference curves, which are based on the above factors. Depending on information such as actual flaw location and size, the crack growth rate reference curves provide simplified conclusions as to whether the flaw will propagate to an unacceptable size in 10, 20, 30, or 40 years. Each of the flaw evaluations used one or more of these curves to demonstrate that flaws will not propagate to unacceptable sizes prior to 40 years. The numbers of transients used to develop these curves bound the numbers of transients in the 60-year projections provided in Section 4.3.1. The Fatigue Monitoring (B.3.1.1) program will be used to ensure that the numbers of transients used in these curves will not be exceeded during the period of extended operation.

TLAA Disposition: 10 CFR 54.21 (c)(1)(iii) – The ASME Section XI crack growth analyses will be managed by the Fatigue Monitoring (B.3.1.1) program, which will monitor transient cycles and require corrective action prior to exceeding number of transient cycles used in the evaluations which support these conclusions.

Fracture Toughness Input to Analyses – Irradiation Embrittlement of Reactor Vessel Beltline and Extended Beltline Components

TLAA Description:

Byron and Braidwood have performed flaw evaluations on reactor vessels consistent with ASME Section XI, Subarticle IWB-3600. The flaw evaluations were performed consistently with the methodologies in WCAP-11063, "Handbook on Flaw Evaluations For Byron Unit 1 and 2 Steam Generators and Pressurizers" earlier in plant life, and with those in WCAP-12046 "Handbook on Flaw Evaluations for the Byron and Braidwood Units 1 and 2 Reactor Vessels." These methodologies use as a bases, analyses which use fracture toughness as an input. Loss of fracture toughness occurs in those portions of the reactor vessel exposed to neutron radiation embrittlement over the life of the reactor vessel. Therefore, the analyses using fracture toughness as an input supporting the flaw evaluations are TLAAs.

TLAA Evaluation:

Since fracture toughness will be changing as a result of operating into the period of extended operation and new locations will become a part of the extended beltline, any effects on the analyses are evaluated.

Active Beltline Region

Figures A.1-2 thru A.1-6 of WCAP-12046 (Reference 4.8.28) shows the flaw evaluation charts for the beltline region are valid for RT_{NDT} < 200°F. As presented in Section 4.2, the projected RTNDT for Byron and Braidwood at 57 EFPY is < 200°F and, therefore, the flaw evaluation charts in WCAP-12046 are still applicable for the period of extended operation.

Extended Beltline Region (components or welds away from the beltline region)

In the reactor vessel, the next material below the active beltline is the Lower shell to Bottom Head Ring Circumferential Weld. The calculated fluence on that weld is approximately $4x10^{15}$ n/cm^2 for the four BBS units. Even considering a worst case Chemistry Factor, the increase in RT_{PTS} is only 2°F, which is negligible. The fluence will only be lower further down the reactor vessel wall, so effects will continue to be negligible.

Above the active beltline and above the inlet and outlet nozzles, the next material is the Vessel Flange-to-Nozzle Shell Forging Circumferential Weld. The fluence in this weld is projected to be below $1X10^{17}$ n/cm^2, therefore, the embrittlement effects again are considered negligible.

Just above the active beltline, the increase in the RT_{PTS} for 57 EFPY from 32 EFPY due to irradiation at the Nozzle shell forgings and associated welds is approximately 10 to 20°F.

As provided in Section 4.2.3, the largest value of RT_{PTS} from all the extended beltline regions in the four BBS units is 90°F. The calculated K_{Ic} and K_{Ia} (fracture toughness) value is greater than 200 ksi-in$^{1/2}$ based on RT_{PTS} = 90°F and the limiting temperature from the bounding transient. Since the flaw evaluation charts in the WCAP-12046 for the extended beltline regions are determined based on an upper shelf limit of 200 ksi-in$^{1/2}$, the flaw evaluation charts in WCAP-12046 for the extended beltline region remain valid for the period of extended operation.

TLAA Disposition: 10 CFR 54.21 (c)(1)(i) – The ASME Section XI analyses supporting the flaw evaluations for the reactor vessel remain valid during the period of extended operation.

4.8 REFERENCES

4.8.1. Regulatory Guide 1.190, “Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence,” U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, March 2001.

4.8.2. Westinghouse Electric Company Document WCAP-14040-A, Revision 4, “Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves,” May 2004.

4.8.3. Westinghouse Electric Company Document WCAP-16083-NP-A, Revision 0, “Benchmark Testing of the FERRET Code for Least Squares Evaluation of Light Water Reactor Dosimetry,” May 2006.

4.8.4. Regulatory Guide 1.99, Revision 2, “Radiation Embrittlement of Reactor Vessel Materials,” U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, May 1988.

4.8.5. NUREG-0800,Fracture Toughness Requirements, “Branch Technical Position 5-3, Revision 2, Contained in Chapter 5 of “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition,” March 2007

4.8.6. NUREG/CR-6260, “Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components,” February 1985

4.8.7. NUREG/CR-5704, “Effects of LWR Coolant Environments on Fatigue Design Curves of Austenitic Stainless Steels,” April 1999

4.8.8. ASTM E 185-82, “Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels, E 706,” July 1985

4.8.9. NUREG/CR-6583, “Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low-Alloy Steels,” April 1999.

4.8.10. NUREG/CR-6909, “Effects of the LWR Coolant Environments on the Fatigue Life of Reactor Materials,” February 2007.

4.8.11. Nuclear Regulatory Commission, Regulatory Issue Summary RIS 2008-30, “Fatigue Analysis of Nuclear Power Plant Components,” December 2008.

4.8.12. Nuclear Regulatory Commission, Regulatory Issue Summary RIS 2011-14, “Metal Fatigue Analysis Performed by Computer Software,” December 2011.

4.8.13. EPRI Report Number 1024995, “Environmentally-Assisted Fatigue Screening, Process and Technical Bases for Identifying EAF Limiting Locations,” August 2012

4.8.14. Westinghouse Electric Company Document WCAP-14559, Revision 1, “Technical Justification for Eliminating Large Primary Loop Piping Rupture as the Structural Design Basis for the Byron and Braidwood Units 1 and 2 Nuclear Power Plants.”

4.8.15. NRC Letter to Commonwealth Edison, dated October 25, 1996, “Safety Evaluation (SE) Regarding Leak-Before-Break Analysis – Byron Stations, Units 1 and 2, and Braidwood Station, Units 1 and 2 (TAC Nos. M95342, M95343, M95344, and M95345).”

4.8.16. NRC Letter to Commonwealth Edison dated April 19, 1991, “Safety Evaluation of Leak-Before-Break Methodology Applicable to Accumulator Piping and Reactor Coolant Bypass Piping (TAC Nos. 73306, 73307, 73308, and 73309).”

4.8.17. Westinghouse Electric Company Document WCAP-14422, Revision 2A, “License Renewal Evaluation: Aging Management for Reactor Coolant system Supports,” December 2000.

4.8.18. NUREG-0588, “Interim Staff Position on Environmental qualification of Safety-Related Electrical Equipment,” July 1981.

4.8.19. Regulatory Guide 1.89, Revision 1, “Environmental Qualification of Certain electric Equipment Important to Safety for Nuclear Power Plants,” U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, June 1984.

4.8.20. Exelon, Byron and Braidwood Units 1 and 2 Updated Final Safety Analysis Report (UFSAR), Revision 14.

4.8.21. Regulatory Guide 1.35.1, “Determining Prestressing Forces for Inspection of Prestress Concrete Containments,” July 1990.

4.8.22. NRC Information Notice 99-10, “Degradation of Prestressing Tendon Systems in Prestressed Concrete Containments;” Attachment 3, “Comparison and Trending of Prestressing Forces,” April 13, 1999.

4.8.23. NUREG/CR-4513, Revision 1, “Estimation of Fracture Toughness of Cast Stainless Steels during Thermal Aging in LWR Systems,” U.S. Nuclear Regulatory Commission, August 1994.

4.8.24. IEEE 323-1974, "Qualifying Class 1E Equipment for Nuclear Power Generating Stations," The Institute of Electrical and Electronics Engineers, Inc., 1974.

4.8.25. Commonwealth Edison Letter to Office of Nuclear Reactor Regulation dated November 13, 1991, “Braidwood Unit 2 Flaw Evaluation Report for RHR Heat Exchanger Nozzle to Shell Welds.”

4.8.26. NRC Letter to Commonwealth Edison, dated November 21, 1991, “Residual Heat Removal Heat Exchanger Nozzle to Shell Welds (TAC NO. M82087).”

4.8.27. Westinghouse Electric Company Document WCAP-11063, "Handbook on Flaw Evaluations For Byron Unit 1 and 2 Steam Generators and Pressurizers,” March 1986.

4.8.28. Westinghouse Electric Company Document WCAP-12046 Revision 1, "Handbook on Flaw Evaluations for the Byron and Braidwood Units 1 and 2 Reactor Vessels," September 2003.

4.8.29. NRC Letter to Exelon, dated November 27, 2006, "Byron Station, Unit Nos. 1 and 2, and Braidwood Station, Unit Nos. 1 and 2 – Issuance of Amendments RE: Reactor Coolant System Pressure and Temperature Limits Report (TAC Nos. MC8693, MC8694, MC8695 AND MC8696)."

4.8.30. NUREG-1800, Revision 2, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," December 2010

4.8.31. ASME Code Case N-706-1, "Alternative Examination Requirements of Table IWB-2500-1 and IWC-2500-1 for PWR Stainless Steel Residual and Regenerative Heat Exchangers Section XI, Division 1," Approval Date January 10, 2007.

4.8.32. Westinghouse Electric Company Document WCAP-14535A, "Topical Report on Reactor Coolant Pump Flywheel Inspection Elimination," November 1996.

4.8.33. Westinghouse Electric Company Document WCAP-15666-A, Revision 1, "Extension of Reactor Coolant Pump Motor Flywheel Examination," October 2003

4.8.34. Commonwealth Edison Letter to Office of Nuclear Reactor Regulation, dated August 25, 1992, "Byron/Braidwood Stations Flaw Evaluation Methodology for RHR Heat Exchanger Nozzle to Shell Welds NRC Docket No. 50-454, 50-455, 50-456, 50-457."

APPENDIX A UPDATED FINAL SAFETY ANALYSIS REPORT SUPPLEMENT TABLE OF CONTENTS

A.1.0 Introduction

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

The application for a renewed operating license is required by 10 CFR 54.21(d) to include a FSAR Supplement. This appendix, which includes the following sections, comprises the FSAR supplement:

- Section A.1.1 contains a listing of the aging management programs that correspond to NUREG-1801 Chapter XI programs, including the status of the programs at the time the License Renewal Application was submitted.
- Section A.1.2 contains a listing of the plant-specific aging management programs, including the status of the programs at the time the License Renewal Application was submitted.
- Section A.1.3 contains a listing of aging management programs that correspond to NUREG-1801 Chapter X programs associated with Time-Limited Aging Analyses, including the status of the programs at the time the License Renewal Application was submitted.
- Section A.1.4 contains a listing of the Time-Limited Aging Analyses summaries (TLAAs).
- Section A.1.5 contains a discussion of the Quality Assurance Program and Administrative Controls.
- Section A.1.6 contains a discussion of the Operating Experience program.
- Section A.2 contains a summarized description of the aging management programs.
- Section A.2.1 contains a summarized description of the NUREG-1801 Chapter XI programs for managing the effects of aging.
- Section A.2.2 contains a summarized description of the plant-specific programs for managing the effects of aging.
- Section A.3 contains a summarized description of the NUREG-1801 Chapter X programs that support the TLAAs.
- Section A.4 contains a summarized description of the TLAAs applicable to the period of extended operation.
- Section A.5 contains the License Renewal Commitment List.

The integrated plant assessment for license renewal identified new and existing aging management programs necessary to provide reasonable assurance that systems, structures, and components within the scope of license renewal will continue to perform their intended functions consistent with the Current Licensing Basis (CLB) for the period of extended operation. The period of extended operation is defined as 20 years from the unit's current operating license expiration date.

A.1.1 NUREG-1801 Chapter XI Aging Management Programs

The Byron and Braidwood NUREG-1801 Chapter XI Aging Management Programs (AMPs) are described in this section. The AMPs are either existing, existing with enhancements (enhanced) or new.

The following list reflects the status of these programs at the time of the License Renewal Application (LRA) submittal. Commitments for program additions and enhancements are identified in the Appendix A.5 License Renewal Commitment List.

1. ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (Section A.2.1.1) [Existing - Requires Enhancement]
2. Water Chemistry (Section A.2.1.2) [Existing]
3. Reactor Head Closure Stud Bolting (Section A.2.1.3) [Existing - Requires Enhancement]
4. Boric Acid Corrosion (Section A.2.1.4) [Existing]
5. Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (Section A.2.1.5) [Existing]
6. Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (Section A.2.1.6) [New]
7. PWR Vessel Internals (Section A.2.1.7) [New]
8. Flow-Accelerated Corrosion (Section A.2.1.8) [Existing]
9. Bolting Integrity (Section A.2.1.9) [Existing - Requires Enhancement]
10. Steam Generators (Section A.2.1.10) [Existing - Requires Enhancement]
11. Open-Cycle Cooling Water System (Section A.2.1.11) [Existing - Requires Enhancement]
12. Closed Treated Water Systems (Section A.2.1.12) [Existing - Requires Enhancement]
13. Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (Section A.2.1.13) [Existing - Requires Enhancement]
14. Compressed Air Monitoring (Section A.2.1.14) [Existing - Requires Enhancement]
15. Fire Protection (Section A.2.1.15) [Existing - Requires Enhancement]

16. Fire Water System (Section A.2.1.16) [Existing - Requires Enhancement]
17. Aboveground Metallic Tanks (Section A.2.1.17) [New]
18. Fuel Oil Chemistry (Section A.2.1.18) [Existing - Requires Enhancement]
19. Reactor Vessel Surveillance (Section A.2.1.19) [Existing - Requires Enhancement]
20. One-Time Inspection (Section A.2.1.20) [New]
21. Selective Leaching (Section A.2.1.21) [New]
22. One-Time Inspection of ASME Code Class 1 Small Bore-Piping (Section A.2.1.22) [New]
23. External Surfaces Monitoring of Mechanical Components (Section A.2.1.23) [New]
24. Flux Thimble Tube Inspection (Section A.2.1.24) [Existing]
25. Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (Section A.2.1.25) [New]
26. Lubricating Oil Analysis (Section A.2.1.26) [Existing]
27. Monitoring of Neutron-Absorbing Materials Other than Boraflex (Section A.2.1.27) [Existing]
28. Buried and Underground Piping (Section A.2.1.28) [Existing - Requires Enhancement]
29. ASME Section XI, Subsection IWE (Section A.2.1.29) [Existing - Requires Enhancement]
30. ASME Section XI, Subsection IWL (Section A.2.1.30) [Existing - Requires Enhancement]
31. ASME Section XI, Subsection IWF (Section A.2.1.31) [Existing - Requires Enhancement]
32. 10 CFR Part 50, Appendix J (Section A.2.1.32) [Existing]
33. Masonry Walls (Section A.2.1.33) [Existing - Requires Enhancement]
34. Structures Monitoring (Section A.2.1.34) [Existing - Requires Enhancement]
35. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (Section A.2.1.35) [Existing - Requires

Enhancement]

36. Protective Coating Monitoring and Maintenance Program (Section A.2.1.36) [Existing - Requires Enhancement]
37. Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section A.2.1.37) [New]
38. Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits (Section A.2.1.38) [New]
39. Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section A.2.1.39) [New]
40. Metal-Enclosed Bus (Section A.2.1.40) [Existing - Requires Enhancement]
41. Fuse Holders (Byron Only) (Section A.2.1.41) [New]
42. Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section A.2.1.42) [New]

A.1.2 Plant-Specific Aging Management Programs

None. The Byron and Braidwood Stations, Units 1 and 2 License Renewal Application does not include plant-specific aging management programs.

A.1.3 NUREG-1801 Chapter X Aging Management Programs

The NUREG-1801 Chapter X Aging Management Programs (AMP) associated with Time-Limited Aging Analyses are described in the following sections. The AMPs are either consistent with generally accepted industry methods as discussed in NUREG-1801 Chapter X or require enhancements. The following list reflects the status of these programs at the time of the License Renewal Application (LRA) submittal. Commitments for program additions and enhancements are identified in Appendix A.5 License Renewal Commitment List.

1. Fatigue Monitoring (Section A.3.1.1) [Existing - Requires Enhancement]
2. Concrete Containment Tendon Prestress (Section A.3.1.2) [Existing - Requires Enhancement]
3. Environmental Qualification (EQ) of Electric Components (Section A.3.1.3) [Existing]

A.1.4 Time-Limited Aging Analyses

Summaries of the Time-Limited Aging Analyses applicable to the period of extended operation are included in the following sections:

1. Reactor Vessel Neutron Embrittlement Analysis (Section A.4.2)
2. Metal Fatigue (Section A.4.3)
3. Environmental Qualification (EQ) of Electric Components (Section A.4.4)
4. Concrete Containment Tendon Prestress Analyses (Section A.4.5)
5. Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analysis (Section A.4.6)
6. Other Plant-Specific Time-Limited Aging Analyses (Section A.4.7)

A.1.5 Quality Assurance Program and Administrative Controls

The Quality Assurance Program implements the requirements of 10 CFR 50, Appendix B, and is consistent with the summary in Appendix A.2, “Quality Assurance For Aging Management Programs (Branch Technical Position IQMB-1)” of NUREG-1800. The Quality Assurance Program includes the elements of corrective action, confirmation process, and administrative controls, and is applicable to the safety-related and nonsafety-related systems, structures, and components (SSCs) that are subject to Aging Management Review (AMR).

A.1.6 Operating Experience

Operating experience from plant-specific and industry sources is captured and systematically reviewed on an ongoing basis in accordance with the Quality Assurance program, which meets the requirements of 10 CFR Appendix B, and the Operating Experience program, which meets the requirements of NUREG-0737, “Clarification of TMI Action Plan Requirements,” Item I.C.5, “Procedures for Feedback of Operating Experience to Plant Staff.” The Operating Experience program interfaces with and relies on active participation in the Institute of Nuclear Power Operations” operating experience program, as endorsed by the NRC. The Operating Experience program will be enhanced to ensure, through the ongoing review of both internal and external operating experience, that the license renewal aging management programs are effective to manage the aging effects for which they are credited throughout the period of extended operation. The aging management programs are either enhanced or new programs developed when the review of operating experience indicates that the existing programs do not provide reasonable assurance that aging effects are being effectively managed.

The Operating Experience program will be enhanced to:

1. Require the review of internal and external operating experience for aging-related degradation or impacts to aging management activities, to determine if improvements to Byron and Braidwood Units 1 and 2 aging management activities are warranted. NRC and industry guidance documents and standards applicable to aging management are considered part of this information (e.g., License Renewal Interim Staff Guidance (LR-ISG) documents, NUREG-1801 (GALL) revisions, etc.) Ensure there are written expectations for identifying and processing these documents as operating experience.

2. Establish criteria to define aging-related degradation. In general, the criteria will be used to identify aging that is in excess of what would be expected, relative to design, previous inspection experience and the inspection intervals.

3. Establish identification coding within the corrective action program for use in identification, trending and communications of aging-related degradation. Provide a definition for the coding. This coding will assist plant personnel in ensuring that, in addition to addressing the specific issue, the adequacy of existing aging management programs is assessed. Station personnel are required to periodically assess the performance of the aging management programs, including insights obtained through operating experience. Adverse trends are entered into the corrective action program for evaluation. This could lead to AMP revisions or the establishment of new AMPs, as appropriate.

4. Require communication of significant internal aging-related degradation, associated with SSCs in the scope of license renewal, to other Exelon plants and to the industry. Criteria will be established for determining when aging-related degradation is significant.

5. Provide training to those responsible for screening, evaluating and communicating operating experience items related to aging management and aging-related degradation. This training will be commensurate with their role in the process, will be provided periodically and include provisions to accommodate personnel turnover.

These enhancements will be implemented no later than the date that the renewed operating licenses are issued and conducted on an ongoing basis throughout the terms of the renewed licenses.

A.2.0 Aging Management Programs

A.2.1 NUREG-1801 Chapter XI Aging Management Programs

This section provides UFSAR summaries of the NUREG-1801 Chapter XI programs credited for managing the effects of aging.

A.2.1.1 ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD

The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program is an existing condition-monitoring program that consists of periodic volumetric, surface, and/or visual examinations of ASME Class 1, 2, and 3 pressure-retaining components, including welds, pump casings, valve bodies, integral attachments, and pressure-retaining bolting for assessment, identification of signs of age-related degradation, and establishment of corrective actions. The program includes examinations and tests performed to identify and manage cracking, loss of fracture toughness, and loss of material in Class 1, 2, and 3 piping and components. This ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program is implemented in accordance with 10 CFR 50.55a and ASME Code, Section XI. These activities include examinations, testing, detection, monitoring and trending, and evaluation of results to confirm that aging effects are managed during the period of extended operation.

The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program will be enhanced to:

1. Conduct a visual inspection of the accessible portions of the ASME Class 2 reactor vessel flange leakage monitoring tube every other refueling outage.

This enhancement will be implemented prior to the period of extended operation.

A.2.1.2 Water Chemistry

The Water Chemistry aging management program is an existing mitigative program whose activities mitigate the loss of material due to corrosion, cracking due to stress corrosion cracking (SCC) and related mechanisms, and reduction of heat transfer due to fouling in components exposed to a reactor coolant, steam, treated borated water, and treated water environment. The program controls water chemistry for impurities (e.g., chloride, fluoride, and sulfate) that accelerate corrosion. Major component types include the reactor vessel, reactor internals, pressurizer vessel, steam generator internals, heat exchangers, tanks, piping, piping elements, and piping components. The primary system portion of this program consists of the reactor coolant system and related interfacing systems containing reactor coolant, treated borated water, and treated water. The secondary system portion of the program consists of the various secondary systems containing steam and treated water. The Byron and Braidwood Water Chemistry aging management program relies on monitoring and control of water chemistry to keep peak levels of various detrimental contaminants below system-specific limits, based on EPRI 1014986, “PWR Primary Water Chemistry Guidelines,” Revision 6, and EPRI 1016555, “PWR Secondary Water Chemistry Guidelines,” Revision 7.

A.2.1.3 Reactor Head Closure Stud Bolting

The Reactor Head Closure Stud Bolting aging management program is an existing preventive and condition monitoring program that provides for preventive and condition monitoring activities to manage reactor head closure studs and associated RPV head flange threads, nuts, and washers for cracking and loss of material. The program is implemented through station procedures based on the examination and inspection requirements specified in ASME Code, Section XI, Table IWB-2500-1 and preventive measures to mitigate cracking. The program also relies on recommendations to address reactor head stud bolting aging-related degradation delineated in NUREG-1339 and NRC Regulatory Guide 1.65.

The Reactor Head Closure Stud Bolting aging management program will be enhanced to:

1. Revise the procurement requirements for reactor head closure stud material to assure that the maximum yield strength of replacement material is limited to a measured yield strength less than 150 ksi.

This enhancement will be implemented prior to the period of extended operation.

A.2.1.4 Boric Acid Corrosion

The Boric Acid Corrosion aging management program is an existing condition monitoring program that manages the aging effects of mechanical, electrical, and structural components within the scope of license renewal that are susceptible to boric acid corrosion from systems that contain borated water. The Boric Acid Corrosion aging management program manages loss of material on piping, piping components, and piping elements, heat exchangers, ducting and components, containment liners, penetration bellows and sleeves, bolting, cabinets and enclosures, miscellaneous steel, and other structural components. The Boric Acid Corrosion aging management program manages increased resistance of connection/corrosion of connector contact surfaces on connector contacts for electrical connectors. The program consists of visual examinations of external surfaces that are potentially exposed to borated water leakage. The program includes walkdowns to allow timely discovery of leak paths and requires the removal of boric acid residues. The identification of the leakage source and the adjacent mechanical, electrical, and structural components in the leakage pathway area is performed to assess the damage. Follow-up inspections are performed to ensure that the corrective actions were adequate and have addressed the identified age-related degradation. Additionally, the program includes examinations conducted during ISI pressure tests performed in accordance with the ASME Code, Section XI requirements.

This program is implemented in response to NRC GL 88-05 and operating experience.

A.2.1.5 Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components

The Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components aging management program is an existing condition monitoring program that manages primary water stress corrosion cracking (PWSCC) of nickel alloy-based components and associated welds, as well as loss of material due to boric acid induced corrosion in susceptible, safety-related components in the vicinity of nickel-alloy reactor coolant pressure boundary components. This condition monitoring program provides inspection requirements for the reactor pressure vessel components, steam generator primary components, pressurizer components, and reactor coolant system pressure boundary piping containing PWSCC susceptible materials designated alloys 600/82/182. The program also includes inspection requirements for reactor pressure vessel upper heads.

A.2.1.6 Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)

The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) aging management program is a new condition monitoring program that provides assurance that reactor coolant pressure boundary CASS components (i.e., Class 1 piping and control rod assembly pressure boundary components) susceptible to thermal aging embrittlement meet their intended functions. The ASME Code Class 1 CASS components are maintained by inspecting and evaluating the extent of thermal aging embrittlement in accordance with the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI. The Byron and Braidwood ASME Section XI Inservice Inspection program is augmented by the implementation of the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) aging management program which monitors the aging effect of loss of fracture toughness due to thermal aging embrittlement of ASME Code Class 1 CASS components with service conditions above 250 degrees Celsius (482 degrees Fahrenheit).

The Thermal Aging Embrittlement of CASS program will include a screening methodology to determine component susceptibility to thermal aging embrittlement based on casting method, molybdenum content, and percent ferrite. For “potentially susceptible” components, thermal aging embrittlement management will be accomplished through either, qualified visual inspections, such as enhanced visual examination, qualified ultrasonic testing methodology, or component-specific flaw tolerance evaluation. Inspections or evaluations are not required for components that are determined not to be susceptible to thermal aging embrittlement. Screening for ASME Code Class 1 CASS components susceptible to thermal aging embrittlement is not required for pump casings and valve bodies. The existing ASME Section XI inspection requirements are adequate for managing the aging effects of Class 1 pump casings and valve bodies.

This new aging management program will be implemented prior to the period of extended operation.

A.2.1.7 PWR Vessel Internals

The PWR Vessel Internals aging management program is a new condition monitoring program that implements the guidance of EPRI 1022863 (MRP-227-A), "PWR Internals Inspection and Evaluation Guideline" and EPRI 1016609 (MRP-228), "Inspection Standard for PWR Internals" to manage the aging effects on reactor vessel internal (RVI) components.

The new program is used to manage the effects of age-related degradation that are applicable to the RVI components. These aging effects include: (a) various forms of cracking, including stress corrosion cracking (SCC), primary water stress corrosion cracking (PWSCC), irradiation assisted stress corrosion cracking (IASCC), or cracking due to fatigue/cyclical loading; (b) loss of material due to wear; (c) loss of fracture toughness due to neutron irradiation embrittlement; (d) changes in dimension due to void swelling and irradiation growth; and (e) loss of preload due to thermal and irradiation-enhanced stress relaxation or creep.

There are no RVI components that require additional aging management actions made of susceptible cast austenitic stainless steel, martensitic stainless steel, or precipitation-hardened stainless steel at the Byron and Braidwood Stations, therefore the aging effect of loss of fracture toughness due to thermal aging does not apply.

The PWR Vessel Internals aging management program is a new program and will be implemented no later than the date that the renewed operating licenses are issued.

A.2.1.8 Flow-Accelerated Corrosion

The Flow-Accelerated Corrosion (FAC) aging management program is an existing condition monitoring program based on implementation of EPRI guidelines in NSAC-202L-R3, "Recommendations for an Effective Flow Accelerated Corrosion Program." Program activities include analyses to determine critical locations, baseline inspections to determine the extent of wall thinning at these critical locations, and follow-up inspections to confirm or quantify the predictions, and take long term corrective actions. Repairs and replacements are performed as necessary. Inspections are performed using ultrasonic, visual, or other approved testing techniques capable of detecting wall thinning. The program provides guidance for prediction, detection, and monitoring wall thinning in piping, piping components, and piping elements, and heat exchangers due to FAC.

A.2.1.9 Bolting Integrity

The Bolting Integrity aging management program is an existing condition monitoring program. The program provides for aging management for loss of preload, cracking, and loss of material due to corrosion of closure bolting on pressure retaining joints within the scope of license renewal. The Bolting Integrity program incorporates NRC and industry recommendations delineated in NUREG-1339, “Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants,” EPRI NP-5769, “Degradation and Failure of Bolting in Nuclear Power Plants,” and EPRI TR-104213, “Bolted Joint Maintenance & Applications Guide.”

The program credits visual inspection of pressure retaining bolted joints in ASME Class 1, 2, and 3 systems for leakage and age-related degradation during system pressure tests performed in accordance with ASME Section XI, 2001 Edition through the 2003 Addenda. In addition, the Bolting Integrity aging management program credits volumetric, surface, and visual inspections of ASME Class 1, 2, and 3 bolts, nuts, washers, and associated bolting components performed in accordance with ASME Section XI, Subsections IWB, IWC, and IWD. The integrity of non-ASME (nonsafety-related) pressure retaining bolted joints (in non-ASME Class 1, 2, 3 and MC systems) is monitored by detection of visible leakage, evidence of past leakage, or other age-related degradation during maintenance activities and walkdowns in plant areas that contain systems within scope of license renewal. Inspection activities of closure bolting on pressure retaining joints within the scope of license renewal in submerged environments will be performed in conjunction with associated component maintenance activities.

The Bolting Integrity aging management program is supplemented by ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program, as described in A.2.1.1, for inspection of safety-related closure bolting on pressure retaining joints. Inspection activities for closure bolting on pressure retaining joints in buried and underground environments are performed by the Buried and Underground Piping (A.2.1.28) program when closure bolting on pressure retaining joints are exposed by excavation.

The Primary Containment (MC) pressure bolting is managed as part of ASME Section XI, Subsection IWE (A.2.1.29) program. The ASME Section XI, Subsection IWF (A.2.1.31) program manages ASME Class 1, 2, 3 and MC piping and component supports bolting. Structural bolting, other than ASME Class 1, 2, 3, and MC piping and component supports is managed as part of the Structures Monitoring (A.2.1.34) program and R.G. 1.127, Inspection of Water Control Structures Associated With Nuclear Power Plants (A.2.1.35) program. Crane and hoist bolting is managed by the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (A.2.1.13) program. The heating and ventilation system bolting is managed by the External Surfaces Monitoring of Mechanical Components (A.2.1.23) program. Reactor head closure bolting is managed by the Reactor Head Closure Stud Bolting (A.2.1.3) program. The above bolting is not included in the Bolting Integrity Program.

The Bolting Integrity aging management program will be enhanced to:

1. Prohibit the use of lubricants containing molybdenum disulfide on pressure retaining bolted joints.
2. Prohibit the use of high strength bolting (actual measured yield strength equal to or greater than 150 ksi) for pressure retaining bolted joints in portions of systems within the scope of the Bolting Integrity program.
3. Perform visual inspection of submerged bolting on fire protection system pumps (Byron only) and well water system deep well pumps (Byron only) when submerged portions of the pumps are overhauled or replaced during maintenance activities.

These enhancements will be implemented prior to the period of extended operation.

A.2.1.10 Steam Generators

The Steam Generators aging management program is an existing preventive, mitigative, condition monitoring, and performance monitoring program. The program establishes the operation, maintenance, testing, inspection, and repair requirements for the steam generators to ensure that plant technical specification surveillance requirements, ASME Code requirements, the Maintenance Rule performance criteria are met, thereby adequately managing the aging effects of steam generator tubes, plugs, and secondary side internal components. The aging effects include cracking, loss of material, reduction of heat transfer, and wall thinning. The program identifies and maintains the steam generator design and licensing bases and implements NEI 97-06, “Steam Generator Program Guidelines.” NEI 97-06 establishes a framework for prevention, inspection, evaluation, repair and leakage monitoring measures.

Tube sleeve repair is currently not allowed by plant technical specifications for Byron and Braidwood Stations, Unit 1 and Unit 2 nor are there any sleeves currently installed. If BBS were to implement sleeving repair methods in the future, a Technical Specification change would be required and the sleeving would be incorporated into the Steam Generators aging management program.

The Steam Generators aging management program will be enhanced to:

1. Validate that primary water stress corrosion cracking of the divider plate welds to the primary head and tubesheet cladding is not occurring. BBS commits to perform one (1) of the following three (3) resolution options for Units 1 and 2:

   Option 1: Inspection

   Perform a one-time inspection, under the Steam Generators program, of each steam generator to assess the condition of the divider plate welds and the effectiveness of the Water Chemistry (A.2.1.2) program. For the Byron and Braidwood, Unit 1 steam generators which were replaced in 1998, the inspection will be performed between 2018 and the start of the period of extended operation to allow the steam generators to acquire at least twenty years of service. For the Byron and Braidwood, Unit 2 steam generators, which currently have at least twenty years of service, the inspection will be performed prior to entering the period of extended operation. The examination technique(s) will be capable of detecting primary water stress corrosion cracking (PWSCC) in the divider plate assemblies and associated welds.

or

Option 2: Analysis

Perform an analytical evaluation of the steam generator divider plate welds in order to establish a technical basis which concludes that the steam generator reactor coolant pressure boundary is adequately maintained with the presence of steam generator divider plate weld cracking. The analytical evaluation will be submitted to the NRC for review and approval prior to entering associated period of extended operation.

or

Option 3: Industry/NRC Studies

If results of industry and NRC studies and operating experience document that potential failure of the steam generator reactor coolant pressure boundary due to PWSCC of the steam generator divider plate welds is not a credible concern, this commitment will be revised to reflect that conclusion.

2. Validate that primary water stress corrosion cracking of the tube-to-tubesheet welds is not occurring on BBS Unit 1. BBS commit to perform one (1) of the following three (3) resolution options for Unit 1:

   Option 1: Inspection

   Perform a one-time inspection, under the Steam Generators program, of a representative number of tube-to-tubesheet welds in each steam generator to determine if PWSCC cracking is present. Since the Byron and Braidwood, Unit 1 steam generators were replaced in 1998, the inspection will be performed between 2018 and the start of the period of extended operation to allow the steam generators to acquire at least twenty years of service. The examination technique(s) will be capable of detecting primary water stress corrosion cracking (PWSCC) in the tube-to-tubesheet welds. If cracking is identified, the condition will be resolved through repair or engineering evaluation to justify continued service, as appropriate, and a periodic monitoring program will be established to perform routine tube-to-tubesheet weld inspections for the remaining life of the steam generators.

or

Option 2: Analysis - Susceptibility

Perform an analytical evaluation of the steam generator tube-to-tubesheet welds to determine that the welds are not susceptible to primary water stress corrosion cracking. The evaluation for determining that the tube-to-tubesheet welds are not susceptible to primary water stress corrosion cracking will be submitted to the NRC for review and approval prior to entering the associated period of extended operation.

or

Option 3: Analysis – Pressure Boundary

Perform an analytical evaluation of the steam generator tube-to-tubesheet welds redefining the reactor coolant pressure boundary of the tubes, where the steam generator tube-to-tubesheet welds are not required to perform a reactor coolant pressure boundary function. The redefinition of the reactor coolant pressure boundary will be submitted to the NRC for review and approval prior to entering the associated period of extended operation.

These enhancements will be implemented prior to entering the period of extended operation.

A.2.1.11 Open-Cycle Cooling Water System

The Open-Cycle Cooling Water System (OCCWS) aging management program is an existing preventive, mitigative, condition monitoring, and performance monitoring program based on the implementation of NRC GL 89-13, which includes (a) surveillance and control of bio-fouling, (b) tests to verify heat transfer, (c) routine inspection and maintenance program, (d) system walkdown inspection, and (e) review of maintenance, operating, and training practices and procedures. The Open-Cycle Cooling Water System program applies to components constructed of various materials, including steel, stainless steel, gray cast iron, copper alloys, nickel alloys, titanium, and polymeric materials.

The Open-Cycle Cooling Water System (OCCWS) aging management program manages heat exchangers, piping, piping elements, and piping components in safety-related and nonsafety-related raw water systems that are exposed to a raw water environment for loss of material and reduction of heat transfer. The guidelines of NRC Generic Letter 89-13 are implemented through the site GL 89-13 activities for heat exchangers and the Raw Water Corrosion program for piping segments. System and component testing, visual inspections, non-destructive examination (NDE) (i.e., ultrasonic testing and eddy current testing), and chemical injection are conducted to ensure that identified aging effects are managed such that system and component intended functions and integrity are maintained.

The OCCWS aging management program includes those systems that transfer heat from safety-related systems, structures, and components to the ultimate heat sink as defined in GL 89-13. Periodic heat transfer testing, visual inspection, and cleaning of safety-related heat exchangers with a heat transfer intended function is performed in accordance with the sites' commitments to GL 89-13 to verify heat transfer capabilities. Additionally, safety-related piping segments are NDE tested periodically to ensure that there is no significant loss of material, which could cause a loss of intended function.

Nonsafety-related piping segments which have the potential for spatial interactions with safety-related equipment will be NDE tested periodically as delineated in the enhancement described below.

The Open-Cycle Cooling Water System aging management program will be enhanced to:

1. Perform periodic volumetric inspections for loss of material in the non-essential service water system piping at a minimum of two (2) locations on each unit in both the auxiliary building and the turbine building for a total of four (4) periodic inspections per unit every refueling cycle.

This enhancement will be implemented prior to the period of extended operation.

A.2.1.12 Closed Treated Water Systems

The Closed Treated Water Systems program is an existing mitigative and condition monitoring program that includes (a) nitrite-based and glycol-based water treatment, including pH control and the use of corrosion inhibitors, to modify the chemical composition of the water such that the function of the equipment is maintained and such that the effects of corrosion are minimized; (b) chemical testing of the water to ensure that the water treatment program maintains the water chemistry within acceptable guidelines; and (c) inspections to determine the presence or extent of corrosion and/or cracking. The Closed Treated Water Systems program manages the loss of material, the reduction of heat transfer, and cracking in piping, piping components, piping elements, tanks, and heat exchangers.

The Closed Treated Water Systems aging management program will be enhanced to:

1. Perform condition monitoring, including periodic visual inspections and non-destructive examinations, to verify the effectiveness of water chemistry control at mitigating aging effects. A representative sample of piping and components will be selected based on likelihood of corrosion, fouling, or cracking and inspected at an interval not to exceed once in 10 years during the period of extended operation. The selection of components to be inspected will focus on locations

which are most susceptible to age-related degradation, where practical.

2. Perform periodic sampling, analysis, and trending of water chemistry for the essential service water makeup pump engine glycol-based jacket water system to verify the effectiveness of water chemistry control at mitigating aging effects (Byron only).

These enhancements will be implemented prior to the period of extended operation.

A.2.1.13 Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems

The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems aging management program is an existing condition monitoring program that evaluates the effectiveness of maintenance monitoring activities for cranes and hoists that are within the scope of license renewal. The existing activities consist of periodic visual inspections for loss of material on the structural components of the bridge, trolley, girders, bolting, and rails in the rail system. The program also manages loss of preload of associated bolted connections.

For those cranes or hoists with associated Time-Limited Aging Analyses, the effects of past and future usage, including the number and magnitude of lifts, are evaluated in Section 4.7.2 of the license renewal application.

The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems aging management program will be enhanced to:

1. Consistently include inspections of structural components and bolting for loss of material due to corrosion, rails for loss of material due to wear and corrosion, and bolted connections for evidence of loss of preload.

2. Ensure periodic inspections are performed on all cranes, hoists, monorails, and rigging beams within the scope of license renewal, including those that are infrequently in use.

These enhancements will be implemented prior to the period of extended operation.

A.2.1.14 Compressed Air Monitoring

The Compressed Air Monitoring aging management program is an existing condition and performance monitoring program that manages the loss of material on piping, piping elements, and piping components in the compressed air systems. The Compressed Air Monitoring aging management program includes monitoring of moisture content and contaminants such that specified limits are maintained and inspection of components for indications of loss of material.

The Compressed Air Monitoring aging management program is based on Byron and Braidwood Stations' response to NRC Generic Letter 88-14, "Instrument Air Supply Problems" and utilizes guidance and standards provided by ANSI/ISA-S7.3-1975, "Quality Standard for Instrument Air"; INPO SOER 88-01, "Instrument Air System Failures"; and ASME OM-S/G-1998, Part 17, "Performance Testing of Instrument Air Systems in Light-Water Reactor Power Plants." The Compressed Air Monitoring aging management program activities implement the moisture content and contaminant criteria of ANSI/ISA-S7.3 (incorporated into ANSI/ISA-S7.0.01-1996). Program activities include air quality checks at various locations to ensure that dew point, particulates, and hydrocarbons are maintained within the specified limits and periodic inspections of select compressed air system component internal surfaces for signs of loss of material due to corrosion.

The Compressed Air Monitoring aging management program will be enhanced to:

1. Inspect critical component internal surfaces for signs of loss of material due to corrosion and document deficiencies in the corrective action program.

This enhancement will be implemented prior to the period of extended operation.

A.2.1.15 Fire Protection

The Fire Protection aging management program is an existing condition and performance monitoring program that includes various testing and inspections. This program requires the periodic visual inspection of fire barrier penetration seals; fire barrier walls, ceilings, and floors; fire resistant insulations and wraps; structural steel fireproofing; and combustible fluid retaining curbs and berms. These inspections will detect signs of age-related degradation; such as cracking, spalling, hardening, loss of bond, loss of form, loss of material, and loss of strength; prior to loss of intended function. The program also includes periodic visual inspections of fire doors and fire dampers, and periodic functional testing of fire doors to ensure that their operability is maintained. The Fire Protection aging management program also includes periodic inspection and testing of the halon and low-pressure carbon dioxide fire suppression systems to ensure age-related degradation is detected and corrected prior to loss of intended function. The periodic visual inspections and functional testing included in this aging management program ensure the fire protection barriers and system are maintained operational during the period of extended operation.

The Fire Protection aging management program will be enhanced to:

1. Include visual inspections of the earthen berm enclosing the outdoor fuel oil storage tanks for signs of age-related degradation such as loss of material and loss of form that could affect the intended function of the berm.

2. Provide additional inspection guidance to identify age-related degradation of fire barrier walls, ceilings, and floors or aging effects such as cracking, spalling, and loss of material.
3. Include visual inspection of halon and low-pressure carbon dioxide fire suppression system piping and component external surfaces for signs of corrosion or other age-related degradation.

These enhancements will be implemented prior to the period of extended operation.

A.2.1.16 Fire Water System

The Fire Water System aging management program is an existing condition monitoring program that provides for system pressure monitoring, system header flushing, buried ring header flow testing, pump performance testing, hydrant full flow flushing and full flow verification, sprinkler and deluge system flushing and flow testing, hydrostatic testing, and inspection activities. Major component types managed by this program include sprinklers, fittings, valves, hydrants, hose stations, standpipes, tanks, pumps, and aboveground and buried piping and components. There are no underground (i.e., below grade but contained within a tunnel or vault) piping and components within the scope of the Fire Water System aging management program.

Opportunistic visual inspections, performed when the internal surface of the system is made accessible due to normal plant maintenance activities, and existing volumetric non-destructive examinations will be credited to ensure age related degradation is identified prior to loss of system intended function.

Buried ring header flow tests measure hydraulic resistance and compare results with previous testing as a means of evaluating the internal piping conditions. Monitoring system piping flow characteristics ensures that signs of loss of material will be detected in a timely manner.

System functional tests, flow tests, flushes, and inspections are performed in accordance with the applicable guidance from National Fire Protection Association (NFPA) codes and standards. These activities are performed periodically to ensure that the loss of material due to corrosion aging effect is managed such that the system and component intended functions are maintained.

The Fire Water System aging management program will be enhanced to:

1. Replace sprinkler heads or perform 50-year sprinkler head testing using the guidance of NFPA 25 “Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems” (2002 Edition), Section 5.3.1.1.1. This testing will be performed at the 50-year in-service date and every 10 years thereafter.
2. Provide for chemical addition, accompanied with system flushing to allow for adequate dispersal of the chemicals throughout the system,

to prevent or minimize microbiologically induced corrosion (Byron only).

These enhancements will be implemented prior to the period of extended operation, with the testing and inspections performed in accordance with the schedule described above.

A.2.1.17 Aboveground Metallic Tanks

The Aboveground Metallic Tanks program is a new condition monitoring program which manages loss of material on the external surfaces of aboveground metallic tanks within the scope of license renewal. The program applies only to aluminum condensate storage tanks which are supported on concrete and a four inch sand cushion above compacted backfill. The original plant design specifications do not require the aluminum condensate storage tanks to be coated or painted on the external surface as a preventive measure to mitigate corrosion. This is due to the corrosion resistance properties of aluminum. This program includes preventive measures to mitigate corrosion by protecting the external surfaces of metallic components, per standard industry practice, with sealant at the concrete-component interface.

The program requires periodic visual inspections for degradation of the external surface of the lagging, flashing, insulation, roofing, and accessible sealant. The program also requires periodic visual inspections of the tank external surfaces and includes, on a sampling basis, removal of selected tank lagging and insulation to permit inspections of the external tank surfaces and exposed sealants.

Program effectiveness is determined by measuring the thickness of the tank bottoms to ensure that significant age-related degradation is not occurring and that the component’s intended function is maintained during the period of extended operation.

This new aging management program will be implemented prior to the period of extended operation. Tank bottom UT inspections will be performed within the five (5) year period prior to the period of extended operation, between years five (5) and 10 of the period of extended operation, and whenever a tank is drained.

A.2.1.18 Fuel Oil Chemistry

The Fuel Oil Chemistry program is an existing mitigative and condition monitoring program that manages loss of material and reduction in heat transfer in piping, piping elements, piping components, tanks, and heat exchangers. The Fuel Oil Chemistry aging management program relies on a combination of surveillance procedures and maintenance activities being implemented to provide assurance that contaminants are monitored and controlled in fuel oil for systems and components within the scope of license renewal. The program requires fuel oil parameters to be maintained at acceptable levels in accordance with Technical Specifications, Technical Requirement Manual, and ASTM Standards (ASTM D 0975-98/-06b, D 2709-

96e, D 4057-95, and D 5452-98). Fuel oil sampling and analysis is performed in accordance with approved procedures for new and stored fuel oil. Fuel oil tanks are periodically drained of accumulated water, cleaned, and internally inspected to minimize exposure to fuel oil contaminants. These activities effectively manage the effects of aging by maintaining contaminants at acceptably low concentrations.

The Fuel Oil Chemistry aging management program will be enhanced to:

1. Provide for the periodic cleaning of the Fire Protection Fuel Oil Storage Tank (Byron only).

2. Provide for periodic draining of water from the Auxiliary Feedwater Day Tanks, Diesel Generator Day Tanks, Essential Service Water Make/Up Pump Fuel Oil Storage Tanks (Byron only), and Fire Protection Fuel Oil Storage Tanks.

3. Include analysis for the levels of microbiological organisms in the Auxiliary Feedwater Day Tanks and Essential Service Water Make-up Pumps Diesel Oil Storage Tanks (Byron only).

4. Include analysis for water and sediment content, particulate concentration, and the levels of microbiological organisms for the Diesel Generator Day Tanks.

5. Include analysis for water and sediment content and the levels of microbiological organisms for the Diesel Generator Fuel Oil Storage Tanks.

6. Include analysis for particulate concentration and the levels of microbiological organisms for the Fire Protection Fuel Oil Storage Tanks.

7. Include internal inspections of the Fire Protection Fuel Oil Storage Tanks at least once during the 10 year period prior to the period of extended operation, and at least once every 10 years during the period of extended operation. Each diesel fuel tank will be drained and cleaned, the internal surfaces visually inspected (if physically possible), and, if evidence of degradation is observed during inspections, or if visual inspection is not possible, these diesel fuel tanks will be volumetrically inspected.

8. Include monitoring and trending for the levels of microbiological organisms for the Auxiliary Feedwater Day Tanks and Essential Service Water Make-up Pumps Diesel Oil Storage Tanks (Byron only).

9. Include monitoring and trending for water and sediment content, particulate concentration, and the levels of microbiological organisms for the Diesel Generator Day Tanks.

10. Include monitoring and trending for water and sediment content and the levels of microbiological organisms for the Diesel Generator Fuel Oil Storage Tanks.

11. Include monitoring and trending for total particulate concentration and the levels of microbiological organisms for the Fire Protection Fuel Oil Storage Tanks.

These enhancements will be implemented prior to the period of extended operation.

A.2.1.19 Reactor Vessel Surveillance

The Reactor Vessel Surveillance aging management program is an existing condition monitoring program that extends the scope of 10 CFR Part 50, Appendix H, “Reactor Vessel Material Surveillance Program Requirements.” The program provides sufficient material and dosimetry data to monitor loss of fracture toughness due to neutron irradiation embrittlement until the end of the period of extended operation, and determine the need for operating restrictions on the irradiation temperature (i.e., cold leg operating temperature), neutron spectrum, and neutron fluence. There were six (6) specimen capsules installed in each Byron and Braidwood Station (BBS) reactor pressure vessel (RPV) prior to plant start-up. The capsules contain representative RPV material specimens, neutron dosimeters, and thermal monitors (eutectic alloy). All six (6) specimen capsules have been withdrawn from each of the BBS RPVs. Three (3) specimen capsules from each RPV were tested and the remaining three (3) untested specimen capsules from each RPV are currently stored in the spent fuel pool. Of the three (3) untested specimen capsules from each RPV at least one (1) untested specimen capsule has been irradiated in excess of the projected peak neutron fluence of the associated RPV at the end of the period of extended operation. Capsules that have been withdrawn will be tested as necessary to fulfill the surveillance capsule recommendations contained in ASTM 185-82 as required by 10 CFR Part 50, Appendix H. Operating restrictions will be established to ensure that the plant is operated under the conditions to which the surveillance capsules were exposed. All capsules tested for the period of extended operation will meet the test procedures and reporting requirements of ASTM E 185-82, “Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels” to the extent practicable for the configuration of the specimens in the capsule. Any changes to the capsule withdrawal schedule, including spare capsules, must be approved by the NRC prior to implementation. Untested capsules placed in storage must be maintained for possible future insertion.

The program also monitors plant operating conditions to ensure appropriate steps are taken if reactor vessel exposure conditions are altered, such as the review and updating of 60-year fluence projections to support upper shelf energy calculations and pressure-temperature limit curves. The program also includes condition monitoring by removal and analysis of ex-core neutron dosimetry sensor sets to validate neutron exposure projection calculations through the period of extended operation in accordance with Regulatory Guide

1.190, “Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence.” These measures are effective in monitoring the extent of neutron irradiation embrittlement to prevent significant degradation of the reactor pressure vessel during the period of extended operation.

The Reactor Vessel Surveillance aging management program will be enhanced to:

1. Establish operating restrictions to ensure that the plant is operated under the conditions to which the surveillance capsules were exposed. The operating restrictions are as follows:

   Byron Station, Unit 1:

   - Cold leg operating temperature limitation: 525 degrees Fahrenheit (minimum) to 590 degrees Fahrenheit (maximum)
   - RPV beltline material fluence: 3.21E+19 n/cm2 (E >1.0 MeV) (maximum)

   Byron Station, Unit 2; Braidwood Station Units 1 and 2:

   - Cold leg operating temperature limitation: 525 degrees Fahrenheit (minimum) to 590 degrees Fahrenheit (maximum)
   - RPV beltline material fluence: 3.19E+19 n/cm2 (E >1.0 MeV) (maximum)

   If the reactor pressure vessel exposure conditions (neutron fluence, neutron spectrum) or irradiation temperature (cold leg inlet temperature) are altered, then the basis for the projection to the end of the period of extended operation needs to be reviewed and, if deemed appropriate, updates are made to the Reactor Vessel Surveillance program. Any changes to the Reactor Vessel Surveillance program must be submitted for NRC review and approval in accordance with 10 CFR Part 50, Appendix H.

This enhancement will be implemented prior to the period of extended operation.

A.2.1.20 One-Time Inspection

The One-Time Inspection aging management program is a new condition monitoring program that will be used to verify the system-wide effectiveness of the Water Chemistry (A.2.1.2) program, Fuel Oil Chemistry (A.2.1.18) program, and Lubricating Oil Analysis (A.2.1.26) program which are designed to prevent or minimize age-related degradation so that there will not be a loss of intended function during the period of extended operation. The program manages loss of material, cracking, and reduction of heat transfer in piping, piping components, piping elements, tanks, pump casings, heat exchangers, and other components within the scope of license renewal. The program identifies inspections focused on locations that are isolated from the flow stream, that are stagnant, or that have low flow for extended periods and are susceptible to the gradual accumulation or concentration of agents that promote certain aging effects. A representative sample size of 20 percent of the population (up to a maximum of 25 component inspections) will be established for each of the sample groups and will focus on the bounding or lead components most susceptible to aging due to time in service and severity of operating conditions. The program verifies either no unacceptable age-related degradation is occurring or triggers additional actions that will assure the intended function of affected components will be maintained during the period of extended operation.

The elements of the program include (a) determination of the sample size of components to be inspected based on an assessment of materials of fabrication, environment, plausible aging effects, and plant-specific and industry operating experience, (b) identification of the inspection locations in the system or component based on the potential for the aging effect to occur, (c) determination of the examination technique, including acceptance criteria that would be effective in managing the aging effect for which the component is examined, and (d) an evaluation of the need for follow-up examinations to monitor the progression of aging if age-related degradation is found that could adversely impact an intended function before the end of the period of extended operation.

This program is not used for systems or components with known age-related degradation or when the environment in the period of extended operation is not expected to be equivalent to that in the prior 40 years. Periodic inspections will be used in these cases.

The One-Time Inspection program will be implemented prior to the period of extended operation. The one-time inspections will be performed within the 10 year period prior to the period of extended operation.

A.2.1.21 Selective Leaching

The Selective Leaching aging management program is a new condition monitoring program that includes one-time inspections to demonstrate the absence of selective leaching of a representative sample of susceptible components within the scope of license renewal. Components include piping and fittings, valve bodies, pump casings, heat exchanger components, and structural members. The materials of construction for these components are gray cast iron and copper alloy with greater than 15 percent zinc. There are no aluminum bronze in-scope components with greater than eight (8) percent aluminum. A sample size of 20 percent of susceptible components will be subject to a one-time inspection with a maximum of 25 inspections for each of the susceptible material and environment combination groups.

These one-time inspections for loss of material due to selective leaching will include visual examinations, supplemented by hardness tests or other mechanical examination techniques such as destructive testing, scraping, or chipping of selected components that are susceptible to selective leaching. These inspections are to determine whether loss of material due to selective leaching is occurring and whether the process will affect the ability of the components to perform their intended function during the period of extended operation. The material degradation evaluation may require confirmation of selective leaching through a metallurgical evaluation. If loss of material due to selective leaching is identified, further evaluation of the extent of selective leaching will be performed under the corrective action program, which may include an expansion of the inspection sample size and locations.

The Selective Leaching aging management program will be implemented prior to the period of extended operation. One-time inspections will be performed within the five (5) year period prior to entering the period of extended operation.

A.2.1.22 One-Time Inspection of ASME Code Class 1 Small-Bore Piping

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program is a new condition monitoring program that will manage the aging effect of cracking in ASME Code Class 1 small-bore piping that is less than nominal pipe size of four (4) inches (NPS 4), and greater than or equal to one (1) inch (NPS 1). The program, which includes pipes, fittings, branch fittings, branch connections, and all associated full penetration (butt) and partial penetration (socket) welds, will augment ASME Code, Section XI requirements. The program includes measures to verify that degradation is not occurring or aging is insignificant, thereby, either confirming that there is no need to manage aging-related degradation or validating the effectiveness of any existing program for the period of extended operation.

The program implements one-time inspection of a sample of piping full penetration (butt) and partial penetration (socket) welds that are susceptible to cracking using volumetric examinations. The inspection sample size will include at least 25 butt welds and 25 socket welds within the population of program welds on each Byron and Braidwood unit. Inspection of socket welds will be performed by volumetric examination techniques demonstrated to be capable of detecting cracking. If such volumetric techniques are not available by the time of the inspections, the examination method will be by destructive testing. If destructive testing is performed, each socket weld test will be credited as equivalent to two volumetrically examined welds. Inspections required by the program will augment ASME Code, Section XI requirements.

Cracking of ASME Code Class 1 small-bore piping due to intergranular stress corrosion or fatigue due to cyclical loading has not been experienced at Byron and Braidwood Stations. Therefore, this one-time inspection program is applicable and adequate to manage this aging effect for the period of extended operation. A plant specific periodic inspection program will be implemented if evidence of cracking caused by intergranular stress corrosion or fatigue due to cyclical loading is revealed in ASME Code Class 1 small-bore piping, and design changes have not been implemented to correct the cause.

The new One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program will be implemented prior to the period of extended operation. One-time inspections will be performed and evaluated within the six (6) year period prior to the period of extended operation.

A.2.1.23 External Surfaces Monitoring of Mechanical Components

The External Surfaces Monitoring of Mechanical Components aging management program is a new condition monitoring program that directs visual inspections of external surfaces of components be performed during system inspections and walkdowns. The program consists of periodic visual inspections of metallic and elastomeric components such as piping, piping components, ducting, elastomeric components, and other components within the scope of license renewal. The program manages aging effects of metallic and elastomeric components through visual inspection of external surfaces for evidence of loss of material. Visual inspections are augmented by physical manipulation as necessary to detect hardening and loss of strength of elastomers.

The external surfaces of components that are buried are inspected via the Buried and Underground Piping (A.2.1.28) program. The external surfaces of above ground tanks are inspected via the Aboveground Metallic Tanks (A.2.1.17) program. Internal surfaces are inspected via the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (A.2.1.25) program.

This new aging management program will be implemented prior to the period of extended operation.

A.2.1.24 Flux Thimble Tube Inspection

The Flux Thimble Tube Inspection aging management program is an existing condition monitoring program that manages the loss of material in flux thimble tubes due to wear (i.e., wall thinning). Flux thimble tubes, which provide a path for the in-core neutron flux monitoring system detectors, establish part of the reactor coolant pressure boundary and are subject to flow-induced fretting which causes wear. The program uses the non-destructive examination methodology of eddy current testing to periodically inspect the full length of all flux thimble tubes, which encompasses the path from the reactor vessel instrument nozzle to the fuel assembly instrument guide. The results of the periodic eddy current testing are evaluated and trended to determine if corrective actions are required or if the inspection frequency needs to be changed to ensure reactor coolant pressure boundary integrity is maintained. Corrective actions include flux thimble tube limited repositioning (one-time), replacement, or isolation (removal from service).

The Flux Thimble Tube Inspection program implements the recommendations of NRC IE Bulletin 88-09, “Thimble Tube Thinning in Westinghouse Reactors.” This existing aging management program will continue to be implemented during the period of extended operation.

A.2.1.25 Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components

The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components aging management program is a new condition monitoring program that directs visual inspections of internal surfaces of components within the scope of license renewal be performed when they are made accessible during periodic system and component surveillances or during the performance of maintenance activities. The program provides assurance that existing environmental conditions are not causing material degradation that could result in loss of intended function.

The program consists of visual inspections of the internal surfaces of metallic components such as piping, piping elements and piping components, ducting components, tanks, heat exchangers, and other components that are exposed to air-indoor uncontrolled, diesel exhaust, condensation, and any water system other than open-cycle cooling water system, closed treated water system, and fire water system. The program also consists of visual inspections of the internal surfaces of elastomeric components that are exposed to condensation, treated water, fuel oil, and lubricating oil augmented by physical manipulation or pressurization to detect hardening or loss of strength where appropriate. The program will manage the aging effects of loss of material, reduction of heat transfer, and cracking for metallic components. The program will also manage the aging effects of loss of material and hardening and loss of strength for elastomeric components. The program includes provisions for visual inspections of the internal surfaces of components not managed under other aging management programs.

This new aging management program will be implemented prior to the period of extended operation.

A.2.1.26 Lubricating Oil Analysis

The Lubricating Oil Analysis aging management program is an existing preventive and mitigative program that ensures that the oil environment in the mechanical systems is maintained to the required quality to prevent or mitigate age-related degradation of components within the scope of this program. The Lubricating Oil Analysis program ensures that oil systems are maintained free of contaminants (primarily water and particulates), thereby, preserving an environment that is not conducive to loss of material or reduction of heat transfer in piping, piping components, piping elements, valve bodies, pump casings, gear boxes, tanks, and heat exchangers exposed to an oil environment. Testing activities include sampling and analysis of lubricating oil for detrimental contaminants. The presence of oil contaminants (e.g., water or particulates) may also indicate in-leakage and corrosion product buildup.

A.2.1.27 Monitoring of Neutron-Absorbing Materials Other than Boraflex

The Monitoring of Neutron-Absorbing Materials Other than Boraflex aging management program is an existing condition monitoring program that periodically inspects and analyzes test coupons of the Boral material in the spent fuel storage racks to determine if the neutron-absorbing capacity of the material has degraded over time. This program ensures that a five (5) percent sub-criticality margin in the spent fuel pool is maintained during the period of extended operation by monitoring for loss of material, changes in dimension, and loss of neutron-absorption capacity of the Boral material. The existing coupon inspection frequency ensures at least one (1) coupon is examined during each 10 year period, beginning 10 years prior to the period of extended operation.

A.2.1.28 Buried and Underground Piping

The Buried and Underground Piping aging management program is an existing preventive, mitigative, and condition monitoring program that manages the external surface aging effects for buried and underground piping. The program manages aging through preventive, mitigative (e.g., coatings, backfill quality, and cathodic protection), and inspection activities for piping and components within the scope of license renewal. It manages the aging effects of loss of material at Byron and Braidwood Stations, as well as cracking and change in material properties (e.g., cracking, blistering, and change in color) at Braidwood Station only.

External inspection of buried components will occur opportunistically when they are excavated for any reason.

The Buried and Underground Piping aging management program will be enhanced to:

1. Perform manual examinations, in addition to visual inspections, to detect hardening, softening, or other changes in material properties for buried polymeric piping (Braidwood only).

2. Cracking will be managed for stainless steel components, utilizing a method that has been demonstrated to be capable of detecting cracking, whenever coatings are removed and expose the base material (Braidwood only).

3. Ensure all underground carbon steel essential service water system piping within the scope of license renewal is coated in accordance with NACE SP0169-2007 prior to the period of extended operation (Byron only).

4. Direct visual inspections of coated piping and components will be performed by an individual possessing a NACE Coating Inspector Program Level 2 or 3 operator qualification, or by an individual who has attended the EPRI Comprehensive Coatings Course and completed the EPRI Buried Pipe Condition Assessment and Repair Training Computer Based Training Course.

5. Inspection quantities of buried piping within the scope of license renewal will be performed in accordance with LR-ISG-2011-03, Element 4, Table 4a, and based upon the as-found results of cathodic

protection system availability and effectiveness during each 10 year period, beginning 10 years prior to the period of extended operation.

6. The buried carbon steel condensate system piping within the scope of license renewal will be addressed, through means of a long term mitigation strategy, prior to entering the period of extended operation. Mitigation may include activities such as fully recoating, complete replacement with like or upgraded material, installation of internal polymeric sleeves, and routing of pipe above ground or in an engineered trench for leak detection. Inspections of the condensate system piping will be performed in accordance with LR-ISG-2011-03, Element 4, Table 4a, and based on the mitigation strategy implemented (Braidwood only).

7. Inspection quantities of underground piping within the scope of license renewal will be performed in accordance with LR-ISG-2011-03, Element 4, Table 4b, during each 10 year period, beginning 10 years prior to the period of extended operation.

8. If adverse indications are detected during inspection, inspection sample sizes within the affected piping categories will be doubled. If adverse indications are found in the expanded sample, an analysis will be conducted to determine the extent of condition and extent of cause. The size of the follow-on inspections will be determined based on the analysis. Timing of the additional inspections will be based on the severity of the identified degradation and the consequences of leakage. In all cases, the additional inspections will be performed within the same 10-year inspection interval in which the original adverse indication was identified. Expansion of sample size may be limited by the extent of piping subject to the observed degradation mechanism.

9. In performing cathodic protection surveys, only the -850mV polarized potential criterion specified in NACE SP0169-2007 for steel piping will be used for acceptance criteria and determination of cathodic protection system effectiveness, unless the -100mV polarization criteria can be demonstrated effective through use of buried coupons, electrical resistance probes, or placement of reference cells in the immediate vicinity of the piping being measured. An upper limit of -1200mV for pipe-to-soil potential measurements of coated pipes will also be established, so as to preclude potential damage to coatings.

10. An extent of condition evaluation will be conducted if observed coating damage caused by non-conforming backfill has been evaluated as significant. The extent of condition evaluation will be conducted to ensure that the as-left condition of backfill in the vicinity of the observed damage will not lead to further degradation.

These enhancements will be implemented prior to the period of extended operation.

A.2.1.29 ASME Section XI, Subsection IWE

The ASME Section XI, Subsection IWE aging management program is an existing program based on ASME Section XI, Subsection IWE requirements and complies with the provisions of 10 CFR 50.55a. This program is in accordance with ASME Section XI, Subsection IWE, 2001 edition through the 2003 Addenda.

The program consists of periodic visual and volumetric examination of pressure retaining components of steel and concrete containments for signs of degradation, assessment of damage, and corrective actions. The program includes aging management of surfaces and components such as bolting for containment closure, containment liner, containment penetrations (electrical, instrumentation, and control assemblies), mechanical penetrations, penetration bellows at the containment boundary, penetration sleeves at the containment boundary, and the personnel airlock and equipment hatch. The moisture barrier, which is a sealant between the bottom of the containment liner and the base mat, is included within the scope of the program.

Examination methods include visual and volumetric testing as required by ASME Section XI, Subsection IWE. Observed conditions that have the potential for impacting an intended function are evaluated for acceptability in accordance with ASME requirements and corrected in accordance with corrective action program

The ASME Section XI, Subsection IWE aging management program will be enhanced to:

1. Provide guidance for specification of bolting material, lubricant and sealants, and installation torque or tension to prevent or mitigate degradation and failure of structural bolting.

This enhancement will be implemented prior to the period of extended operation.

A.2.1.30 ASME Section XI, Subsection IWL

The ASME Section XI, Subsection IWL aging management program is an existing program that consists of (a) periodic visual inspection of concrete surfaces for reinforced and unbonded, prestressed concrete containments, and (b) periodic visual inspection and sample tendon testing of unbonded post-tensioning systems for prestressed concrete containments for signs of degradation, assessment of damage, and corrective actions, and testing of the tendon corrosion protection medium and free water. Measured tendon lift-off forces are compared to predicted tendon forces calculated in accordance with RG 1.35.1.

Reinforced concrete surfaces are inspected for material degradation, including loss of material, cracking, increase in porosity and permeability, and loss of bond. A sample of each tendon wire type (vertical, hoop, dome) for the post-tensioning system is tested for loss of prestress. One tendon wire of each type is also examined for loss of material and subject to physical testing to determine yield strength, ultimate tensile strength, and elongation. The end anchorage for the unbonded post-tensioning system is inspected for loss of material.

This program is in accordance with ASME Section XI, Subsection IWL, 2001 edition through the 2003 addenda, and complies with the provisions of 10 CFR 50.55a.

The ASME Section XI, Subsection IWL aging management program will be enhanced to:

1. Include additional augmented examination requirements after post-tensioning system repair/replacement activities in accordance with Table IWL-2521-2.

2. A one-time inspection of one (1) vertical and one (1) horizontal tendon on each unit will be performed prior to the period of extended operation. The inspection will consist of visually examining one (1) wire from each of the two (2) types of tendons at a worst-case location based on evidence of free water, grease discoloration, and grease chemistry results. This location will serve as a leading indicator for potential degradation or tendon surface corrosion (Braidwood only).

3. In order to monitor for tendon exposure to free water and moisture and manage any potential adverse effects, a periodic tendon water monitoring and grease sampling program will be implemented (Braidwood only). The program will consist of:

   a. A baseline inspection of tendon grease caps at the bottom of all vertical and dome tendons, as well as all below-grade horizontal tendons, prior to the period of extended operation. The baseline inspection will check for evidence of free water and grease discoloration, with further actions taken based on the condition of the grease.

   b. A follow-up tendon grease cap inspection of all vertical and dome tendons, as well as all below-grade horizontal tendons, will be performed within 10 years of the initial inspection, using the same approach as the baseline inspection.

   c. For those tendons where free water, moisture, and grease did not meet acceptance criteria during the two (2) previous inspections, periodic monitoring of grease chemistry and moisture, free water, and grease discoloration will be performed on a frequency not to exceed 10 years.

   Corrective actions will be taken as necessary to ensure that the tendon grease meets ASME Section XI, Subsection IWL requirements.

4. Explicitly require that areas of concrete deterioration and distress be recorded in accordance with the guidance provided in ACI 349.3R.

5. Include quantitative acceptance criteria, based on the "Evaluation Criteria" provided in Chapter 5 of ACI 349.3R, that will be used to augment the qualitative assessment of the Responsible Engineer.

These enhancements will be implemented prior to the period of extended operation.

A.2.1.31 ASME Section XI, Subsection IWF

The ASME Section XI, Subsection IWF aging management program is an existing program that consists of periodic visual examinations of component supports, evaluation, and corrective actions. The scope of the program includes ASME Class 1, 2, 3, and MC piping and component supports and high-strength structural bolting. The supports are examined for signs of degradation such as loss of material, loss of mechanical function, and loss of pre-load. The program is implemented through corporate and station procedures, which provide inspection and acceptance criteria consistent with the requirements of the ASME Code, Section XI, Subsection IWF as approved in 10 CFR 50.55a. This program is in accordance with ASME Section XI, Subsection IWF, 2001 Edition through the 2003 Addenda. The monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant degradation.

The ASME Section XI, Subsection IWF aging management program will be enhanced to:

1. Add the MC supports for the transfer tube in the refueling cavity in the Containment Structure and refueling canal in the Fuel Handling Building to the scope of the program.
2. Provide guidance for proper specification of bolting material, lubricant and sealants, and installation torque or tension to prevent or mitigate degradation and failure of structural bolting.
3. Provide procedural guidance, regarding the selection of supports to be inspected on subsequent inspections, when a support is repaired in accordance with the corrective action program. The enhanced guidance will ensure that the supports inspected on subsequent inspections are representative of the general population.

These enhancements will be implemented prior to the period of extended operation.

A.2.1.32 10 CFR Part 50, Appendix J

The 10 CFR Part 50, Appendix J aging management program is an existing performance monitoring program that monitors leakage rates through the containment pressure boundary, including the containment liner, associated welds, penetrations, fittings, and other access openings, in order to detect degradation of the containment pressure boundary. Corrective actions are taken if leakage rates exceed acceptance criteria. The Primary Containment Leakage Rate Testing Program (LRT) provides for aging management of pressure boundary degradation for electrical penetration assemblies, mechanical penetrations, penetration bellows and sleeves, the containment liner, bolting, personnel airlock, equipment hatch, and seals, gaskets, and moisture barriers, due to aging effects from the loss of material, loss of sealing, loss of leaktightness, loss of preload, or cracking in systems penetrating containment. Consistent with the current licensing basis, the containment leak rate tests are performed in accordance with the regulations and guidance provided in 10 CFR Part 50, Appendix J, Option B; Regulatory Guide 1.163, "Performance-Based Containment Leak-Test Program"; NEI 94-01, "Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J,"; and ANSI/ANS 56.8, "Containment System Leakage Testing Requirements."

A.2.1.33 Masonry Walls

The Masonry Walls program is an existing program implemented as part of the Structures Monitoring (A.2.1.34) program. Masonry wall condition monitoring is based on guidance provided in IE Bulletin 80-11, "Masonry Wall Design," and NRC Information Notice 87-67, "Lessons Learned from Regional Inspections of Licensee Actions in Response to IE Bulletin 80-11," and is implemented through station procedures.

The Masonry Walls aging management program addresses loss of material, and cracking due to age-related degradation of masonry walls and will inspect for shrinkage or separation, along with gaps between the supports and masonry walls. The program relies on periodic visual inspections, conducted at a frequency not to exceed five years, to monitor and maintain the condition of masonry walls within the scope of license renewal. Masonry walls that are considered fire barriers are also managed by the Fire Protection (A.2.1.15) program.

The Masonry Walls aging management program will be enhanced to:

1. Add masonry walls in the following structures to the program scope:
    a. Radwaste and Service Building Complex
        i. Radwaste Building
        ii. Original Service Building
    b. Turbine Building Complex
    c. Switchyard Structures
        i. Relay House
2. Provide additional guidance for inspection of masonry walls for shrinkage, separation, and for gaps between the supports and the masonry walls that could impact the intended function of the masonry walls.
3. Require that personnel performing inspections and evaluations meet

the qualifications described in ACI 349.3R.

These enhancements will be implemented prior to the period of extended operation.

A.2.1.34 Structures Monitoring

The Structures Monitoring program is an existing program that was developed to implement the requirements of 10 CFR 50.65 and is based on NUMARC 93-01, Rev. 2 “Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,” and Regulatory Guide 1.160, Rev. 2 “Monitoring the Effectiveness of Maintenance at Nuclear Power Plants.” The program includes elements of the Masonry Walls (A.2.1.33) program. The program relies on periodic visual inspections and monitoring of the condition of structures and structural components, structural bolting, component supports, and masonry block walls to ensure that aging degradation leading to loss of intended functions will be detected and that the extent of degradation can be determined. The inspections are conducted on a frequency not to exceed five (5) years.

The Structures Monitoring aging management program will be enhanced to:

1. Add the following structures;
   a. Radwaste and Service Building Complex
      i. Radwaste Building
      ii. Original Service Building
   b. Turbine Building Complex
   c. Yard Structures
      i. Transformer foundations
      ii. Valve and line enclosures
   d. Fire protection structures-features
      i. Transformer fire barrier walls
      ii. Fuel oil storage tank berm
2. Add the following components and commodities;
   a. Blowout panels
   b. Building features – doors and seals, bird screens, louvers, windows
   c. Compressible joints and seals, gaskets and moisture barriers
   d. Concrete curbs
   e. Electrical cable trays, conduits and tube tracks

   f. Hatches and plugs
   g. Insulation including jacketing
   h. Manholes, handholes and duct banks
   i. Metal components, including metal decking for concrete slabs, miscellaneous steel, sump screens and trench covers, and scuppers around the spent fuel pool
   j. New fuel storage racks
   k. Offgas stack and flue
   l. Panels, racks, cabinets, and other enclosures
   m. Penetration seals and sleeves
   n. Pipe whip restraints, jet impingement shields, and spray shields
   o. Pipe, electrical and equipment component support members
   p. Sliding surfaces
   q. Spent fuel pool gates
   r. Sumps and liners

3. Monitor groundwater chemistry on a frequency not to exceed five (5) years for pH, chlorides, and sulfates and evaluate results exceeding the threshold criteria to assess impact, if any, on below grade concrete.

4. Based on groundwater chemistry monitoring results, select and inspect every five (5) years a structure that will be used as a leading indicator for the condition of below grade concrete exposed to groundwater.

5. Require (a) evaluation of the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas and (b) examination of representative samples of the exposed portions of the below grade concrete, when excavated for any reason.

6. Provide guidance for proper specification of high strength bolting material and lubricant to prevent or mitigate degradation and failure of structural bolting.

7. Revise storage requirements for high strength bolts to include recommendations of Research Council on Structural Connections (RSCS) Specification for Structural Joints Using High Strength Bolts, Section 2.0.

8. Clarify that loose bolts and nuts, and cracked high strength bolts are not acceptable unless accepted by engineering evaluations.
9. Include the potential for reduction in concrete anchor capacity due to local concrete degradation.
10. Require that personnel performing inspections and evaluations meet the qualifications specified within ACI 349.3R with respect to knowledge of in-service inspection of concrete and visual acuity requirements.
11. Require acceptance and evaluation of structural concrete using quantitative criteria based on Chapter 5 of ACI 349.3R.
12. Perform inspection of elastomeric components such as vibration isolation elements and structural seals for cracking, loss of material and hardening. Visual inspections of elastomeric components are to be supplemented by feel or manipulation to detect hardening.
13. Monitor accessible sliding surfaces to detect loss of mechanical function or significant loss of material due to wear, corrosion, debris, dirt, distortion, or overload that could restrict or prevent sliding of surfaces as required by design.
14. Formalize requirements for the monitoring of the leak detection sight glasses associated with the refuel cavity, transfer canal, spent fuel pool, and refueling water storage tank on a periodic basis.
15. Require visual inspections of submerged concrete structural elements by dewatering a structure or by a diver if the structure is not dewatered at least once every five (5) years (Byron only).

These enhancements will be implemented prior to the period of extended operation.

A.2.1.35 RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants

The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, aging management program is an existing condition monitoring program that consists of inspection and surveillance programs to provide management of aging effects for slopes, cooling pond, intake structure, and other water control structures associated with emergency cooling water systems or flood protection based on RG 1.127, Rev. 1. There are no dams or canals within the scope of the program. The program monitors the condition of the River Screen House and Essential Service Water Cooling Towers at Byron, and the Essential Service Cooling Pond and Lake Screen Structures at Braidwood. In addition to reinforced concrete and earthen structures, the program also includes structural steel, structural bolting, miscellaneous steel components (trash rack bars) associated with the water control structures, and cooling tower fill and drift eliminators associated with the Essential Service Water Cooling Towers. The RG 1.127, Inspection of Water-Control Structures

Associated with Nuclear Power Plants, aging management program addresses age-related deterioration, degradation due to extreme environmental conditions, and the effects of natural phenomena that may affect the intended function of the water-control structures. The program is used to manage conditions such as, loss of material, cracking, loss of bond, increase in porosity and permeability, change in material properties, reduction in heat transfer, loss of strength, or loss of form. The inspection of the water-control structures are performed at intervals no more than five (5) years. Elements of the program are designed to detect degradation and take corrective actions to prevent the loss of an intended function.

The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, Program will be enhanced to:

1. Provide guidance for specification of structural bolting material, and bolting lubricants to prevent or mitigate degradation and failure of structural bolting.
2. Revise storage requirements for structural bolting to include recommendations of Research Council on Structural Connections (RSCS) Specification for Structural Joints Using High Strength Bolts, Section 2.0.
3. Include the potential for reduction in concrete anchor capacity due to local concrete degradation.
4. Include all aging affects addressed by ACI 349.3R in procedures and require acceptance and evaluation of structural concrete using quantitative criteria based on Chapter 5 of ACI 349.3R.
5. Clarify that loose bolts and nuts, and cracked bolts are not acceptable unless accepted by engineering evaluations.
6. Require that steel components subject to RG 1.127 are inspected for loss of material.
7. Require that inspectors work under the direction of a qualified engineer for submerged concrete inspections.
8. Require special inspections also be performed in the event of large floods, hurricanes, and intense local rainfalls.
9. Require increased inspection frequency if the extent of the degradation is such that the structure or component may not meet its design basis if allowed to continue uncorrected until the next normally scheduled inspection.
10. Require (a) evaluation of the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas and (b) examination of representative samples of the exposed portions of the below grade concrete, when excavated for any reason.

11. Monitor raw water and groundwater chemistry at least once every five (5) years for pH, chlorides, and sulfates and verify that it remains non-aggressive, or evaluate results exceeding criteria to assess impact, if any, on submerged concrete.

12. Based on groundwater chemistry monitoring results, select and inspect every five (5) years a structure that will be used as a leading indicator for the condition of below grade concrete exposed to groundwater.

13. Require visual inspections of submerged concrete structural components by dewatering a structure or by a diver if the structure is not dewatered at least once every five (5) years. Maintenance procedures will be enhanced to require opportunistic inspection of submerged concrete structures when they are dewatered and made accessible.

14. Require that degraded conditions be documented and trended until the condition is no longer occurring or until a corrective action is implemented.

15. Clarify parameters to be monitored and inspected at the Essential Service Water Cooling Towers to include visual inspection for loss of material and reduction of heat transfer for the cooling tower fill, and visual inspection with physical manipulation for change in material properties associated with the PVC drift eliminators and fiberglass support beams for the drift eliminators (Byron only).

16. Manage the condition of the Byron Essential Service Water Cooling Towers (SXCTs) as follows:

    a. Monitor and trend inspection activities at the SXCTs on an increased frequency, with inspections of the entire tower on a three (3) year interval, and inspections of the fill support beams and air-inlet framing on a 1.5-year interval. The recommendations in Chapter 5 of ACI 349.3R will be used for quantitative acceptance and evaluation criteria.

    b. Develop a repair plan to address degradation of the SXCTs with specific emphasis and consideration for the fill support beams. Repairs that are required will be scheduled based on a ranking of the condition observed and the potential for the degradation to progress or propagate.

The Byron Essential Service Water Cooling Tower inspection and maintenance plan will be initiated upon receipt of the renewed licenses, and will continue through the period of extended operation to ensure the condition of the SXCT is maintained. The remainder of the enhancements will be implemented prior to the period of extended operation.

A.2.1.36 Protective Coating Monitoring and Maintenance Program

The Protective Coating Monitoring and Maintenance Program is an existing condition monitoring program that provides for aging management of Service Level I coatings inside BBS containments including selection, application, inspection, and maintenance. The program is comparable to RG 1.54, Revision 2. The failure of the Service Level I coatings could adversely affect the operation of the Emergency Core Cooling Systems (ECCS) by clogging the ECCS suction strainers. Proper maintenance of the Service Level I coating ensures that coating degradation will not impact the operability of the ECCS systems. The program includes a visual examination of all reasonably accessible Service Level 1 coatings inside containment during every refueling outage and includes assessment and repair for any condition that adversely affects the intended function of Service Level I coatings.

Service Level I coatings will prevent or minimize the loss of material due to corrosion but these coatings are not credited for managing the effects of corrosion for the carbon steel containment liners and components at BBS. This program ensures that the Service Level I coatings maintain adhesion so as to not affect the intended function of the ECCS suction strainers.

The program also provides controls over the amount of unqualified coating which is defined as coating inside the containment that has not passed the required laboratory testing, including irradiation and simulated Design Basis Accident (DBA) conditions. Unqualified coating may fail in a way to affect the intended function of the Emergency Core Cooling Systems (ECCS) suction strainers. Therefore, the quantity of unqualified coating is controlled to ensure that the amount of unqualified coating in the containment is kept within acceptable design limits.

The Protective Coating Monitoring and Maintenance Program aging management program will be enhanced to:

1. Add recurring work orders requiring Service Level I coating inspections every refuel outage.
2. Require qualification of coating inspectors to ASTM D 5498.
3. Require qualification of personnel in accordance with ASTM D 7108.
4. Incorporate guidance for inspection and maintenance of Service Level I coatings per Regulatory Guide 1.54 and impose ASTM D 5163-08 requirements for Service Level I coatings condition assessment, reporting, evaluation, and documentation.
5. Require thorough visual inspections of all coatings near sumps or screens associated with the Emergency Core Cooling System (ECCS) by the coatings inspector(s).
6. Specify instruments and equipment that may be needed for Service Level I coatings inspections.

These enhancements will be implemented prior to the period of extended operation.

A.2.1.37 Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

The Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program is a new program that will be used to manage aging of the insulation material for non-EQ cables and connections during the period of extended operation. Accessible cables and connections located in adverse localized environments will be visually inspected at least once every 10 years for cable jacket and connection insulation surface anomalies such as embrittlement, discoloration, cracking, melting, swelling, or surface contamination, that could indicate incipient conductor insulation aging degradation from temperature, radiation, or moisture. An adverse localized environment is a condition in a limited plant area that is significantly more severe than the specified service environment for the cable or connection.

This new program will be implemented prior to the period of extended operation. In addition, the first inspections will be completed prior to the period of extended operation.

A.2.1.38 Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits

The Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits aging management program reviews calibration results or findings of surveillance tests on electrical cables and connections used in circuits with sensitive, high-voltage, low-level current signals. The program is applied to the in-scope portions of the radiation monitoring system (Byron and Braidwood) and the neutron monitoring inputs to the reactor protection system (Braidwood only) to provide an indication of the existence of aging effects based on acceptance criteria related to instrumentation circuit performance. By reviewing the results obtained during normal calibration or surveillance, severe aging degradation may be detected prior to the loss of the cable and connection intended function. The review of calibration results or findings of surveillance tests is performed at least once every 10 years. A proven cable test is performed in cases where cables are not included as part of the calibration or surveillance program testing circuit. The test frequency is based on engineering evaluation and is at least once every 10 years.

This new program will be implemented prior to the period of extended operation. In addition, the first review of the calibration results or findings of surveillance test results or cable tests for license renewal will be completed prior to the period of extended operation.

A.2.1.39 Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

The Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program calls for inaccessible or underground (e.g. in conduit, duct bank, or direct buried) power (greater than or equal to 400 volts) cables exposed to significant moisture to be tested at least once every six (6) years to provide an indication of the condition of the conductor insulation. Significant moisture is defined as periodic exposure to moisture that lasts more than a few days (e.g., cable wetting or submergence in water). Periodic exposures that last less than a few days (e.g., normal rain and drain) are not significant. More frequent testing may occur based on test results and operating experience. The first tests will be completed prior to the period of extended operation. The specific type of test to be used should be capable of detecting reduced insulation resistance of the cable’s insulation system due to wetting or submergence. The condition of the cable insulation can be assessed with reasonable confidence using one or more of the following techniques: Dielectric Loss (Dissipation Factor/Power Factor), AC Voltage Withstand, Partial Discharge, Step Voltage, Time Domain Reflectometry, Insulation Resistance and Polarization Index, Line Resonance Analysis, or other testing that is state-of-the-art at the time the tests are performed. One (1) or more tests may be used to determine the condition of the cables so they will continue to meet their intended function during the period of extended operation.

The inspection frequency for water collection is established based on plant-specific operating experience with cable wetting or submergence in manholes (i.e., the inspection is performed periodically based on water accumulation over time and event driven occurrences such as heavy rain or flooding). The periodic inspection occurs at least annually. The inspection includes direct observation that cables are not wetted or submerged, that cables/splices and cable support structures are intact, and, if installed, dewatering/drainage systems (i.e., sump pumps) and associated alarms operate properly. In addition, dewatering devices, if installed, are inspected and operation verified prior to any known or predicted heavy rain or flooding events.

This new program will be implemented prior to the period of extended operation. In addition, the first cable tests and first manhole inspections for license renewal will be completed prior to the period of extended operation.

A.2.1.40 Metal Enclosed Bus

The Metal Enclosed Bus aging management program is an existing program that calls for the visual inspection of metal enclosed bus (MEB) internal surfaces to detect age-related degradation, including cracks, corrosion, foreign debris, excessive dust buildup, and evidence of moisture intrusion. MEB insulating material is visually inspected for signs of embrittlement, cracking, chipping, melting, swelling, discoloration, or surface contamination, which may indicate overheating or aging degradation. The internal bus insulating supports are visually inspected for structural integrity and signs of cracks. MEB external surfaces are visually inspected for loss of material due to general, pitting, and crevice corrosion. Accessible elastomers (e.g., gaskets, boots, and sealants) are inspected for degradation, including surface cracking, crazing, scuffing, and changes in dimensions (e.g., "ballooning" and "necking"), shrinkage, discoloration, hardening and loss of strength. A sample of accessible bolted connections is inspected for increased resistance of connection by measuring connection resistance using a micro-ohmmeter. These inspections are performed at least once every 10 years.

The Metal-Enclosed Bus aging management program will be enhanced to:

1. Specify that a sample size of 20 percent of the accessible bolted connection population with a maximum sample size of 25 to be inspected for increased resistance of connection by measuring the connection resistance using a micro-ohmmeter.
2. Specify that the external surfaces of metal enclosed bus enclosure assemblies are to be inspected for loss of material due to general, pitting, and crevice corrosion.
3. Specify maximum allowed bus connection resistance values.

These enhancements will be implemented prior to the period of extended operation.

A.2.1.41 Fuse Holders (Byron Only)

The Fuse Holders (Byron Only) aging management program is a new program that consists of fuse holders within the scope of license renewal located outside of active devices that are susceptible to increased resistance of connection due to chemical contamination, corrosion, and oxidation or fatigue caused by ohmic heating, thermal cycling, electrical transients, frequent manipulation, or vibration. These fuse holders are tested by a proven test methodology at least once every 10 years to provide an indication of the condition of the metallic clamp portion of the fuse holders. Testing may include thermography, contact resistance testing, or other appropriate testing methods.

This new program will be implemented at Byron prior to the period of extended operation. In addition, the first tests for license renewal will be completed prior to the period of extended operation.

No fuse holders at Braidwood are required to be managed by this aging management program because there are no in-scope fuse holders located outside of active devices that are susceptible to aging effects at Braidwood.

A.2.1.42 Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

The Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program is a new program. The program consists of a representative sample of electrical connections within the scope of license renewal, which is tested at least once prior to the period of extended operation to confirm that there are no aging effects requiring management during that period. Testing may include thermography, contact resistance testing, or other appropriate testing methods without removing the connection insulation, such as heat shrink tape, sleeving, insulating boots, etc. The one-time test provides additional confirmation to support industry operating experience that shows that electrical connections have not experienced a high degree of failures and that existing installation and maintenance practices are effective.

This new aging management program and one-time tests will be implemented prior to the period of extended operation.

A.2.2 Plant-Specific Aging Management Programs

None. The Byron and Braidwood Stations, Units 1 and 2 License Renewal Application does not include plant-specific aging management programs.

A.3 NUREG-1801 Chapter X Aging Management Programs

A.3.1 Evaluation of Chapter X Aging Management Programs

Aging Management Programs evaluated in Chapter X of NUREG-1801 are associated with Time-Limited Aging Analysis for metal fatigue of the reactor coolant pressure boundary, concrete containment tendon prestress, and environmental qualification (EQ) of electric components. These programs are evaluated in this section.

A.3.1.1 Fatigue Monitoring

The Fatigue Monitoring aging management program is an existing preventive program that manages cumulative fatigue damage of the reactor pressure vessel (RPV) components, reactor coolant pressure boundary piping components, and other components. The Fatigue Monitoring aging management program manages fatigue of piping, piping elements, piping components, bolting, reactor vessels, reactor vessel internals, supports, and heat exchangers.

The Fatigue Monitoring aging management program monitors and tracks critical thermal and pressure transients to ensure each analyzed component does not exceed the number of allowable cycles, thus ensuring that the cumulative usage factor (CUF) for each analyzed component does not exceed the design limit of 1.0 through the period of extended operation. The number of allowable cycles is based on the design fatigue analyses transient inputs. The program requires comparison of the actual operational transient parameters to the applicable design transient definitions to assure the actual operational transients are bounded. If an allowable cycle limit is approached or the severity of an actual operational transient is not bounded by the applicable design transient definition, then this condition is entered into and addressed within the corrective action program to ensure that the design CUF limit is not exceeded.

The Fatigue Monitoring aging management program will be enhanced to:

1. Address the cumulative fatigue damage effects of the reactor coolant environment on component life by evaluating the impact of the reactor

coolant environment on critical components for the plant identified in NUREG/CR-6260. Additional plant-specific component locations in the reactor coolant pressure boundary will be evaluated if they are more limiting than those considered in NUREG/CR-6260.

2. Monitor and track additional plant transients that are significant contributors to component fatigue usage.
3. Evaluate the effects of the reactor coolant system water environment on the reactor vessel internal components with existing fatigue CUF analyses to satisfy the evaluation requirements of ASME Code, Section III, Subsection NG-2160 and NG-3121.

These enhancements will be implemented prior to the period of extended operation.

A.3.1.2 Concrete Containment Tendon Prestress

The Concrete Containment Tendon Prestress aging management program is an existing program that is part of Byron and Braidwood Station's Containment inservice inspection program that is based on ASME Section XI, Subsection IWL criteria, as supplemented by the requirements of 10 CFR 50.55a(b)(2)(viii). The program monitors and manages the loss of tendon prestress in the concrete containment prestressing system for the period of extended operation. The Concrete Containment Tendon Prestress aging management program requires periodic inspection of a sample of tendons during each inspection interval to confirm that individual and group tendon values meet ASME Section XI, Subsection IWL, acceptance criteria. Trending of individual measured tendon prestressing values for each tendon group is accomplished through a regression analysis, consistent with NRC Information Notice (IN) 99-10 guidelines. In accordance with the requirements of ASME Section XI, Subsection IWL, an evaluation will be performed if the tendon prestressing force trend lines predict the prestressing forces in the containment will fall below the minimum required value (MRV) prior to the next scheduled surveillance.

The Concrete Containment Tendon Prestress aging management program will be enhanced to:

1. For each surveillance interval, the predicted lower-limit, minimum required value, and trending lines will be developed for the period of extended operation as part of the regression analysis for each tendon group.

This enhancement will be implemented prior to the period of extended operation.

A.3.1.3 Environmental Qualification (EQ) of Electric Components

The Environmental Qualification (EQ) of Electric Components is an existing program that manages the aging of electrical equipment within the scope of 10 CFR 50.49, "Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants." The program establishes, demonstrates, and documents the level of qualification, qualified configurations, maintenance, surveillance, and replacements necessary to meet 10 CFR 50.49. A qualified life is determined for equipment within the scope of the program and appropriate actions such as replacement or refurbishment are taken prior to or at the end of the qualified life of the equipment so that the aging limit is not exceeded. The various aging effects addressed by this program are adequately managed so that the intended functions of components within the scope of 10 CFR 50.49 are maintained consistent with the current licensing basis during the period of extended operation.

A.4.0 Time-Limited Aging Analyses

As part of the application for a renewed license, 10 CFR 54.21(c) requires that an evaluation of Time-Limited Aging Analyses (TLAAs) for the period of extended operation be provided. The following TLAAs, as defined in 10 CFR 54.3, have been identified and evaluated to meet this requirement.

A.4.1 Identification of Time-Limited Aging Analyses

10 CFR 54.21(c)(2) requires that the application for a renewed license include a list of plant-specific exemptions granted pursuant to 10 CFR 50.12 and in effect that are based upon TLAAs as defined in 10 CFR 54.3. It also requires an evaluation that justifies the continuation of these exemptions for the period of extended operation. Six exemptions were identified that are based upon a TLAA. All six were associated with the development of the Pressure-Temperature (P-T) limits that are applicable for 32 EFPY. It is anticipated that these exemptions will not be required to be in effect during PEO since Byron, Units 1 and 2 and Braidwood, Units 1 and 2 are expected to exceed 32 EFPY prior to the period of extended operation (PEO) necessitating replacement of the P-T limit curves in accordance with 10 CFR 50, Appendix G. Continuation of these exemptions into the PEO, if necessary, is acceptable because the use of the exemptions as a basis for the 32 EFPY P-T limits was approved by the NRC without a limitation with respect to plant operation beyond the original license term. The exemptions and their acceptability are not tied to or limited by the original license term.

The following TLAAs have been identified and evaluated to meet 10 CFR 54.21(c) requirements.

A.4.2 Reactor Vessel Neutron Embrittlement Analysis

10 CFR 50.60 requires that all light-water reactors meet the fracture toughness, P-T limits, and material surveillance program requirements for the reactor coolant pressure boundary as set forth in 10 CFR 50 Appendices G and H. The BBS Reactor Vessel Surveillance program is described in Section A.2.1.19.

The ferritic materials of the reactor vessel are subject to reduction in fracture toughness due to high-energy neutron exposure over time. Neutron embrittlement analyses are used to account for the reduction in fracture toughness associated with the cumulative neutron fluence during the life of the plant. The reactor vessel embrittlement calculations for BBS that evaluated reactor vessel beltline materials for loss of fracture toughness for 40 years are based upon a predicted fluence of 32 EFPY. These analyses were identified as TLAAs as defined in 10 CFR 54.21(c) and they were evaluated for the increased neutron fluence associated with 60 years of operation as described in the subsections below.

A.4.2.1 Neutron Fluence Projections

The fluence projections used as inputs to the original 40-year neutron embrittlement analyses were developed using the discrete ordinates transport fluence methodology. At the time the original projections were prepared, 32 EFPY was considered to represent the amount of power to be generated over 40 years of plant operation.

Updated fluence projections were developed for 60 years of plant operation, based upon 57 Effective Full Power Years (EFPY) for use as inputs to updated neutron embrittlement analyses for the PEO. They were also used to determine if any additional materials will be exposed to fluence greater than 1.0 x 10^{17} n/cm^2 (E > 1.0 MeV) through the PEO, which would be in the extended beltline. The 57 EFPY fluence projections were developed using methodologies that follow the guidance of Regulatory Guide 1.190. The 57 EFPY fluence projections have been determined for reactor vessel beltline and extended beltline materials, which include all reactor vessel forgings and welds that are predicted to be exposed to 1.0 x 10^{17} neutrons/cm2 (n/cm2) or more during 60 years of operation. Therefore, these TLAAs are dispositioned in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.2.2 Upper Shelf Energy

Appendix G of 10 CFR 50, Paragraph IV.A.1.a, states that reactor vessel beltline materials must have Charpy upper-shelf energy of no less than 75 ft-lb initially and must maintain Charpy upper-shelf energy (USE) throughout the life of the vessel of no less than 50 ft-lb, unless it is demonstrated in a manner approved by the Director, Office of Nuclear Reactor Regulation, that lower values of Charpy upper-shelf energy will provide margins of safety against fracture equivalent to those required by Appendix G of Section XI of the ASME Code.

Per Regulatory Guide 1.99, Revision 2, the Charpy USE should be assumed to decrease as a function of fluence according to Figure 2 of the Regulatory Guide when credible surveillance data is not available. If credible surveillance data is available, the decrease in USE may be obtained by plotting the reduced plant surveillance data on Figure 2 of the Regulatory Guide and fitting the data with a line drawn parallel to the existing lines as the upper bound of all of the data.

The USE values for the BBS beltline and extended beltline materials are projected to remain above 50 ft-lb at 57 EFPY of neutron exposure through the period of extended operation. The projections demonstrated that the requirements of 10 CFR 50 Appendix G will continue to be met through the period of extended operation. Therefore, these TLAAs are dispositioned in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.2.3 Pressurized Thermal Shock

10 CFR 50.61(b)(1) provides rules for protection against pressurized thermal shock (PTS) events for pressurized water reactors. Licensees are required to perform an updated assessment of the projected values of the PTS reference temperature (RT_{PTS}) whenever there is a significant change in projected values of RT_{PTS} or upon a request for a change in the expiration date for operation of the facility. The current analyses, evaluated for 32 EFPY fluence values predicted for 40 years of operation, were identified as TLAAs requiring evaluation for 60 years.

Each BBS Units 1 and 2 reactor vessel material that has a surface fluence value that exceeds 1.0 x 10^{17} n/cm^2 (E > 1.0 MeV) at 57 EFPY has been demonstrated to have an RT_{PTS} value less than the applicable screening criterion, which is 270 degrees F for plates, forgings, and axially-oriented welds (longitudinal welds), and 300 degrees F for circumferentially-oriented welds. The RT_{PTS} analyses have been satisfactorily projected for 60 years of operation. Therefore, these TLAAs are dispositioned in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.2.4 Adjusted Reference Temperature

The adjusted reference temperature (ART) of the limiting beltline material is used to adjust the beltline P-T limit curves to account for irradiation effects. Regulatory Guide 1.99, Revision 2, provides the methodology for determining the ART of the limiting material. The initial nil-ductility reference temperature, RT_{NDT}, is the temperature at which a non-irradiated metal (ferritic steel) changes in fracture characteristics from ductile to brittle behavior. RT_{NDT} is evaluated according to the procedures in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, Paragraph NB-2331. Neutron embrittlement increases the RT_{NDT} beyond its initial value.

10 CFR 50, Appendix G, defines the fracture toughness requirements for the life of the vessel. The shift in the initial RT_{NDT} (ΔRT_{NDT}) is evaluated as the difference in the 30 ft-lb index temperatures from the average Charpy curves measured before and after irradiation. This increase (ΔRT_{NDT}) means that higher temperatures are required for the material to continue to act in a ductile manner. The ART is defined as: Initial RT_{NDT} + (ΔRT_{NDT}) + Margin. Since the ΔRT_{NDT} value is a function of 32 EFPY fluence, associated with the 40-year licensed operating period, these ART calculations meet the criteria of 10 CFR 54.3(a) and have been identified as TLAAs requiring evaluation for 60 years.

57 EFPY 1/4T fluence values were used to compute ART values for BBS beltline and extended beltline materials in accordance with Regulatory Guide 1.99, Revision 2 requirements. The projections demonstrate that the ART values in the limiting material for each unit will remain below the NRC Regulatory Guide 1.99, Revision 2, Section 3 acceptance criteria of 200 degrees F through the period of extended operation. Therefore, these TLAAs are dispositioned in accordance with 10 CFR 54.21(c)(1)(ii).

A.4.2.5 Pressure–Temperature Limits

Appendix G of 10 CFR 50 requires that the reactor vessel be maintained within established pressure–temperature (P-T) limits. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the reactor vessel is exposed to increased neutron irradiation, its fracture toughness is reduced. The P-T limits must account for the anticipated reactor vessel fluence.

The current P-T limits are based upon 32 EFPY fluence projections that were considered to represent the amount of power to be generated over 40 years of plant operation, assuming a 40-year average capacity factor of 80 percent. The current P-T limits are located in the unit-specific pressure-temperature limit reports (PTLRs). Since they were originally based upon a 40-year assumption regarding capacity factor, the P-T limits satisfy the criteria of 10 CFR 54.3(a) and have been identified as TLAAs.

In accordance with NUREG-1800, Revision 2, Section 4.2.2.1.3, P-T Limits for the period of extended operation need not be submitted as part of the LRA since P-T limits need to be updated through the Administrative Section of the Technical Specifications and the plant's PTLR process. The Reactor Vessel Surveillance Program will assure that updated P-T limits based on updated ART values will be submitted to the NRC and approved prior to exceeding the current terms of applicability. The analysis for the P-T curves will consider locations outside of the beltline such as nozzles, penetrations and other discontinuities to determine if more restrictive P-T limits are required than would be determined by considering only the reactor vessel beltline materials. The P-T limit curves will be maintained during the period of extended operation using the Administration Section of Technical Specifications to amend the P-T limits through the PTLR process. These TLAAs are dispositioned in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.2.6 Low Temperature Overpressure Protection (LTOP) Analyses

Low temperature overpressure protection (LTOP) system at Byron and Braidwood is required by Technical Specification Limited Condition for Operation 3.4.12. Two pressurizer power-operated relief valves (PORV) are used to provide the automatic relief capability during the design basis mass input (MI) and the design basis heat input (HI) transients to automatically prevent the reactor coolant system pressure from exceeding the pressure-temperature limit curves based on 10 CFR 50, Appendix G. The residual heat removal (RHR) suction relief valves may also be used to provide low-temperature overpressure protection (two RHR suction relief valves or one PORV and one RHR suction relief valve). The design basis MI and HI transients are defined in the Updated Final Safety Analysis Report and Technical Specifications Bases.

Since LTOP system setpoints are based on the P-T limits calculation, which is a TLAA, the calculation of the LTOP setpoints and the supporting safety analyses have been identified as TLAAs.

The LTOP system setpoints are established in the PTLRs and managed consistent with the P-T limits, which will be managed through the period of extended operation as described in Section A.4.2.5, Pressure-Temperature (P-T) Limits. The Reactor Surveillance Program will ensure that updated P-T limits based upon updated ART values will be submitted to the NRC and approved prior to exceeding the current terms of applicability. Therefore, the LTOP system setpoints will be managed through the period of extended operation. These TLAAs are dispositioned in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.3 Metal Fatigue

Metal fatigue was considered explicitly in the design process for pressure boundary components designed in accordance with ASME Section III, Class 1 requirements. Metal fatigue was evaluated implicitly for components designed in accordance with ASME Section III, Class 2 and 3, and ANSI B31.1 requirements. In addition, certain other codes such as ASME Section VIII Division 2, may require a fatigue analysis or assume a stated number of full-range thermal and displacement cycles. Each of these fatigue analyses and evaluations are considered to be Time-Limited Aging Analyses (TLAAs) requiring evaluation for the period of extended operation in accordance with 10 CFR 54.21(c) and are listed below.

A.4.3.1 Transient Inputs to Fatigue Analyses

ASME Section III, Class 1 fatigue analyses are based upon explicit numbers and amplitudes of thermal and pressure transients described in the design specifications. The intent of the design basis transient definitions is to bound a wide range of possible events with varying ranges of severity in temperature, pressure, and flow.

Each BBS component designed in accordance with ASME Section III, Class 1 requiring a fatigue analysis was analyzed and shown to have a CUF less than the allowable design limit of 1.0. Some components were exempted from a fatigue analysis based on the code exemption criteria. Since the fatigue analyses and exemptions from fatigue analysis are based upon a number of cycles postulated to bound 40 years of service, projection of the transients cycles through the period of extended operation is required as an input to demonstrate that the analyses and exemptions remain valid.

Some ASME Section III, Class 2 heat exchangers were analyzed and shown to have a CUF less than the allowable design limit of 1.0. Since the fatigue analyses are based upon a number of cycles postulated to bound 40 years of service, projection of the transients cycles through the period of extended operation is required as an input to demonstrate that the analyses remain valid.

Byron Station, Units 1 and 2, have approximately 33 and 35 years of operation remaining for a 60-year life, and Braidwood Station, Units 1 and 2, have approximately 36 and 37 years of operation for a 60-year life as of the year 2012. Using remaining years of operation, baseline cycle counts, and projection rates, the 60-year projected cycles for each of the transients were determined.

The transients have been projected to the end of the period of extended operation in accordance with 10 CFR 54.21 (c)(1)(ii). The overall conclusion of these evaluations is the existing design transients bound transients projected for 60 years of plant operation. The following fatigue TLAAs have been dispositioned using either the design transients or the projected transients for the period of extended operation.

A.4.3.2 ASME Section III, Class 1, Class 2, and Class 3 Fatigue Analyses

The BBS reactor pressure vessels (RPVs) and reactor coolant pressure boundary (RCPB) piping and components were designed in accordance with the ASME Code Section III, Class 1 requirements. Fatigue analyses were prepared for these components to determine the effects of cyclic loadings resulting from changes in system temperature, pressure, and seismic loading cycles. These ASME Section III, Class 1 fatigue analyses are based upon explicit number and amplitudes of thermal and pressure transients projected during the 40-year design life of the plant. The fatigue analyses were required to demonstrate that the Cumulative Usage Factor (CUF) will not exceed the design limit of 1.0 when the equipment is exposed to all of the postulated transients.

The calculation of fatigue usage factors is part of the current licensing basis and are used to support safety determinations and since the number of occurrences of each transient type was based upon 40-year assumptions, these Class 1 fatigue analyses have been identified as time-limited aging analyses.

Some ASME Section III, Class 2 heat exchangers have fatigue analyses. The fatigue analyses were performed in a manner similar to that used for Class 1 components. The fatigue analyses were required to demonstrate that the cumulative usage factor (CUF) will not exceed the design allowable limit of 1.0 when the equipment is exposed to all of the postulated transients. Since the calculation of fatigue usage factors is part of the current licensing basis and the number of occurrences of each transient type was based upon 40-year assumptions, the fatigue analyses performed for Class 2 heat exchangers have been identified as TLAAs requiring evaluation for the period of extended operation.

The 40-year design transient cycle numbers and severity remain bounding for 60 years of plant operation. Therefore, the fatigue analyses for BBS Class 1 vessels, piping, and components and BBS Class 2 heat exchangers remain valid for the period of extended operation.

The design analysis of some BBS ASME Section III, Class 1 components also used the fatigue exemption provisions of ASME Section III, Subparagraph NB-3222.4 (d) (1) through (6). The exemption determination is also based on the 40-year design transients described in the design specifications. A review of the provisions of ASME Section III, Subparagraph NB-3222.4(d) (1) through (6) shows that the allowance for an exemption is based upon the number of occurrences of design transient events and the severity of the occurrences. Since these fatigue exemptions are based upon the 40-year design transients, they have also been identified as TLAAs that require evaluation for the period of extended operation.

Some ASME Section III, Class 2 and 3 components at BBS were designed to ASME Section III, Paragraph NC-3219 requirements and were shown to meet the criteria for a fatigue exemption per ASME Section III, Subparagraphs NC-3219.2 and NC-3219.3. The approach taken for the fatigue exemption is similar to that taken in ASME Section III, Subparagraphs NB-3222.4(d) (1) through (6) for a fatigue exemption on Class 1 components and is based upon the number of occurrences of design transient events and the severity of the occurrences.

To ensure the transient cycles used in analysis remain bounding, the Fatigue Monitoring (A.3.1.1) program will be used to monitor transient cycles. This ensures the numbers of transients analyzed in the ASME Section III, Class 1 fatigue analyses, the ASME Section III, Class 2 heat exchangers fatigue analyses, and the ASME Section III, Class 1, Class 2, and Class 3 fatigue exemptions will not be exceeded through the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.3.3 ASME Section III, Class 2 and 3 and ANSI B31.1 Allowable Stress Analyses

Piping and components designed in accordance with ASME Section III, Class 2 and 3, and ANSI B31.1 design rules are not required to have an explicit analysis of cumulative fatigue usage, but cyclic loading is considered in a simplified manner in the design process. These codes first require prediction of the overall number of thermal and pressure cycles expected during the 40-year lifetime of these components. Then a stress range reduction factor is determined for that number of cycles using the applicable design code. If the total number of cycles is 7,000 or less, the stress range reduction factor of 1.0 is applied that would not reduce the allowable stress values. For high numbers of cycles, a stress range reduction factor of less than 1.0 is applied that limits the allowable stresses applied to the piping, which reduces the likelihood of failure due to cyclic loading. These are considered to be an implicit fatigue analysis since they are based upon cycles anticipated for the life of the component.

To demonstrate acceptability from a fatigue basis for 60 years of operation for ASME Section III, Class 2 and 3, and ANSI B31.1 components, the transients considered are based on the Class 1 transients in A.4.3.1. The 60-year cycle projections demonstrate that the total number of thermal and pressure cycles will not exceed 7,000 cycles during the period of extended operation.

Therefore, fatigue of ASME Section III, Class 2, 3 and ANSI B31.1 piping will remain valid through the period of extended operation.

The Fatigue Monitoring (A.3.1.1) program will be used to ensure that the numbers of cycles analyzed in the ASME Section III, Class 2 and 3, and ANSI B31.1 analyses will not be exceeded during the period of extended operation. The Fatigue Monitoring (A.3.1.1) program will monitor transient cycles and severities and require action prior to exceeding design limits that would invalidate these conclusions in accordance with 10 CFR 54.21(c)(1)(iii).

For the remaining systems that are affected by different thermal and pressure cycles, an operational review was performed that concluded that the total number of cycles projected for 60 years are significantly less 7,000 cycles. This includes the Auxiliary Feedwater, Emergency Diesel Generator, Fire Protection, Heating Water and Heating Steam System, and Service Water Systems. Therefore, since the projected number of transient cycles does not exceed the number of equivalent full temperature cycles assumed in the implicit stress analysis, the stress range reduction factors originally selected for the components in all of these systems remain applicable. Therefore, the TLAAs remain valid for the period of extended operation.

The ASME Section III, Class 2 and 3 and ANSI B31.1 allowable stress calculations for the Auxiliary Feedwater, Emergency Diesel Generator, Fire Protection, Heating Water and Heating Steam, and Service Water System remain valid for the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(i).

A.4.3.4 Class 1 Component Fatigue Analyses Supporting GSI-190 Closure

NUREG-1800, Revision 2, provides a recommendation for evaluating the effects of the reactor water environment on the fatigue life of ASME Section III Class 1 components that contact reactor coolant to support closure of GSI-190. One method acceptable to the NRC for satisfying this recommendation is to assess the impact of the reactor coolant environment on a sample of critical components. These critical components should include those selected in NUREG/CR-6260, ‘Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components.” The components that are applicable to Byron and Braidwood Units 1 and 2 are the ones listed for a newer vintage Westinghouse plant. BBS considered adding additional component locations if they are considered to be more limiting than those considered in NUREG/CR-6260.

The environmental fatigue analyses prepared for the BBS, Units 1 and 2 limiting components, equivalent to the locations evaluated in NUREG/CR-6260 for newer vintage Westinghouse plants, demonstrate that cumulative environmental fatigue usage values do not exceed the ASME allowable cumulative fatigue usage value of 1.0. Since the analyses are based on design cycles and 60-year cycle projections, monitoring of usage through the period of extended operation is required to ensure these conclusions remain valid. Where reduced numbers of cycles were used in the environmental fatigue analyses, they will be considered the new CLB cycle limits in the Fatigue

Monitoring Program during the period of extended operation. The reduced numbers of cycles are equal to or greater than the 60-year projected cycles.

A review of the screening CUF_{en} for the equipment and piping locations identifies the Pressurizer Spray Nozzle as the most limiting plant specific component location based on the value of the screening CUF_{en}. Consistent with the methods utilized for the NUREG/CR-6260 locations, the Pressurizer Spray Nozzle was successfully evaluated for EAF to show the CUF_{en} to be less than the allowable of 1.0. Additional locations, from the list of limiting locations determined to be potentially limiting, will be evaluated prior to the period of extended operation.

In accordance with 10 CFR 54.21(c)(1)(iii), the Fatigue Monitoring (A.3.1.1) program will be used to ensure that the numbers of cycles used for the environmental fatigue analyses will not be exceeded during the period of extended operation. Additional locations determined to be potentially limiting based on transient section differences will be evaluated. The Fatigue Monitoring (A.3.1.1) program will monitor transient cycles and severities and require action prior to exceeding environmental fatigue usage limits. The program will also ensure additional component locations which may be more limiting than the NUREG/CR-6260 component locations will be evaluated prior to the period of extended operation.

A.4.3.5 Reactor Vessel Internals Fatigue Analyses

BBS reactor vessel internals were designed and procured prior to the issuance of ASME Section III, Subsection NG. The intent of the code is applied with load combinations and allowable stresses, consistent with the requirements of ASME Section III, Subsection NG. The reactor vessel internals were designed to withstand stress originating from the same operating conditions as the reactor vessel. Using the reactor vessel internals stress reports, cumulative usage factors (CUF) less than one were determined for the maximum alternating stresses using the design transient cycles from each transient and the design ASME Code fatigue curve.

The analyses performed for the reactor vessel internals components are based on a subset of the RCS design transients used in the fatigue analyses for the reactor vessel. As stated in subsection A.4.3.1, the transient cycle projections demonstrated that the transient cycle limits applicable to the reactor vessel internals will not be exceeded for 60 years of operation. Therefore, the analyses will remain valid through the period of extended operation and the cumulative usage factors will remain within the allowable limit of 1.0. The Fatigue Monitoring (A.3.1.1) program will monitor transient cycles and severities and require action prior to exceeding design limits that would invalidate these conclusions. Therefore, the analyses will be managed through the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.3.6 High-Energy Line Break (HELB) Analyses Based Upon Fatigue

Locations of postulated high-energy line breaks (HELB) are based upon two limiting stress criteria and a cumulative usage factor criterion. Meeting any one of the criteria results in a break being postulated. The postulations of break locations based on the fatigue criterion at BBS have been identified as TLAAs.

Transient cycle projections were performed that determined the 40-year transient cycle limits will not be exceeded in 60 years. The fatigue analyses were demonstrated to remain valid for the period of extended operation. The Fatigue Monitoring (A.3.1.1) program will monitor transient cycles used as inputs for the determination of postulated break locations, and ensure that the number of analyzed cycles will not be exceeded. If a limit is approached, corrective action will be required prior to exceeding design limits in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.3.7 NRC Bulletin 88-11 Revised Fatigue Analysis of the Pressurizer Surge Line for Thermal Cycling and Stratification

NRC Bulletin 88-11, issued in December 1988, requested utilities to establish and implement a program to confirm the integrity of the pressurizer surge line. The program required both visual inspection of the surge line and demonstration that the design requirements of the surge line are satisfied, including the consideration of stratification effects. The demonstration was an ASME Section III fatigue analysis to account for thermal stratification. The analysis uses time-limited assumptions such as thermal and pressure transients, operating cycles, and the licensed life of the plant. Therefore, the analyses required by NRC Bulletin 88-11 have been identified as TLAAs.

The original analyses performed to demonstrate compliance with design requirements considered ASME Code requirements and utilized the design set of NSSS transients. Pressurizer surge line stratification sub-transients were developed based on plant operating procedures, surge line monitoring data from similar units, and historical records for each BBS unit. The ASME Code stress limits and cumulative usage factor requirements were shown to be acceptable for the current license of BBS. The Fatigue Monitoring (A.3.1.1) program will monitor transient cycles and severities which are the inputs to these analyses and require action prior to exceeding design limits that would invalidate these conclusions in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.3.8 ASME Section III, Subsection NF Class 1 Component Supports Allowable Stress Analyses

BBS Class 1 component supports, which includes supports for the reactor vessel, steam generator, reactor coolant pump, and pressurizer, are designed in accordance with ASME Section III, Subsection NF, and are inherently designed for a minimum of 20,000 stress cycles. These are considered to be implicit fatigue analyses since they are based upon cycles anticipated for the life of the component. Westinghouse report WCAP-14422, Revision 2-A, documents a technical evaluation of cumulative fatigue for the period of extended operation, on ASME Class 1 component supports in Westinghouse nuclear plant, including Byron and Braidwood. The report concludes that the number of actual loading transients that will affect ASME III Class 1 component supports is projected to be significantly lower than 20,000 loading cycles through 60 years of operation. The NRC documented its review of WCAP-14422, Revision 2-A, in an SER contained in a November 17, 2000 letter. With respect to fatigue, the staff agreed with this assessment in WCAP-14422, provided that each license renewal applicant justifies the use of installed materials not listed in Table 2-4 of the WCAP. This requirement is the result of a concern that the Table 2-4 of the WCAP only contains higher strength materials with a presumed limit of 20,000 loading cycles while the design of some Class 1 supports at older Westinghouse plants may have used the 1963 AISC manual, which specifies a limit of 10,000 loading cycles. Even though BBS Class 1 component supports were designed to ASME Section III, Subsection NF 1974 Edition through the 1975 Summer Addenda requirements and not the AISC 1963 Edition, design documents were reviewed and the majority of installed Class 1 component support materials were found in Table 2-4 of the WCAP. Several materials were identified that were not documented in the table. The evaluation of these different materials showed that their yield strength and fatigue resistance properties are consistent with the materials in Table 2-4 of the WCAP or that the materials are used as shim materials, which are not subject to fatigue since shim materials do not experience cyclical tensile stresses.

The Fatigue Monitoring (A.3.1.1) program will monitor transient cycles and require action prior to exceeding design limits that would invalidate these conclusions. Therefore, this TLAA will be managed in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.3.9 Fatigue Design of Spent Fuel Pool Liner and Spent Fuel Storage Racks for Seismic Events

The new spent fuel storage racks, which were replaced in 2000 and 2001, are designed in accordance with ASME Section III, Division 1, Subsection NF, and were analyzed for fatigue due to seismic events using methods similar to those for ASME Section III, Division 1, Subsection NB. The analyses include a fatigue evaluation of the replacement spent fuel storage racks and for the spent fuel pool liner for the cyclic loads imposed by twenty (20) OBE events plus one (1) SSE event. The analyses calculated a cumulative usage factor (CUF) of less than 1.0 for the spent fuel storage racks. The analyses also includes a fatigue evaluation of the spent fuel pool liner for the loads imposed by the new racks, and uses the same input of twenty (20) OBE events plus one (1) SSE event. The analyses calculated a CUF of less than 1.0 for the spent fuel pool liner. Therefore, these analyses were identified as TLAAs that require evaluation for the period of extended operation.

OBE events are monitored by the Fatigue Monitoring (A.3.1.1) program. No OBE events have occurred to date. SSE events are more severe than OBE events, and since no OBE events have occurred, no SSE events have occurred to date. The Fatigue Monitoring (A.3.1.1) program will continue to be used to manage fatigue of these components through the period of extended operation by monitoring OBE and SSE events. The Fatigue Monitoring

(A.3.1.1) program will manage fatigue of these components through the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.3.10 Pressurizer Heater Sleeve Structural Assessment

During the Braidwood Unit 1 refueling outage in May 2006, a leak was discovered in Reactor Coolant Pressurizer heating element penetration sleeve number 52. The sleeve was repaired in accordance with ASME Section III, Subsection NB. The design analysis for the repair evaluated fatigue in accordance with ASME Section III, Subparagraph NB-3222.4. The fatigue evaluation assumed 200 RCS heatup and cooldown transients and has been identified as a TLAA requiring evaluation for the period of extended operation. The 60-year projections of the design transients in Section A.4.3.1 for heatups and cooldowns are less than those used in this analysis. The Fatigue Monitoring (A.3.1.1) program will monitor the transient cycles and require action prior to exceeding the design limits in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.4 Environmental Qualification (EQ) of Electric Components

Thermal, radiation, and cyclical aging analyses of plant electrical and instrumentation components, developed to meet 10 CFR 50.49 requirements, have been identified as time-limited aging analyses (TLAAs) for BBS. The NRC has established nuclear station environmental qualification (EQ) requirements in 10 CFR 50.49 and 10 CFR 50, Appendix A, Criterion 4. 10 CFR 50.49 specifically requires that an EQ program be established to demonstrate that certain electrical components located in harsh plant environments are qualified to perform their safety function in those harsh environments after the effects of inservice aging. Harsh environments are defined as those areas of the plant that could be subject to the harsh environmental effects of a loss-of-coolant accident (LOCA), high energy line break (HELB), or post-LOCA radiation. 10 CFR 50.49 requires that the effects of significant aging mechanisms be addressed as part of environmental qualification. Aging evaluations for electrical components in the BBS EQ Program that specify a qualification of at least 40 years have been identified as TLAAs for license renewal because the criteria contained in 10 CFR 54.3 are met.

The Environmental Qualification (EQ) of Electric Components (A.3.1.3) program will manage the effects of aging effects for the components associated with the environmental qualification TLAA. This program implements the requirements of 10 CFR 50.49 (as further defined and clarified by NUREG-0588, and RG 1.89, Rev. 1). Component aging evaluations are reanalyzed on a routine basis to extend the qualifications of components as part of the BBS EQ Program. Important attributes for the reanalysis of an aging evaluation include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions (if acceptance criteria are not met). The Environmental Qualification (EQ) of Electric Components (A.3.1.3) program methodology is further described in Section A.3.1.3.

Under the BBS EQ Program, the reanalysis of an aging evaluation could extend the qualification of the component. If the qualification cannot be extended by reanalysis, the component must be refurbished, replaced, or re-qualified prior to exceeding the period for which the current qualification remains valid. A reanalysis is to be performed in a timely manner such that sufficient time is available to refurbish, replace, or re-qualify the component if the reanalysis is unsuccessful.

The effects of aging on the intended function(s) will be adequately managed for the period of extended operation. The BBS Environmental Qualification (EQ) of Electric Components (A.3.1.3) program has been demonstrated to be capable of programmatically managing the qualified lives of the electrical and instrumentation components falling within the scope of the program for license renewal in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.5 Concrete Containment Tendon Prestress Analyses

The Byron and Braidwood Stations Containment Structures are a prestressed concrete shell made up of a cylinder with a shallow dome roof and flat foundation slab. The cylindrical and dome portions of the containment structures are prestressed by a post-tensioning system. The prestressing forces decrease with time due to relaxation of the steel tendons and creep and shrinkage of the concrete.

The original design of the Containment Structures considered an estimate of the loss of prestressing forces over time to ensure that prestressing forces remained above the minimum required values at the end of the 40 year period. Examinations performed as part of the Concrete Containment Tendon Prestress (A.3.1.2) aging management program, in accordance with ASME Section XI, Subsection IWL requirements, include the measurement of the prestressing force values from multiple tendons within each tendon group (vertical, hoop, and dome) during periodic examinations. These measurements are compared to minimum required values and predicted lower limit force values to verify that the Containment Structure is performing its intended function, as well as to compare the actual loss of prestress rate to the predicted rate. Trend lines of the individual tendon prestressing force values for each tendon group are developed to predict future tendon prestressing force values to ensure the Containment Structure will continue to perform its intended function.

Trend lines calculated based on the most recent tendon surveillances for all three tendons groups at Byron and Braidwood Stations, Units 1 and 2, have been extended from 40 years to 60 years. In all cases, the trend lines indicate the prestressing forces will remain above the minimum required values through the end of the period of extended operation. The continued implementation of the existing Concrete Containment Tendon Prestress (A.3.1.2) aging management program will provide reasonable assurance that the loss of containment tendon prestress will be adequately managed so that the intended functions are maintained during the period of extended operation. Therefore, this TLAA is dispositioned in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.6 Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analyses

The Byron and Braidwood prestressed concrete Containment Structures are designed to contain the radioactive material released that would be in the unlikely event of design basis accidents. Each Containment Structure includes a welded carbon steel plate liner attached to the entire inside surface. The liner provides a leak-tight membrane. The prestressed concrete Containment Structure and the portion of the carbon steel liner that is, backed by concrete, conform to the ASME Section III, Division 2. The Containment Structure design also includes components that are not backed by concrete, including emergency personnel airlocks, equipment access hatches and integral personnel airlocks, piping and electrical penetrations, and bellows. These features are defined as Class MC components, which are designed in accordance with ASME Section III, Division 1 requirements to withstand design basis accident pressures corresponding to design basis accidents.

A.4.6.1 Containment Liner Plates Fatigue

Each Containment Structure includes a welded carbon steel plate liner attached to the entire inside surface that provides a leak-tight membrane. The original design required a fatigue evaluation in accordance with ASME Section III, Division 1, Subsection NE, based upon design inputs including RCS heatup and cooldown transients and seismic transients. The evaluation determined that the fatigue exemption criteria of ASME Section III, Subparagraph NE-3222.4(d) were met. A re-evaluation confirmed that these exemption criteria remain satisfied through the period of extended operation, since the original design transients bound the 60-year projections for these transients through the period of extended operation. Therefore, the fatigue exemption remains valid through the period of extended operation. The effects of aging on the intended function(s) of the liner will be adequately managed for the period of extended operation by the Fatigue Monitoring (A.3.1.1) program, which monitors transient cycles to ensure the transient limits are not exceeded during the period of extended operation, validating the assumptions used in these evaluations. Therefore, this TLAA will be managed in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.6.2 Containment Airlocks and Hatches Fatigue

The Byron and Braidwood emergency personnel airlock, personnel airlock with equipment hatch, and all penetrations and nozzles associated with personnel airlocks are designed as Class MC components in accordance with the 1971 Edition of ASME Section III, Subsection NE, through the Summer 1973 Addenda. The original design analysis performed a fatigue exemption determination in accordance with ASME Section III, Subparagraph NE-3222.4(d), with design inputs including RCS heatup and cooldown transients and seismic transients. A re-evaluation confirmed that the original inputs remain valid. The temperature differences have not changed because the design transients have not been redefined. The 60-year transient projections show that the transient limits will not be exceeded during the period of extended operation. Therefore, the numbers of temperature and pressure cycles considered in determining the components were exempt from fatigue analysis will not be exceeded. The effects of aging on the intended function(s) of the Class MC components will be adequately managed for the period of extended operation by the Fatigue Monitoring (A.3.1.1) program, which monitors transient cycles to ensure the transient design limits will not be exceeded during the period of extended operation, validating the assumptions used in this analysis. Therefore, this TLAA will be managed in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.6.3 Containment Electrical Penetrations Fatigue

The Byron and Braidwood prestressed concrete Containment Structures include electrical penetrations designed in accordance with ASME Section III, Division 1, Subsection NE, 1977 Edition through Summer 1978 Addenda requirements. The original design analysis for the Byron and Braidwood Containment Structure electrical penetrations determined that the design inputs met the exemption criteria of ASME Section III, Subparagraph NE-3222.4(d) and that no fatigue analysis was required. A re-evaluation confirmed that the exemption criteria remain valid through the period of extended operation since the original design transients bound the 60-year projections for these transients through the period of extended operation. The effects of aging on the intended function(s) of the Containment Structure electrical penetrations will be adequately managed for the period of extended operation by the Fatigue Monitoring (A.3.1.1) program, which monitors transient cycles to ensure they do not exceed their design limits, validating the assumptions used in these evaluations. Therefore, this TLAA will be managed in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.6.4 Containment Piping Penetrations Fatigue

The Byron and Braidwood Containment Structure piping penetrations are designed to the requirements of the 1971 Edition of ASME Section III, Subsection NE, through the Summer 1973 Addenda. The Containment Structure instrument and process piping penetrations were analyzed in accordance with design specifications that required fatigue evaluation of in accordance with subparagraph NB-3222.4(e) or NE-3222.4(e) of ASME Section III. The resulting piping penetration stress analyses contain fatigue evaluations that have been identified as TLAAs.

The original design specifications for the containment piping penetrations define the design transients applicable for the fatigue analyses. The same transients are addressed in Section A.4.3.1, along with the 60-year projections. The numbers of some load/unload cycles were originally underestimated in the Main Steam and Feedwater containment piping penetration analyses and were not consistent with the governing Westinghouse transient design specification. Review of these analyses show that there is sufficient margin to accommodate the greater number of transients in the Westinghouse specification. For the remaining penetration analyses, the 60-year projected numbers of cycles are less than the numbers analyzed, so these analyses will remain valid through the period of extended operation. The effects of aging on the intended function(s) of the containment penetrations will be adequately managed for the period of extended operation by the Fatigue Monitoring (A.3.1.1) program, which monitors transient cycles to ensure they do not exceed their design limits. The program also ensures that, if a transient limit is approached corrective action is taken to reanalyze components prior to exceeding a transient limit. Therefore, this TLAA will be managed in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.6.5 Fuel Transfer Tube Bellows Fatigue

The fuel transfer tubes connect the refueling cavity (inside the Containment Structure) to the fuel transfer canal (inside the Fuel Handling Building). The fuel transfer tubes pass through the Containment Structure wall and through the exterior wall of the Fuel Handling Building. Guard pipe assemblies, which also function as penetration sleeves, are utilized for the fuel transfer tubes. There are three expansion bellows in each penetration sleeve, designed to the requirements of the 1974 Edition of ASME Section III, Subsection NE through the Summer 1974 Addenda. These design inputs for these bellows include 1 SSE transient and all postulated design basis conditions. The original design transients bound the corresponding 60-year projections for these transients. Therefore, the bellows fatigue analyses remain valid through the period of extended operation. The effects of aging on the intended function(s) of the fuel transfer tube bellows will be adequately managed for the period of extended operation by the Fatigue Monitoring (A.3.1.1) program, which monitors transient cycles to ensure the transient limits are not exceeded through the period of extended operation. Therefore, this TLAA will be managed in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.6.6 Recirculation Sump Guard Piping Bellows Fatigue

The guard pipe for the containment recirculation sump effluent piping extends from the recirculation sump, inside the Containment Structure, to the sump suction valve chamber inside the Auxiliary Building. The guard pipe is comprised of a 28-inch diameter sleeve that penetrates through the Containment Structure and Auxiliary Building walls and two (2) sets of expansion joints (bellows). One set of bellows seals between the containment sump piping and the guard pipe located inside the Containment Structure and another set of bellows seals between the containment recirculation sump effluent piping and the sump suction valve chamber, inside the Auxiliary Building. These bellows were analyzed in accordance with ASME Section III, subsection NE for fatigue, based upon design inputs including RCS heatup and cooldown transients, OBE transients, and other upset, emergency, and faulted conditions that would fill the containment recirculation sump. The original design transients bound the 60-year projections for these transients through the period of extended operation. The effects of aging on the intended function(s) of the recirculation sump guard pipe bellows will be adequately managed for the period of extended operation by the Fatigue Monitoring (A.3.1.1) program, which monitors transient cycles to ensure they do not exceed their design limits, validating the assumptions used in this analysis. Therefore, this TLAA will be managed in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.7 Other Plant-Specific Time-Limited Aging Analyses

A.4.7.1 Leak-Before-Break

Appendix A, Criterion 4, of 10 CFR 50 allows for the use of leak-before-break (LBB) methodology for excluding the dynamic effects of postulated ruptures in reactor coolant system piping. The fundamental premise of the LBB methodology is that the materials used in nuclear power plant piping are sufficiently tough that even a large through-wall crack would remain stable and would not result in a double-ended pipe rupture. Application of the LBB methodology is limited to those high-energy fluid systems not considered to be overly susceptible to failure from such mechanisms as corrosion, water hammer, fatigue, thermal aging or indirectly from such causes as missile damage or the failure of nearby components. The analyses associated with LBB have been identified as TLAAs.

Original LBB analyses performed for Byron and Braidwood Stations, Units 1 and 2, demonstrated that postulated breaks can be eliminated from the structural design basis in the reactor coolant primary loop piping, safety injection accumulator piping and cold leg nozzles, and reactor coolant bypass piping. The reactor coolant primary loop piping includes cast austenitic stainless steel (CASS) elbows, and the safety injection accumulator piping cold leg nozzles are also fabricated from CASS material. The LBB analyses for these systems were updated for license renewal to consider the effects of additional thermal aging on the fracture toughness of the CASS materials through the period of extended operation. The fracture toughness properties used were based on the fully-aged condition (that has the lowest possible fracture toughness), which is applicable for the period of extended operation. The updated LBB analyses demonstrate that the dynamic effects of the pipe rupture resulting from postulated breaks in the reactor coolant primary loop piping and safety injection accumulator piping cold leg nozzles need not be considered in the structural design basis for BBS Units 1 and 2 for the license renewal period. The analyses have been projected to the end of the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

The safety injection accumulator piping (excluding the cold leg nozzle) and the reactor coolant bypass piping also have LBB analyses that were identified as TLAAs. However, these piping systems do not include CASS materials. A review was performed of the current calculation packages of record for Byron and Braidwood, Units 1 and 2, to obtain the latest piping loads on these systems. It was determined that the loads used in the original analyses are still governing. Therefore, the LBB analyses for the safety injection accumulator piping (excluding the cold leg nozzle) and reactor coolant bypass piping, remain valid for the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(i).

A.4.7.2 Crane Load Cycle Limits

The below cranes within the scope of license renewal were reviewed and found to be designed in accordance with the Crane Manufacturers Association of America (CMAA) Specification 70. Cranes designed in accordance with

CMAA-70 include considerations for frequency of operation and expected size of lifts, relative to their maximum load capacity. Based upon these considerations, cranes are designated a given service classification with an expected number of lifts over their life, which also correlates to a number of cycles on structural members. These assumptions on the number of planned cycles over the 40-year life of the crane provide the basis for the TLAA evaluation.

Containment Polar Crane

The containment polar crane was designed in accordance with CMAA-70 for Class A service, which includes consideration of 100,000 cycles over the life of the crane. The number of anticipated lifts for the containment polar crane is estimated to be 1,900 through the period of extended operation, which is less than the 100,000 cycles specified for Class A cranes in CMAA-70.

Fuel Handling Building Crane

The fuel handling building crane was designed in accordance with CMAA-70 for Class A service, which includes consideration of 100,000 cycles over the life of the crane. The number of anticipated lifts for the fuel handling building crane is estimated to be 7,200 through the period of extended operation, which is less than the 100,000 cycles specified for Class A cranes in CMAA-70.

Manipulator Crane

The manipulator crane was designed in accordance with CMAA-70 for Class C service, which includes consideration of 500,000 cycles over the life of the crane. The number of anticipated lifts for the manipulator crane is estimated to be 16,000 through the period of extended operation, which is less than the design value of 500,000 cycles specified for Class C cranes in CMAA-70.

Spent Fuel Pool Bridge Crane

The spent fuel pool bridge crane was designed in accordance with CMAA-70 for Class A service, which includes consideration of 100,000 cycles over the life of the crane. The number of anticipated lifts for the spent fuel pool bridge crane is estimated to be 76,900 through the period of extended operation, which is less than the 100,000 cycles specified for Class A cranes in CMAA-70.

Turbine Building Crane

The turbine building crane was designed in accordance with CMAA-70 for Class A service, which includes consideration of 100,000 cycles over the life of the crane. The number of anticipated lifts for the turbine building crane is estimated to be less than 5,100 through the period of extended operation, which is less than the 100,000 cycles specified for Class A cranes in CMAA-70.

These analyses remain valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.7.3 Mechanical Environmental Qualification

Qualified lives for safety-related mechanical components located in harsh environments are established based on aging concerns in accordance with the provisions of Criterion 4 of Appendix A to 10 CFR Part 50. As part of the qualification, replacement intervals were identified as required either on the basis of aging performed during an IEEE 323-1974 qualification test program or on the basis of published material aging data. The results of qualification tests or other published material aging data have been documented in individual mechanical component Environmental Qualification Binders. The design basis conditions during the period of extended operation will remain the same as those in the current license period. Therefore, the design basis event parameters, including the temperature, radiation, and humidity, do not require further evaluation for license renewal. The individual mechanical components Environmental Qualification Binders are revised to address the 60 year component service requirements. This ensures the effects of aging on the intended function(s) of mechanical components included under Environmental Qualification requirements will be adequately addressed for the period of extended operation. Therefore the aging effects on the mechanical components included under Environmental Qualification requirements will be managed for the period of extended operation, and the TLAAs are dispositioned in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.7.4 Residual Heat Removal Heat Exchangers Tube Side Inlet and Outlet Nozzles Fracture Mechanics Analysis

During ultrasonic (UT) examinations in 1991, indications were found in the residual heat removal heat (RHR) exchanger tube side nozzles of both the Braidwood 2A and 2B RHR heat exchangers. Subsequently, UT examinations were performed of all the residual heat removal (RHR) heat exchanger tube side inlet and outlet nozzles at Byron and Braidwood and any indications exceeding the Subarticle IWB-3500 acceptance standards were dispositioned with the results of the fracture mechanics analysis. To develop the maximum allowable indication size and determine crack growth rates, the analysis uses the startup and shutdowns of the RHR system coincident with the number of plant heatup and cooldowns as inputs. Since the numbers of design transients analyzed are based on the current licensed operation period, the fracture mechanics analysis has been identified as a TLAA that requires evaluation for the period of extended operation.

The analysis considers the numbers of RHR system startups and shutdowns to be coincident with the 200 RCS heatup and cooldown design transients. Since the 60-year projections of heatup and cooldown transients provided in Section A.4.3.1 have been demonstrated to be lower than the transient design limit of 200 cycles, the transient inputs to the analysis also remain bounded by the transient design limits in Section A.4.3.1. The Fatigue Monitoring (A.3.1.1) program will be used to ensure these limits are not exceeded.

The Fatigue Monitoring (A.3.1.1) program will monitor the transient cycles to ensure the transient inputs used in the fracture mechanics analysis will not be exceeded during the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.7.5 Reactor Coolant Pump Flywheel Fatigue Crack Growth Analysis

Due to industry operating experience, the possibility of reactor coolant pump overspeed or reactor coolant pump vibration prompted concerns regarding the potential effects of missiles that might result from the failure of the reactor coolant pump motor flywheel including damage to reactor coolant pump seals or other pressure boundary components.

The reactor coolant pump flywheel inspection program is specified in Technical Specifications 5.5.7. Compliance with Regulatory Guide 1.14, "Reactor Coolant Pump Flywheel Integrity," is set forth in Appendix A, including a description of the inservice inspection program for pump flywheels.

The basis for the 10-year inspection interval for the reactor coolant flywheels is provided by a fatigue crack growth analysis that assumes 6000 starts and stops during the 60-year life of the flywheels. The analysis has been identified as a TLAA.

Based on the 60-year projections of reactor coolant pump starts and stopsdescribed in Section A.4.3.1, the maximum number of start-stop cycles projected to occur in 60 years in any BBS Unit is 1,755 cycles. Therefore, since the number of analyzed cycles significantly exceeds the number of projected cycles, the RCP flywheel fatigue analysis has been demonstrated to remain valid through the period of extended operation.

Based on the above information, the RCP flywheel fatigue analyses remain valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

A.4.7.6 Byron Unit 2 Pressurizer Seismic Restraint Lug Flaw Evaluation

In September 2005, an indication exceeding the acceptance standards of ASME Section XI, Subarticle IWB-3500 1989 Edition was found on a Byron Unit 2 pressurizer seismic lug. Investigation concluded that the indication was not service-induced, but rather was due to lack of fusion in the original weld. A flaw growth analysis was performed in accordance with ASME Section XI, Subarticle IWB-3600, 1989 Edition, which concluded that the indication size will remain within acceptable limits for the current remaining licensed operating period. The analysis assumed input transients for the current licensed operating period based on 40-year operation, and has therefore been identified as a TLAA requiring evaluation for the period of extended operation.

The number of design transients assumed in the analysis bound the numbers of transients projected to occur through the period of extended operation. The ASME Section XI flaw growth analysis will be managed by the Fatigue Monitoring (A.3.1.1) program, which will monitor transient cycles and require corrective action prior to exceeding assumed input transients cycles to ensure the transient inputs used in the analysis will not be exceeded during the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii)..

A.4.7.7 Braidwood Unit 2 Feedwater Indication Pipe Elbow Fatigue Crack Growth Evaluation

In October 2009, an axial indication was identified on a 16-inch main feedwater line elbow, downstream of the feedwater regulating valves. A flaw growth analysis performed in accordance with ASME Section XI Subarticle IWB-3600, that concluded the crack size will remain within acceptable limits over the 40-year life of the plant. The analysis used design transient inputs assumed for the current licensed operating period, including 240 RCS heatup transients, 200 RCS cooldown transients, 240 reactor trip transients, and 160 reactor trips with RCS cooldown transients. The flaw growth analysis has been identified as a TLAA requiring evaluation for the period of extended operation. The number of design transients assumed in the analysis bound the number of transients projected to occur through the period of extended operation.

The Fatigue Monitoring (A.3.1.1) program will monitor the transient cycles ensure the transient inputs used in the ASME Section XI flaw growth analysis will not be exceeded during the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

A.4.7.8 Analyses Supporting Flaw Evaluations of Primary System Components

Fatigue Crack Growth Analyses

BBS Units 1 and 2 have performed pre-emptive flaw evaluations on reactor vessel, pressurizer, primary steam generator sub-components, and primary coolant components (i.e. primary system components) consistent with ASME Section XI, Subarticle IWB-3600. The flaw evaluations were performed consistently with the methodologies in with WCAP-11063, "Handbook on Flaw Evaluations for Byron Unit 1 and 2 Steam Generators and Pressurizers", earlier in plant life, and now with those in WCAP-12046 Revision 1, "Handbook on Flaw Evaluations for the Byron and Braidwood Units 1 and 2 Reactor Vessels". The handbooks for flaw evaluation methodology are based on crack growth rate analyses that used 40-year design transients as inputs to the crack growth rate reference curves, which were used in evaluating each of the components. Since the flaw evaluation handbooks are based on analyses, which have time-limited inputs (e.g. number of transients assumed over 40 years), these analyses supporting flaw evaluations of primary system components have been identified as TLAAs.

The number of design transients used to develop these curves bound the number of transients projected to occur in 60 years, provided in Section A.4.3.1. The Fatigue Monitoring (A.3.1.1) program will be used to ensure that the number of transients used in these curves will not be exceeded during the period of extended operation.

The ASME Section XI crack growth analyses will be managed by the Fatigue Monitoring Program (A.3.1.1), which will monitor transient cycles and require corrective action prior to exceeding numbers of transients cycles used in the evaluations, which support these conclusions in accordance with 10 CFR 54.21(c)(1)(iii).

Fracture Toughness Input to Analyses – Irradiation Embrittlement of Reactor Vessel Beltline and Extended Beltline Components

The analyses also use fracture toughness as an input. Loss of fracture toughness occurs in those portions of the reactor vessel exposed to neutron fluence over the life of the reactor vessel. Therefore, the analyses using fracture toughness as an input, which are based upon 40-year fluence values, have been identified as TLAAs.

Since fracture toughness will be changing as a result of operating into the period of extended operation and new locations will become a part of the extended beltline, any effects on the analyses are evaluated. For the active beltline region, the projected RT_{NDT} for Byron and Braidwood resulting from fluence associated with 57 EFPY in 60 years remains less than 200°F. Therefore, the flaw evaluation per WCAP-12046 remains applicable for the period of extended operation.

For the extended beltline region even considering a worst case Chemistry Factor, the increase in RT_{PTS} is only 2 degrees F, which is negligible. The fluence will only be lower further down the reactor vessel wall, so effects will continue to be negligible.

Just above the beltline region, the calculated K_{Ic} and K_{Ia} (fracture toughness) value is greater than 200 ksi-in$^{1/2}$ based on RT_{PTS} = 90°F and the limiting temperature from the bounding transient. Since the flaw evaluations for the extended beltline regions are determined based on an upper shelf limit of 200 ksi-in$^{1/2}$, the flaw evaluations for the extended beltline region remain valid for the period of extended operation.

The ASME Section XI analyses supporting the flaw evaluations for the reactor vessel remain valid during the period of extended operation in accordance with 10 CFR 54.21 (c)(1)(i).

A.5 License Renewal Commitment List

Explanatory notes within this table provide the basis for station-specific differences as follows:

Note 1 – Enhancement at one Station only; other Station currently performs activity
Note 2 – Design difference
Note 3 – Enhancement due to operating experience

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
1	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD is an existing program that will be enhanced to: 1. Conduct a visual inspection of the accessible portions of the ASME Class 2 reactor vessel flange leakage monitoring tube every other refueling outage.	Program to be enhanced prior to the period of extended operation.	Section A.2.1.1
2	Water Chemistry	Existing program is credited.	Ongoing	Section A.2.1.2
3	Reactor Head Closure Stud Bolting	Reactor Head Closure Stud Bolting is an existing program that will be enhanced to: 1. Revise the procurement requirements for reactor head closure stud material to assure that the maximum yield strength of replacement material is limited to a measured yield strength less than 150 ksi.	Program to be enhanced prior to the period of extended operation.	Section A.2.1.3
4	Boric Acid Corrosion	Existing program is credited.	Ongoing	Section A.2.1.4
5	Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components	Existing program is credited.	Ongoing	Section A.2.1.5
6	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) is a new program that manages the aging effects of loss of fracture toughness due to thermal aging embrittlement of ASME Code Class 1 CASS components with service conditions above 250°C (482°F). The program will include a screening methodology to	Program to be implemented prior to the period of extended operation.	Section A.2.1.6

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		determine component susceptibility to thermal aging embrittlement based on casting method, molybdenum content, and percent ferrite. For "potentially susceptible" components, thermal aging embrittlement management will be accomplished through either, qualified visual inspections, such as enhanced visual examination, qualified ultrasonic testing methodology, or component-specific flaw tolerance evaluation.		
7	PWR Vessel Internals	The PWR Vessel Internals is a new program that manages the aging effects of various forms of cracking, including stress corrosion cracking (SCC), primary water stress corrosion cracking (PWSCC), irradiation assisted stress corrosion cracking (IASCC), or cracking due to fatigue/cyclical loading; loss of material due to wear; loss of fracture toughness due to neutron irradiation embrittlement; changes in dimension due to void swelling and irradiation growth; and loss of preload due to thermal and irradiation-enhanced stress relaxation or creep. Program examination methods include visual examination, enhanced visual examination, volumetric examination, and direct physical measurements.	Program to be implemented no later than the date that the renewed operating licenses are issued.	Section A.2.1.7
8	Flow-Accelerated Corrosion	Existing program is credited.	Ongoing	Section A.2.1.8
9	Bolting Integrity	Bolting Integrity is an existing program that will be enhanced to: 1. Prohibit the use of lubricants containing molybdenum disulfide on pressure retaining bolted joints. 2. Prohibit the use of high strength bolting (actual measured yield strength equal to or greater than 150 ksi) for pressure retaining bolted joints in portions of systems within the scope of the Bolting Integrity program. 3. Perform visual inspection of submerged bolting on fire protection system pumps (Byron only) Note 1 and well water system deep well pumps (Byron only) Note 2 when submerged portions of the pumps are overhauled or replaced during maintenance activities.	Program to be enhanced prior to the period of extended operation.	Section A.2.1.9

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
10	Steam Generators	Steam Generators is an existing program that will be enhanced to: 1. Validate that primary water stress corrosion cracking of the divider plate welds to the primary head and tubesheet cladding is not occurring. BBS commits to perform one (1) of the following three (3) resolution options for Units 1 and 2: Option 1: Inspection Perform a one-time inspection, under the Steam Generators program, of each steam generator to assess the condition of the divider plate welds and the effectiveness of the Water Chemistry (A.2.1.2) program. For the Byron and Braidwood, Unit 1 steam generators which were replaced in 1998, the inspection will be performed between 2018 and the start of the period of extended operation to allow the steam generators to acquire at least twenty years of service. For the Byron and Braidwood, Unit 2 steam generators which currently have at least twenty years of service, the inspection will be performed prior to entering the period of extended operation. The examination technique(s) will be capable of detecting primary water stress corrosion cracking (PWSCC) in the divider plate assemblies and associated welds. or Option 2: Analysis Perform an analytical evaluation of the steam generator divider plate welds in order to establish a technical basis which concludes that the steam generator reactor coolant pressure boundary is adequately maintained with the presence of steam generator divider plate weld cracking. The analytical evaluation will be submitted to the NRC for review and approval prior to entering associated period of extended operation. or	Program to be enhanced prior to the period of extended operation.	Section A.2.1.10

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		<u>Option 3: Industry/NRC Studies</u> If results of industry and NRC studies and operating experience document that potential failure of the steam generator reactor coolant pressure boundary due to PWSCC of the steam generator divider plate welds is not a credible concern, this commitment will be revised to reflect that conclusion. 2. Validate that primary water stress corrosion cracking of the tube-to-tubesheet welds is not occurring on BBS Unit 1. BBS commit to perform one (1) of the following three (3) resolution options for Unit 1: <u>Option 1: Inspection</u> Perform a one-time inspection, under the Steam Generators (A.2.1.10) program, of a representative number of tube-to-tubesheet welds in each steam generator to determine if PWSCC cracking is present. Since the Byron and Braidwood Unit 1 steam generators were replaced in 1998, the inspection will be performed between 2018 and the start of the period of extended operation to allow the steam generators to acquire at least twenty years of service. The examination technique(s) will be capable of detecting primary water stress corrosion cracking (PWSCC) in the tube-to-tubesheet welds. If cracking is identified, the condition will be resolved through repair or engineering evaluation to justify continued service, as appropriate, and a periodic monitoring program will be established to perform routine tube-to-tubesheet weld inspections for the remaining life of the steam generators. or		

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		Option 2: Analysis - Susceptibility Perform an analytical evaluation of the steam generator tube-to-tubesheet welds to determine that the welds are not susceptible to primary water stress corrosion cracking. The evaluation for determining that the tube-to-tubesheet welds are not susceptible to primary water stress corrosion cracking will be submitted to the NRC for review and approval prior to entering the associated period of extended operation. or Option 3: Analysis – Pressure Boundary Perform an analytical evaluation of the steam generator tube-to-tubesheet welds redefining the reactor coolant pressure boundary of the tubes, where the steam generator tube-to-tubesheet welds are not required to perform a reactor coolant pressure boundary function. The redefinition of the reactor coolant pressure boundary will be submitted to the NRC for review and approval prior to entering the associated period of extended operation		
11	Open-Cycle Cooling Water System	Open-Cycle Cooling Water System is an existing program that will be enhanced to: 1. Perform periodic volumetric inspections for loss of material in the non-essential service water system piping at a minimum of two (2) locations on each unit in both the auxiliary building and the turbine building for a total of four (4) periodic inspections per unit every refueling cycle.	Program to be enhanced prior to the period of extended operation.	Section A.2.1.11

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
12	Closed Treated Water Systems	Closed Treated Water Systems is an existing program that will be enhanced to: 1. Perform condition monitoring, including periodic visual inspections and non-destructive examinations, to verify the effectiveness of water chemistry control at mitigating aging effects. A representative sample of piping and components will be selected based on likelihood of corrosion, fouling, or cracking and inspected at an interval not to exceed once in 10 years during the period of extended operation. The selection of components to be inspected will focus on locations which are most susceptible to age-related degradation, where practical. 2. Perform periodic sampling, analysis, and trending of water chemistry for the essential service water makeup pump engine glycol-based jacket water system to verify the effectiveness of water chemistry control at mitigating aging effects (Byron only) $^{\text{Note 2}}$.	Program to be enhanced prior to the period of extended operation.	Section A.2.1.12
13	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems is an existing program that will be enhanced to: 1. Consistently include inspections of structural components and bolting for loss of material due to corrosion, rails for loss of material due to wear and corrosion, and bolted connections for evidence of loss of preload. 2. Ensure periodic inspections are performed on all cranes, hoists, monorails, and rigging beams within the scope of license renewal, including those that are infrequently in use.	Program to be enhanced prior to the period of extended operation.	Section A.2.1.13
14	Compressed Air Monitoring	Compressed Air Monitoring is an existing program that will be enhanced to: 1. Inspect critical component internal surfaces for signs of loss of material due to corrosion and document deficiencies in the corrective action program.	Program to be enhanced prior to the period of extended operation.	Section A.2.1.14

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
15	Fire Protection	Fire Protection is an existing program that will be enhanced to: 1. Include visual inspections of the earthen berm enclosing the outdoor fuel oil storage tanks for signs of age-related degradation such as loss of material and loss of form that could affect the intended function of the berm. 2. Provide additional inspection guidance to identify age-related degradation of fire barrier walls, ceilings, and floors or aging effects such as cracking, spalling, and loss of material. 3. Include visual inspection of halon and low-pressure carbon dioxide fire suppression system piping and component external surfaces for signs of corrosion or other age-related degradation.	Program to be enhanced prior to the period of extended operation.	Section A.2.1.15
16	Fire Water	Fire Water is an existing program that will be enhanced to: 1. Replace sprinkler heads or perform 50-year sprinkler head testing using the guidance of NFPA 25 “Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems” (2002 Edition), Section 5.3.1.1.1. This testing will be performed at the 50-year in-service date and every 10 years thereafter. 2. Provide for chemical addition accompanied with system flushing to allow for adequate dispersal of the chemicals throughout the system, to prevent or minimize microbiologically induced corrosion (Byron only) Note 3.	Program to be enhanced prior to the period of extended operation. Inspection schedule identified in commitment.	Section A.2.1.16
17	Aboveground Metallic Tanks	Aboveground Metallic Tanks is a new program that manages aging effects of loss of material on the external surfaces of aboveground metallic tanks within the scope of license renewal by performing periodic visual inspections for degradation of the external surface of the tank, lagging, flashing, insulation, roofing, and accessible sealant. Program effectiveness is determined by measuring the thickness of the tank bottoms to ensure that significant age-related degradation is not occurring. Tank bottom UT inspections will be performed within	Program to be implemented prior to the period of extended operation. UT inspection schedule identified in commitment.	Section A.2.1.17

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		the five (5) year period prior to the period of extended operation, between years five (5) and ten of the period of extended operation, and whenever a tank is drained.		
18	Fuel Oil Chemistry	Fuel Oil Chemistry is an existing program that will be enhanced to: 1. Provide for the periodic cleaning of the Fire Protection Fuel Oil Storage Tank (Byron only) Note 1. 2. Provide for periodic draining of water from the Auxiliary Feedwater Day Tanks, Diesel Generator Day Tanks, Essential Service Water Make/Up Pump Fuel Oil Storage Tanks (Byron only) Note 2, and Fire Protection Fuel Oil Storage Tanks. 3. Include analysis for the levels of microbiological organisms in the Auxiliary Feedwater Day Tanks and Essential Service Water Make-up Pumps Diesel Oil Storage Tanks (Byron only) Note 2. 4. Include analysis for water and sediment content, particulate concentration, and the levels of microbiological organisms for the Diesel Generator Day Tanks. 5. Include analysis for water and sediment content and the levels of microbiological organisms for the Diesel Generator Fuel Oil Storage Tanks. 6. Include analysis for particulate concentration and the levels of microbiological organisms for the Fire Protection Fuel Oil Storage Tanks. 7. Include internal inspections of the Fire Protection Fuel Oil Storage Tanks at least once during the 10-year period prior to the period of extended operation, and at least once every 10 years during the period of extended operation. Each diesel fuel tank will be drained and cleaned, the internal surfaces visually inspected (if physically possible), and, if evidence of degradation is observed during inspections, or if visual inspection is not possible, these diesel fuel tanks will be volumetrically inspected.	Program to be enhanced prior to the period of extended operation.	Section A.2.1.18

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		8. Include monitoring and trending for the levels of microbiological organisms for the Auxiliary Feedwater Day Tanks and Essential Service Water Make-up Pumps Diesel Oil Storage Tanks (Byron only) Note 2. 9. Include monitoring and trending for water and sediment content, particulate concentration, and the levels of microbiological organisms for the Diesel Generator Day Tanks. 10. Include monitoring and trending for water and sediment content and the levels of microbiological organisms for the Diesel Generator Fuel Oil Storage Tanks. 11. Include monitoring and trending for total particulate concentration and the levels of microbiological organisms for the Fire Protection Fuel Oil Storage Tanks.		
19	Reactor Vessel Surveillance	Reactor Vessel Surveillance is an existing program that will be enhanced to: 1. Establish operating restrictions to ensure that the plant is operated under the conditions to which the surveillance capsules were exposed. The operating restrictions are as follows: Byron Station, Unit 1: - Cold leg operating temperature limitation: 525 degrees Fahrenheit (minimum) to 590 degrees Fahrenheit (maximum). - RPV beltline material fluence: 3.21E+19 n/cm2 (E >1.0 MeV) (maximum). Byron Station, Unit 2; Braidwood Station Units 1 and 2: - Cold leg operating temperature limitation: 525 degrees Fahrenheit (minimum) to 590 degrees Fahrenheit (maximum).	Program to be enhanced prior to the period of extended operation.	Section A.2.1.19

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		- RPV beltline material fluence: 3.19E+19 n/cm2 (E >1.0 MeV) (maximum). If the reactor pressure vessel exposure conditions (neutron fluence, neutron spectrum) or irradiation temperature (cold leg inlet temperature) are altered, then the basis for the projection to the end of the period of extended operation needs to be reviewed and, if deemed appropriate, updates are made to the Reactor Vessel Surveillance program. Any changes to the Reactor Vessel Surveillance program must be submitted for NRC review and approval in accordance with 10 CFR Part 50, Appendix H.		
20	One-Time Inspection	One-Time Inspection is a new program that will be used to verify the system-wide effectiveness of the Water Chemistry, Fuel Oil Chemistry and Lubricating Oil Analysis programs.	Program to be implemented prior to the period of extended operation. One-time inspections will be performed within the ten year period prior to the period of extended operation.	Section A.2.1.20
21	Selective Leaching	Selective Leaching is a new program that will include one-time inspections of a representative sample of susceptible components to determine if loss of material due to selective leaching is occurring.	Program to be implemented prior to the period of extended operation. One-time inspections will be performed within the five (5) year period prior to the period of extended operation.	Section A.2.1.21
22	One-Time Inspection of ASME Code Class 1 Small-Bore Piping	One-Time Inspection of ASME Code Class 1 Small-Bore Piping is a new program that will manage the aging effect of cracking in Class 1 small-bore piping that is less than nominal pipe size (NPS) 4-inches, and greater than or equal to NPS 1-inch.	Program to be implemented prior to the period of extended operation. One-time Inspections will be performed and evaluated within the six (6) year period prior to the period of extended operation.	Section A.2.1.22

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
23	External Surfaces Monitoring of Mechanical Components	External Surfaces Monitoring of Mechanical Components is a new program that manages aging effects of metallic and elastomeric materials through periodic visual inspection of external surfaces for evidence of loss of material. Visual inspections are augmented by physical manipulation as necessary to detect hardening and loss of strength of elastomers.	Program to be implemented prior to the period of extended operation.	Section A.2.1.23
24	Flux Thimble Tube Inspection	Existing program is credited.	Ongoing	Section A.2.1.24
25	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components is a new program that manages aging effects of metallic and elastomeric materials through visual inspections of internal surfaces for evidence of loss of material. Visual inspections are augmented by physical manipulation as necessary to detect hardening and loss of strength of elastomers.	Program to be implemented prior to the period of extended operation.	Section A.2.1.25
26	Lubricating Oil Analysis	Existing program is credited.	Ongoing	Section A.2.1.26
27	Monitoring of Neutron-Absorbing Materials Other than Boraflex	Existing program is credited.	Ongoing	Section A.2.1.27
28	Buried and Underground Piping	Buried and Underground Piping is an existing program that will be enhanced to: 1. Perform manual examinations, in addition to visual inspections, to detect hardening, softening, or other changes in material properties for buried polymeric piping (Braidwood only) $^{\text{Note 2}}$. 2. Cracking will be managed for stainless steel components, utilizing a method that has been demonstrated to be capable of detecting cracking, whenever coatings are removed and expose the base material (Braidwood only) $^{\text{Note 2}}$. 3. Ensure all underground carbon steel essential service water system piping within the scope of license renewal is coated in accordance with NACE SP0169-2007 prior to the period of extended operation (Byron only) $^{\text{Note 1}}$.	Program to be enhanced prior to the period of extended operation.	Section A.2.1.28

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		4. Direct visual inspections of coated piping and components will be performed by an individual possessing a NACE Coating Inspector Program Level 2 or 3 operator qualification, or by an individual who has attended the EPRI Comprehensive Coatings Course and completed the EPRI Buried Pipe Condition Assessment and Repair Training Computer Based Training Course. 5. Inspection quantities of buried piping within the scope of license renewal will be performed in accordance with LR-ISG-2011-03, Element 4, Table 4a, and based upon the as-found results of cathodic protection system availability and effectiveness during each ten year period, beginning 10 years prior to the period of extended operation. 6. The buried carbon steel condensate system piping within the scope of license renewal will be addressed, through means of a long term mitigation strategy, prior to entering the period of extended operation. Mitigation may include activities such as fully recoating, complete replacement with like or upgraded material, installation of internal polymeric sleeves, and routing of pipe above ground or in an engineered trench for leak detection. Inspections of the condensate system piping will be performed in accordance with LR-ISG-2011-03, Element 4, Table 4a, and based on the mitigation strategy implemented (Braidwood only) Note 3. 7. Inspection quantities of underground piping within the scope of license renewal will be performed in accordance with LR-ISG-2011-03, Element 4, Table 4b, during each 10 year period, beginning 10 years prior to the period of extended operation. 8. If adverse indications are detected during inspection, inspection sample sizes within the affected piping categories will be doubled. If adverse indications are found in the expanded sample, an analysis will be conducted to determine the extent of condition and extent of cause. The size of the follow-on inspections will be determined based on the analysis. Timing of the additional inspections will be based on the severity of the		

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		identified degradation and the consequences of leakage. In all cases, the additional inspections will be performed within the same 10-year inspection interval in which the original adverse indication was identified. Expansion of sample size may be limited by the extent of piping subject to the observed degradation mechanism. 9. In performing cathodic protection surveys, only the -850mV polarized potential criterion specified in NACE SP0169-2007 for steel piping will be used for acceptance criteria and determination of cathodic protection system effectiveness, unless the -100mV polarization criteria can be demonstrated effective through use of buried coupons, electrical resistance probes, or placement of reference cells in the immediate vicinity of the piping being measured. An upper limit of -1200mV for pipe-to-soil potential measurements of coated pipes will also be established, so as to preclude potential damage to coatings. 10. An extent of condition evaluation will be conducted if observed coating damage caused by non-conforming backfill has been evaluated as significant. The extent of condition evaluation will be conducted to ensure that the as-left condition of backfill in the vicinity of the observed damage will not lead to further degradation.		
29	ASME Section XI, Subsection IWE	ASME Section XI, Subsection IWE is an existing program that will be enhanced to: 1. Provide guidance for specification of bolting material, lubricant and sealants, and installation torque or tension to prevent or mitigate degradation and failure of structural bolting.	Program to be enhanced prior to the period of extended operation.	Section A.2.1.29
30	ASME Section XI, Subsection IWL	ASME Section XI, Subsection IWL is an existing program that will be enhanced to: 1. Include additional augmented examination requirements after post-tensioning system repair/replacement activities in accordance with Table IWL-2521-2.	Program to be enhanced prior to the period of extended operation.	Section A.2.1.30

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		2. A one-time inspection of one (1) vertical and one (1) horizontal tendon on each unit will be performed prior to the period of extended operation. The inspection will consist of visually examining one (1) wire from each of the two (2) types of tendons at a worst-case location based on evidence of free water, grease discoloration, and grease chemistry results. This location will serve as a leading indicator for potential degradation or tendon surface corrosion (Braidwood only) Note 3. 3. In order to monitor for tendon exposure to free water and moisture and manage any potential adverse effects, a periodic tendon water monitoring and grease sampling program will be implemented (Braidwood only) Note 3. The program will consist of: a. A baseline inspection of tendon grease caps at the bottom of all vertical and dome tendons, as well as all below-grade horizontal tendons, prior to the period of extended operation. The baseline inspection will check for evidence of free water and grease discoloration, with further actions taken based on the condition of the grease. b. A follow-up tendon grease cap inspection of all vertical and dome tendons, as well as all below-grade horizontal tendons, will be performed within 10 years of the initial inspection, using the same approach as the baseline inspection. c. For those tendons where free water, moisture, and grease did not meet acceptance criteria during the two (2) previous inspections, periodic monitoring of grease chemistry and moisture, free water, and grease discoloration will be performed on a frequency not to exceed 10 years. Corrective actions will be taken as necessary to ensure that the tendon grease meets ASME Section XI, Subsection IWL requirements		

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		4. Explicitly require that areas of concrete deterioration and distress be recorded in accordance with the guidance provided in ACI 349.3R. 5. Include quantitative acceptance criteria, based on the "Evaluation Criteria" provided in Chapter 5 of ACI 349.3R, that will be used to augment the qualitative assessment of the Responsible Engineer.		
31	ASME Section XI, Subsection IWF	ASME Section XI, Subsection IWF is an existing program that will be enhanced to: 1. Add the MC supports for the transfer tube in the refueling cavity in the Containment Structure and refueling canal in the Fuel Handling Building to the scope of the program. 2. Provide guidance for proper specification of bolting material, lubricant and sealants, and installation torque or tension to prevent or mitigate degradation and failure of structural bolting. 3. Provide procedural guidance, regarding the selection of supports to be inspected on subsequent inspections, when a support is repaired in accordance with the corrective action program. The enhanced guidance will ensure that the supports inspected on subsequent inspections are representative of the general population.	Program to be enhanced prior to the period of extended operation.	Section A.2.1.31
32	10 CFR Part 50, Appendix J	Existing program is credited.	Ongoing	Section A.2.1.32
33	Masonry Walls	Masonry Walls is an existing program that will be enhanced to: 1. Add masonry walls in the following structures to the program scope: a. Radwaste and Service Building Complex i. Radwaste Building ii. Original Service Building b. Turbine Building Complex	Program to be enhanced prior to the period of extended operation.	Section A.2.1.33

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		c. Switchyard Structures i. Relay House 2. Provide additional guidance for inspection of masonry walls for shrinkage, separation, and for gaps between the supports and the masonry walls that could impact the intended function of the masonry walls. 3. Require that personnel performing inspections and evaluations meet the qualifications described in ACI 349.3R.		
34	Structures Monitoring	Structures Monitoring is an existing program that will be enhanced to: 1. Add the following structures: a. Radwaste and Service Building Complex i. Radwaste Building ii. Original Service Building b. Turbine Building Complex c. Yard Structures i. Transformer foundations ii. Valve and line enclosures d. Fire protection structures-features i. Transformer fire barrier walls ii. Fuel oil storage tank berm 2. Add the following components and commodities: a. Blowout panels b. Building features – doors and seals, bird screens, louvers, windows c. Compressible joints and seals, gaskets and moisture barriers d. Concrete curbs e. Electrical cable trays, conduits and tube tracks f. Hatches and plugs g. Insulation including jacketing h. Manholes, handholes and duct banks i. Metal components, including metal decking for concrete slabs, miscellaneous steel, sump screens and trench covers, and scuppers around the spent fuel pool j. New fuel storage racks	Program to be enhanced prior to the period of extended operation.	Section A.2.1.34

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		k. Offgas stack and flue l. Panels, racks, cabinets, and other enclosures m. Penetration seals and sleeves n. Pipe whip restraints, jet impingement shields, and spray shields o. Pipe, electrical and equipment component support members p. Sliding surfaces q. Spent fuel pool gates r. Sumps and liners 3. Monitor groundwater chemistry on a frequency not to exceed five (5) years for pH, chlorides, and sulfates and evaluate results exceeding the threshold criteria to assess impact, if any, on below-grade concrete. 4. Based on groundwater chemistry monitoring results, select and inspect every five (5) years a structure that will be used as a leading indicator for the condition of below grade concrete exposed to groundwater. 5. Require (a) evaluation of the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas and (b) examination of representative samples of the exposed portions of the below grade concrete, when excavated for any reason. 6. Provide guidance for proper specification of high strength bolting material and lubricant to prevent or mitigate degradation and failure of structural bolting. 7. Revise storage requirements for high strength bolts to include recommendations of Research Council on Structural Connections (RSCS) Specification for Structural Joints Using High Strength Bolts, Section 2.0. 8. Clarify that loose bolts and nuts, and cracked high strength bolts are not acceptable unless accepted by engineering evaluations.		

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		9. Include the potential for reduction in concrete anchor capacity due to local concrete degradation. 10. Require that personnel performing inspections and evaluations meet the qualifications specified within ACI 349.3R with respect to knowledge of in-service inspection of concrete and visual acuity requirements. 11. Require acceptance and evaluation of structural concrete using quantitative criteria based on Chapter 5 of ACI 349.3R. 12. Perform inspection of elastomeric components such as vibration isolation elements and structural seals for cracking, loss of material and hardening. Visual inspections of elastomeric components are to be supplemented by feel or manipulation to detect hardening. 13. Monitor accessible sliding surfaces to detect loss of mechanical function or significant loss of material due to wear, corrosion, debris, dirt, distortion, or overload that could restrict or prevent sliding of surfaces as required by design. 14. Formalize requirements for the monitoring of the leak detection sight glasses associated with the refuel cavity, transfer canal, spent fuel pool, and refueling water storage tank on a periodic basis. 15. Require visual inspections of submerged concrete structural elements by dewatering a structure or by a diver if the structure is not dewatered at least once every five (5) years (Byron only) Note 2.		
35	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants is an existing program that will be enhanced to: 1. Provide guidance for specification of structural bolting material and bolting lubricants to prevent or mitigate degradation and failure of structural bolting.	The Byron Essential Service Water Cooling Tower inspection and maintenance plan will be initiated upon receipt of the renewed licenses, and will continue through the period of extended	Section A.2.1.35

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		2. Revise storage requirements for structural bolting to include recommendations of Research Council on Structural Connections (RSCS) Specification for Structural Joints Using High Strength Bolts, Section 2.0. 3. Include the potential for reduction in concrete anchor capacity due to local concrete degradation. 4. Include all aging affects addressed by ACI 349.3R in procedures and require acceptance and evaluation of structural concrete using quantitative criteria based on Chapter 5 of ACI 349.3R. 5. Clarify that loose bolts and nuts, and cracked bolts are not acceptable unless accepted by engineering evaluations. 6. Require that steel components subject to RG 1.127 are inspected for loss of material. 7. Require that inspectors work under the direction of a qualified engineer for submerged concrete inspections. 8. Require special inspections also be performed in the event of large floods, hurricanes, and intense local rainfalls. 9. Require increased inspection frequency if the extent of the degradation is such that the structure or component may not meet its design basis if allowed to continue uncorrected until the next normally scheduled inspection. 10. Require (a) evaluation of the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas and (b) examination of representative samples of the exposed portions of the below grade concrete, when excavated for any reason.	operation to ensure the condition of the SXCT is maintained. The remainder of the enhancements will be implemented prior to the period of extended operation.	

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		11. Monitor raw water and groundwater chemistry at least once every five (5) years for pH, chlorides, and sulfates and verify that it remains non-aggressive, or evaluate results exceeding criteria to assess impact, if any, on submerged concrete. 12. Based on groundwater chemistry monitoring results, select and inspect every five (5) years a structure that will be used as a leading indicator for the condition of below grade concrete exposed to groundwater. 13. Require visual inspections of submerged concrete structural components by dewatering a structure or by a diver if the structure is not dewatered at least once every five (5) years. Maintenance procedures will be enhanced to require opportunistic inspection of submerged concrete structures when they are dewatered and made accessible. 14. Require that degraded conditions be documented and trended until the condition is no longer occurring or until a corrective action is implemented. 15. Clarify parameters to be monitored and inspected at the Essential Service Water Cooling Towers to include visual inspection for loss of material and reduction of heat transfer for the cooling tower fill, and visual inspection with physical manipulation for change in material properties associated with the PVC drift eliminators and fiberglass support beams for the drift eliminators (Byron only) Note 2. 16. Manage the condition of the Byron Essential Service Water Cooling Towers (SXCTs) as follows: a. Monitor and trend inspection activities at the SXCTs on an increased frequency, with inspections of the entire tower on a three (3) year interval, and inspections of the fill support beams and air-inlet framing on a 1.5-year interval. The recommendations in Chapter 5 of ACI 349.3R will be used for quantitative acceptance and evaluation criteria.		

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		b. Develop a repair plan to address degradation of the SXCTs with specific emphasis and consideration for the fill support beams. Repairs that are required will be scheduled based on a ranking of the condition observed and the potential for the degradation to progress or propagate.		
36	Protective Coating Monitoring and Maintenance Program	Protective Coating Monitoring and Maintenance Program is an existing program that will be enhanced to: 1. Add recurring work orders requiring Service Level I coating inspections every refuel outage. 2. Require qualification of coating inspectors to ASTM D 5498. 3. Require qualification of personnel in accordance with ASTM D 7108. 4. Incorporate guidance for inspection and maintenance of Service Level I coatings per Regulatory Guide 1.54 and impose ASTM D 5163-08 requirements for Service Level I coatings condition assessment, reporting, evaluation, and documentation. 5. Require thorough visual inspections of all coatings near sumps or screens associated with the Emergency Core Cooling System (ECCS) by the coatings inspector(s). 6. Specify instruments and equipment that may be needed for Service Level I coatings inspections.	Program to be enhanced prior to the period of extended operation.	Section A.2.1.36
37	Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements is a new program that will be used to manage aging of the insulation material for non-EQ cables and connections. Accessible cables and connections located in adverse localized environments will be visually inspected at least once every 10 years for indications of reduced insulation resistance, such as embrittlement, discoloration, cracking, melting, swelling, or surface contamination.	Program and initial inspections to be implemented prior to the period of extended operation.	Section A.2.1.37

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
38	Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits is a new program that will be used to manage aging of non-EQ cable and connection insulation of the in-scope portions of the radiation monitoring system (Byron and Braidwood) and the neutron monitoring inputs to the reactor protection system (Braidwood only) Note 2. Calibration and cable tests will be performed and results will be assessed for reduced insulation resistance prior to the period of extended operation and at least once every 10 years during the period of extended operation.	Program and initial assessment of calibration and test results to be implemented prior to the period of extended operation. Assessment schedule identified in commitment.	Section A.2.1.38
39	Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements is a new program that will be used to manage the aging effects and mechanisms of non-EQ, in scope, inaccessible power cables. Cables will be tested using a proven test for detecting reduced insulation resistance of the cable's insulation system. The cables will be tested at least once every 6 years. More frequent testing may occur based on test results and operating experience. Periodic actions will be taken to prevent inaccessible cables from being exposed to significant moisture. Manholes associated with the cables included in this program will be inspected for water collection with subsequent corrective actions (e.g., water removal), as necessary. Prior to the period of extended operation, the frequency of inspections for accumulated water will be established and adjusted based on plant specific operating experience with cable wetting or submergence, including water accumulation over time and event driven occurrences such as heavy rain or flooding. Operation of dewatering devices, if installed, will be verified prior to any known or predicted heavy rain or flooding event. During the period of extended operation, the inspections will occur at least annually.	Program to be implemented prior to the period of extended operation. First cable tests and manhole inspections to be performed prior to the period of extended operation.	Section A.2.1.39
40	Metal Enclosed Bus	Metal Enclosed Bus is an existing program that will be enhanced to: 1. Specify that a sample size of 20 percent of the accessible bolted connection population with a maximum sample size of 25	Program to be enhanced prior to the period of extended operation.	Section A.2.1.40

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		to be inspected for increased resistance of connection by measuring the connection resistance using a micro-ohmmeter. 2. Specify that the external surfaces of metal enclosed bus enclosure assemblies are to be inspected for loss of material due to general, pitting, and crevice corrosion. 3. Specify maximum allowed bus connection resistance values.		
41	Fuse Holders (Byron only) Note 2	Fuse Holders (Byron only) Note 2 aging management program is a new program that applies to fuse holders located outside of active devices that have been identified as susceptible to aging effects. Fuse holders subject to increased resistance of connection or fatigue, will be tested, by a proven test methodology, at least once every 10 years for indications of aging degradation. Visual inspection is not part of this program.	Program and initial tests to be implemented prior to the period of extended operation.	Section A.2.1.41
42	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program is a new program that will implement one-time testing of a representative sample (20 percent with a maximum sample size of 25) of non-EQ electrical cable connections to ensure that either aging of metallic cable connections is not occurring or that the existing preventive maintenance program is effective such that a periodic inspection program is not required.	Program and one-time tests to be implemented prior to the period of extended operation.	Section A.2.1.42
43	Fatigue Monitoring	Fatigue Monitoring is an existing program that will be enhanced to: 1. Address the cumulative fatigue damage effects of the reactor coolant environment on component life by evaluating the impact of the reactor coolant environment on critical components for the plant identified in NUREG/CR-6260. Additional plant-specific component locations in the reactor coolant pressure boundary will be evaluated if they are more limiting than those considered in NUREG/CR-6260. 2. Monitor and track additional plant transients that are significant contributors to component fatigue usage.	Program to be enhanced prior to the period of extended operation. Environmental fatigue evaluations to be performed prior to the period of extended operation.	Section A.3.1.1

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		3. Evaluate the effects of the reactor coolant system water environment on the reactor vessel internal components with existing fatigue CUF analyses to satisfy the evaluation requirements of ASME Code, Section III, Subsection NG-2160 and NG-3121.		
44	Concrete Containment Tendon Prestress	Concrete Containment Tendon Prestress is an existing program that will be enhanced to: 1. For each surveillance interval, the predicted lower-limit, minimum required value, and trending lines will be developed for the period of extended operation as part of the regression analysis for each tendon group.	Program to be enhanced prior to the period of extended operation.	Section A.3.1.2
45	Environmental Qualification (EQ) of Electric Components	Existing program is credited.	Ongoing	Section A.3.1.3
46	Operating Experience	The Operating Experience Program is an existing program that will be enhanced to: 1. Require the review of internal and external operating experience for aging-related degradation or impacts to aging management activities, to determine if improvements to Byron and Braidwood Units 1 and 2 aging management activities are warranted. NRC and industry guidance documents and standards applicable to aging management are considered part of this information (e.g., License Renewal Interim Staff Guidance (LR-ISG) documents, NUREG-1801 (GALL) revisions, etc.) Ensure there are written expectations for identifying and processing these documents as operating experience. 2. Establish criteria to define aging-related degradation. In general, the criteria will be used to identify aging that is in excess of what would be expected, relative to design, previous inspection experience and the inspection intervals. 3. Establish identification coding within the corrective action program for use in identification, trending and communications of aging-related degradation. Provide a definition for the coding.	Program to be enhanced no later than the date that the renewed operating licenses are issued and conducted on an ongoing basis throughout the terms of the renewed licenses.	Section A.1.6

NO.	PROGRAM OR TOPIC	COMMITMENT	IMPLEMENTATION SCHEDULE	SOURCE
		This coding will assist plant personnel in ensuring that, in addition to addressing the specific issue, the adequacy of existing aging management programs is assessed. Station personnel are required to periodically assess the performance of the aging management programs, including insights obtained through operating experience. Adverse trends are entered into the corrective action program for evaluation. This could lead to AMP revisions or the establishment of new AMPs, as appropriate. 4. Require communication of significant internal aging-related degradation, associated with SSCs in the scope of license renewal, to other Exelon plants and to the industry. Criteria will be established for determining when aging-related degradation is significant. 5. Provide training to those responsible for screening, evaluating and communicating operating experience items related to aging management and aging-related degradation. This training will be commensurate with their role in the process, will be provided periodically and include provisions to accommodate personnel turnover.		

APPENDIX B AGING MANAGEMENT PROGRAMS
TABLE OF CONTENTS

B.1 Introduction

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

B.1.1 Overview

License renewal Aging Management Program (AMP) descriptions are provided in this appendix for each program credited for managing aging effects based upon the Aging Management Review (AMR) results provided in Sections 3.1 through 3.6 of this application.

In general, there are four (4) types of AMPs:

- Prevention programs preclude aging effects from occurring.
- Mitigation programs slow the effects of aging.
- Condition monitoring programs inspect/examine for the presence and extent of aging.
- Performance monitoring programs test the ability of a structure or component to perform its intended function.

More than one type of AMP may be implemented for a component to ensure that aging effects are managed.

Part of the demonstration that the effects of aging are adequately managed is to evaluate credited programs and activities against certain required attributes. Each of the AMPs described in this section has ten (10) elements which are consistent with the attributes described in Appendix A.1, “Aging Management Review – Generic (Branch Technical Position RLSB-1)” and in Table A.1-1 “Elements of an Aging Management Program for License Renewal” of NUREG-1800.

Credit has been taken for existing plant programs whenever possible. As such, all programs and activities associated with a system, structure, component, or commodity grouping were considered. Existing programs and activities that apply to systems, structures, components, or commodity groupings were reviewed to determine whether they include the necessary actions to manage the effects of aging.

Existing plant programs were often based on a regulatory commitment or requirement, rather than aging management. Many of these existing programs included the required license renewal 10-element attributes, and have been demonstrated to adequately manage the identified aging effects. If an existing program did not adequately manage an identified aging effect, the program was enhanced as necessary. Occasionally, the creation of a new program was necessary.

In several cases, exceptions to the aging management programs described in NUREG-1801 have been taken. In each case, technical justification is provided.

B.1.2 Method of Discussion

For those AMPs that are consistent with the assumptions made in Sections X and XI of NUREG-1801, or are consistent with exceptions or enhancements, each program discussion is presented in the following format:

- A Program Description abstract of the overall program form and function is provided.
- A NUREG-1801 Consistency statement is made about the program.
- Exceptions to the NUREG-1801 program are outlined and a justification for the exception(s) is provided.
- Enhancements or additions to the NUREG-1801 program are provided. A proposed schedule for completion is discussed.
- Operating Experience (OE) information specific to the program is provided.
- A Conclusion section provides a statement of reasonable assurance that the existing program is effective, or will be effective when implemented, if new or enhanced.

There are no plant-specific aging management programs in the Byron and Braidwood Stations, Units 1 and 2 License Renewal Application.

B.1.3 Quality Assurance Program and Administrative Controls

The Quality Assurance Program implements the requirements of 10 CFR 50, Appendix B, and is consistent with the summary in Appendix A.2, “Quality Assurance for Aging Management Programs (Branch Technical Position IQMB-1)” of NUREG-1800. The Quality Assurance Program includes the elements of corrective action, confirmation process, and administrative controls, and is applicable to the safety-related and nonsafety-related systems, structures, components (SSCs), and commodity groups that are subject to AMR. Generically, the three elements are applicable as follows:

Corrective Actions:

A single corrective action program is applied regardless of the safety classification of the system, structure, component, or commodity group. Corrective actions are implemented through the initiation of an Issue Report in accordance with the Corrective Action Program in place to meet the requirements of 10 CFR 50, Appendix B. The Corrective Action Program requires the initiation of an Issue Report (IR) for actual or potential problems, including unexpected plant equipment degradation, damage, failure, malfunction, or loss of function. Site documents that implement aging management programs for license renewal direct that an IR be prepared in accordance with those procedures whenever non-conforming conditions are found (i.e., the acceptance criteria are not met).

Equipment deficiencies are corrected through the Work Control Process in accordance with plant procedures. The Corrective Action Program specifies that for equipment deficiencies an IR be initiated for condition identification, assignment of significance level and investigation class, investigation, corrective action determination, investigation report review and approval, action tracking, and trend analysis.

The Corrective Action Program implements the requirements of NO-AA-10, the Exelon Quality Assurance Topical Report (QATR), Chapter 16, “Corrective Action.” Specifically, conditions adverse to quality and significant conditions adverse to quality are resolved through direct action, the implementation of corrective actions, and where appropriate, the implementation of corrective actions to prevent recurrence.

Confirmation Process:

The focus of the confirmation process is on the follow-up actions that must be taken to verify effective implementation of corrective actions. The measure of effectiveness is in terms of correcting and precluding repetition of adverse conditions. The Corrective Action Program includes provisions for timely evaluation of adverse conditions and implementation of corrective actions required, including root cause determinations and prevention of recurrence where appropriate (e.g., significant conditions adverse to quality). The Corrective Action Program provides for tracking, coordinating, monitoring, reviewing, verifying, validating, and approving corrective actions, to ensure effective corrective actions are taken. The Corrective Action Program also includes monitoring for potentially adverse trends. The existence of an adverse trend due to recurring or repetitive adverse conditions results in the initiation of an IR. The aging management programs required for license renewal would also result in identification of related unsatisfactory conditions due to ineffective corrective action.

Since the same 10 CFR 50, Appendix B corrective actions and confirmation process is applied for nonconforming safety-related and nonsafety-related systems, structures, and components subject to AMR for license renewal, the Corrective Action Program is consistent with the NUREG-1801 elements.

Administrative Controls:

The document control process applies to all generated documents, procedures, and instructions regardless of the safety classification of the associated system, structure, component, or commodity group. Document control processes are implemented in accordance with the requirements of 10 CFR 50, Appendix B, “Quality Assurance Requirements for Nuclear Power Plants and Fuel Reprocessing Plants.” Implementation is further defined in NO-AA-10, the

Exelon Quality Assurance Topical Report (QATR), Chapter 6, “Document Control.”

Administrative controls procedures provide information on procedures, instructions and other forms of administrative control documents, as well as guidance on classifying these documents into the proper document type and as-building frequency. Revisions will be made to procedures and instructions that implement or administer aging management program requirements for the purposes of managing the associated aging effects for the period of extended operation.

B.1.4 Operating Experience

Operating experience from internal (also referred to as plant-specific) and external (also referred to as industry) sources is captured and systematically reviewed on an ongoing basis in accordance with the Quality Assurance program, which meets the requirements of 10 CFR Appendix B, and the Operating Experience program, which meets the requirements of NUREG-0737, “Clarification of TMI Action Plan Requirements,” Item I.C.5, “Procedures for Feedback of Operating Experience to Plant Staff.” The Operating Experience program interfaces with and relies on active participation in the “Institute of Nuclear Power Operations” Operating Experience program, as endorsed by the NRC.

Operating experience is used at Byron and Braidwood Stations, Units 1 and 2 to enhance plant programs, prevent repeat events, and prevent events that have occurred at other plants. As part of the Exelon fleet, Byron and Braidwood Stations, Units 1 and 2 receive Operating Experience (internal and external to Exelon Nuclear) daily. The Operating Experience process (OPEX) screens, evaluates, and acts on operating experience documents and information to prevent or mitigate the consequences of similar events. The OPEX process reviews operating experience from external and internal sources. External operating experience includes INPO documents, NRC documents (e.g., Information Notices, Regulatory Information Summaries, Interim Staff Guidance), and other documents (e.g., Licensee Event Reports, 10 CFR Part 21 Reports). Internal operating experience includes event investigations, trending reports, and lessons learned from in-house events as captured in Program Health Reports, Assessments, and in the 10 CFR Part 50, Appendix B Corrective Action Program.

Each aging management program (AMP) summary in this appendix contains a discussion of operating experience relevant to the program. This information was obtained through the review of internal operating experience captured by the Corrective Action Program, Program Assessments, Program Health Reports, and through the review of external operating experience. Additionally, operating experience was obtained through interviews with system engineers, program engineers, and other plant personnel. New programs utilized internal and/or external operating experience as applicable, and discuss the operating experience and associated corrective actions as they relate to implementation of the new program. The operating experience in each AMP summary identifies past corrective actions that have resulted in program enhancements and provides objective evidence that the effects of aging have been, and will continue to be, adequately managed so that the intended functions of the structures and components within the scope of each program will be maintained during the period of extended operation.

Ongoing evaluation of operating experience related to aging management will begin no later than receipt of the renewed operating licenses, and will consider the following aspects:

- Systems, structures, or components that are similar or identical to those involved with the identified operating experience issue, to gain relevant lessons learned.
- Material of construction, operating environment, and aging effects associated with the identified aging issue so that lessons learned can be applied to susceptible SSCs within the scope of license renewal.
- Aging mechanisms associated with the operating experience to confirm that Byron and Braidwood Stations have appropriate AMPs in place to manage aging that could be caused by these mechanisms.
- AMPs associated with this operating experience so that if the AMPs have been demonstrated to be ineffective, similar AMPs in place at Byron and Braidwood Stations can be evaluated to determine if AMP changes are appropriate, or a new AMP is needed. Included in this review is consideration of activities, criteria, and evaluations integral to the elements of the plant AMPs.

As described above, the existing Operating Experience process, in conjunction with the Corrective Action Program, has proven to be effective in learning from adverse conditions and events, and improving programs that address aging-related degradation. In order to provide additional assurance that internal and external operating experience related to aging management is used effectively during the period of extended operation, Byron and Braidwood Stations, Units 1 and 2 will enhance its Operating Experience Program to:

1. Require the review of internal and external operating experience for aging-related degradation or impacts to aging management activities, to determine if improvements to Byron and Braidwood Units 1 and 2 aging management activities are warranted. NRC and industry

guidance documents and standards applicable to aging management are considered part of this information (e.g., License Renewal Interim Staff Guidance (LR-ISG) documents, NUREG-1801 (GALL) revisions, etc.) Ensure there are written expectations for identifying and processing these documents as operating experience.

2. Establish criteria to define aging-related degradation. In general, the criteria will be used to identify aging that is in excess of what would be expected, relative to design, previous inspection experience and the inspection intervals.

3. Establish identification coding within the corrective action program for use in identification, trending and communications of aging-related degradation. Provide a definition for the coding. This coding will assist plant personnel in ensuring that, in addition to addressing the specific issue, the adequacy of existing aging management programs is assessed. Station personnel are required to periodically assess the performance of the aging management programs, including insights obtained through operating experience. Adverse trends are entered into the corrective action program for evaluation. This could lead to AMP revisions or the establishment of new AMPs, as appropriate.

4. Require communication of significant internal aging-related degradation, associated with SSCs in the scope of license renewal, to other Exelon plants and to the industry. Criteria will be established for determining when aging-related degradation is significant.

5. Provide training to those responsible for screening, evaluating and communicating operating experience items related to aging management and aging-related degradation. This training will be commensurate with their role in the process, will be provided periodically and include provisions to accommodate personnel turnover.

These enhancements will be implemented no later than the date that the renewed operating licenses are issued and conducted on an ongoing basis throughout the terms of the renewed licenses.

B.1.5 NUREG-1801 Chapter XI Aging Management Programs

The following NUREG-1801 Chapter XI AMPs are described in Section B.2 of this appendix as indicated. Programs are identified as either existing or new to Byron and Braidwood. All programs are or will be consistent with programs discussed in NUREG-1801.

1. ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (Section B.2.1.1) [Existing - Requires Enhancement]

2. Water Chemistry (Section B.2.1.2) [Existing]

3. Reactor Head Closure Stud Bolting (Section B.2.1.3) [Existing - Requires Enhancement]
4. Boric Acid Corrosion (Section B.2.1.4) [Existing]
5. Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (Section B.2.1.5) [Existing]
6. Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (Section B.2.1.6) [New]
7. PWR Vessel Internals (Section B.2.1.7) [New]
8. Flow-Accelerated Corrosion (Section B.2.1.8) [Existing]
9. Bolting Integrity (Section B.2.1.9) [Existing - Requires Enhancement]
10. Steam Generators (Section B.2.1.10) [Existing - Requires Enhancement]
11. Open-Cycle Cooling Water System (Section B.2.1.11) [Existing - Requires Enhancement]
12. Closed Treated Water Systems (Section B.2.1.12) [Existing - Requires Enhancement]
13. Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (Section B.2.1.13) [Existing - Requires Enhancement]
14. Compressed Air Monitoring (Section B.2.1.14) [Existing - Requires Enhancement]
15. Fire Protection (Section B.2.1.15) [Existing - Requires Enhancement]
16. Fire Water System (Section B.2.1.16) [Existing - Requires Enhancement]
17. Aboveground Metallic Tanks (Section B.2.1.17) [New]
18. Fuel Oil Chemistry (Section B.2.1.18) [Existing - Requires Enhancement]
19. Reactor Vessel Surveillance (Section B.2.1.19) [Existing - Requires Enhancement]
20. One-Time Inspection (Section B.2.1.20) [New]
21. Selective Leaching (Section B.2.1.21) [New]
22. One-Time Inspection of ASME Code Class 1 Small Bore-Piping (Section B.2.1.22) [New]
23. External Surfaces Monitoring of Mechanical Components (Section B.2.1.23) [New]

24. Flux Thimble Tube Inspection (Section B.2.1.24) [Existing]
25. Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (Section B.2.1.25) [New]
26. Lubricating Oil Analysis (Section B.2.1.26) [Existing]
27. Monitoring of Neutron-Absorbing Materials Other than Boraflex (Section B.2.1.27) [Existing]
28. Buried and Underground Piping (Section B.2.1.28) [Existing - Requires Enhancement]
29. ASME Section XI, Subsection IWE (Section B.2.1.29) [Existing - Requires Enhancement]
30. ASME Section XI, Subsection IWL (Section B.2.1.30) [Existing - Requires Enhancement]
31. ASME Section XI, Subsection IWF (Section B.2.1.31) [Existing - Requires Enhancement]
32. 10 CFR Part 50, Appendix J (Section B.2.1.32) [Existing]
33. Masonry Walls (Section B.2.1.33) [Existing - Requires Enhancement]
34. Structures Monitoring (Section B.2.1.34) [Existing - Requires Enhancement]
35. RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (Section B.2.1.35) [Existing - Requires Enhancement]
36. Protective Coating Monitoring and Maintenance Program (Section B.2.1.36) [Existing - Requires Enhancement]
37. Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.37) [New]
38. Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits (Section B.2.1.38) [New]
39. Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.39) [New]
40. Metal-Enclosed Bus (Section B.2.1.40) [Existing - Requires Enhancement]
41. Fuse Holders (Byron Only) (Section B.2.1.41) [New]
42. Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.42) [New]

B.1.6 NUREG-1801 Chapter X Aging Management Programs

The following NUREG-1801 Chapter X AMPs are described in Section B.3 of this appendix as indicated. These Chapter X AMPs are existing programs.

1. Fatigue Monitoring (Section B.3.1.1) [Existing - Requires Enhancement]
2. Concrete Containment Tendon Prestress (Section B.3.1.2) [Existing - Requires Enhancement]
3. Environmental Qualification (EQ) of Electric Components (Section B.3.1.3) [Existing]

B.2 Aging Management Programs

B.2.0 NUREG-1801 Aging Management Program Correlation

The correlation between the NUREG-1801 (Generic Aging Lessons Learned (GALL)) programs and the Byron and Braidwood Aging Management Programs (AMPs) is shown below. Links to the sections describing the Byron and Braidwood NUREG-1801 programs are provided.

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	BYRON AND BRAIDWOOD STATION PROGRAM
XI.M1	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (Section B.2.1.1)
XI.M2	Water Chemistry	Water Chemistry (Section B.2.1.2)
XI.M3	Reactor Head Closure Stud Bolting	Reactor Head Closure Stud Bolting (Section B.2.1.3)
XI.M4	BWR Vessel ID Attachment Welds	Not Applicable (Byron and Braidwood are PWR’s)
XI.M5	BWR Feedwater Nozzle	Not Applicable (Byron and Braidwood are PWR’s)
XI.M6	BWR Control Rod Drive Return Line Nozzle	Not Applicable (Byron and Braidwood are PWR’s)
XI.M7	BWR Stress Corrosion Cracking	Not Applicable (Byron and Braidwood are PWR’s)
XI.M8	BWR Penetrations	Not Applicable (Byron and Braidwood are PWR’s)
XI.M9	BWR Vessel Internals	Not Applicable (Byron and Braidwood are PWR’s)

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	BYRON AND BRAIDWOOD STATION PROGRAM
XI.M10	Boric Acid Corrosion	Boric Acid Corrosion (Section B.2.1.4)
XI.M11B	Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (PWRs only)	Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (Section B.2.1.5)
XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) (Section B.2.1.6)
XI.M16A	PWR Vessel Internals	PWR Vessel Internals (Section B.2.1.7)
XI.M17	Flow-Accelerated Corrosion	Flow-Accelerated Corrosion (Section B.2.1.8)
XI.M18	Bolting Integrity	Bolting Integrity (Section B.2.1.9)
XI.M19	Steam Generators	Steam Generators (Section B.2.1.10)
XI.M20	Open-Cycle Cooling Water System	Open-Cycle Cooling Water System (Section B.2.1.11)
XI.M21A	Closed Treated Water Systems	Closed Treated Water Systems (Section B.2.1.12)
XI.M22	Boraflex Monitoring	Not used. Not credited for aging management. This material is not used in the spent fuel pool racks.
XI.M23	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (Section B.2.1.13)
XI.M24	Compressed Air Monitoring	Compressed Air Monitoring (Section B.2.1.14)
XI.M25	BWR Reactor Water Cleanup System	Not Applicable (Byron and Braidwood are PWR's)
XI.M26	Fire Protection	Fire Protection (Section B.2.1.15)
XI.M27	Fire Water System	Fire Water System (Section B.2.1.16)
XI.M29	Aboveground Metallic Tanks	Aboveground Metallic Tanks (Section B.2.1.17)
XI.M30	Fuel Oil Chemistry	Fuel Oil Chemistry (Section B.2.1.18)
XI.M31	Reactor Vessel Surveillance	Reactor Vessel Surveillance (Section B.2.1.19)
XI.M32	One-Time Inspection	One-Time Inspection (Section B.2.1.20)
XI.M33	Selective Leaching	Selective Leaching (Section B.2.1.21)
XI.M35	One-Time Inspection of ASME Code Class 1 Small Bore-Piping	One-Time Inspection of ASME Code Class 1 Small-Bore Piping (Section B.2.1.22)

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	BYRON AND BRAIDWOOD STATION PROGRAM
XI.M36	External Surfaces Monitoring of Mechanical Components	External Surfaces Monitoring of Mechanical Components (Section B.2.1.23)
XI.M37	Flux Thimble Tube Inspection	Flux Thimble Tube Inspection (Section B.2.1.24)
XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (Section B.2.1.25)
XI.M39	Lubricating Oil Analysis	Lubricating Oil Analysis (Section B.2.1.26)
XI.M40	Monitoring of Neutron-Absorbing Materials Other than Boraflex	Monitoring of Neutron-Absorbing Materials Other than Boraflex (Section B.2.1.27)
XI.M41	Buried and Underground Piping and Tanks	Buried and Underground Piping (Section B.2.1.28)
XI.S1	ASME Section XI, Subsection IWE	ASME Section XI, Subsection IWE (Section B.2.1.29)
XI.S2	ASME Section XI, Subsection IWL	ASME Section XI, Subsection IWL (Section B.2.1.30)
XI.S3	ASME Section XI, Subsection IWF	ASME Section XI, Subsection IWF (Section B.2.1.31)
XI.S4	10 CFR Part 50, Appendix J	10 CFR Part 50, Appendix J (Section B.2.1.32)
XI.S5	Masonry Walls	Masonry Walls (Section B.2.1.33)
XI.S6	Structures Monitoring	Structures Monitoring (Section B.2.1.34)
XI.S7	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (Section B.2.1.35)
XI.S8	Protective Coating Monitoring and Maintenance Program	Protective Coating Monitoring and Maintenance Program (Section B.2.1.36)
XI.E1	Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.37)
XI.E2	Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits (Section B.2.1.38)
XI.E3	Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.39)

NUREG-1801 NUMBER	NUREG-1801 PROGRAM	BYRON AND BRAIDWOOD STATION PROGRAM
XI.E4	Metal Enclosed Bus	Metal Enclosed Bus (Section B.2.1.40)
XI.E5	Fuse Holders	Fuse Holders (Byron Only) (Section B.2.1.41)
XI.E6	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements (Section B.2.1.42)
X.M1	Fatigue Monitoring	Fatigue Monitoring (Section B.3.1.1)
X.S1	Concrete Containment Tendon Prestress	Concrete Containment Tendon Prestress (Section B.3.1.2)
X.E1	Environmental Qualification (EQ) of Electrical Components	Environmental Qualification (EQ) of Electric Components (Section B.3.1.3)

B.2.1 NUREG-1801 Chapter XI Aging Management Programs

This section provides program summaries of the NUREG-1801 Chapter XI programs credited for managing the effects of aging. As discussed in Section B.1.4, both plant-specific and industry operating experience has been reviewed and considered as it relates to both new and existing aging management programs.

B.2.1.1 ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD

Program Description

The existing ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program manages the aging effects of cracking, loss of fracture toughness, and loss of material in Class 1, 2, and 3 piping and components exposed to air with borated water leakage, reactor coolant, reactor coolant and neutron flux, treated borated water, steam, and treated water environments. This condition monitoring program includes periodic visual, surface, and volumetric examination and leakage testing of Class 1, 2, and 3 pressure-retaining components including welds, pump casings, valve bodies, integral attachments, and pressure-retaining bolting for assessment, identification of signs of age-related degradation, and establishment of corrective actions. The program includes examinations and tests performed to identify and manage cracking, loss of fracture toughness, and loss of material in Class 1, 2, and 3 piping and components. Inspection of these components is in accordance with Subsections IWB, IWC, and IWD, respectively.

The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program implements the required component examination schedule in accordance with ASME Section XI, Subsection IWB-2400, IWC-2400 or IWD-2400 and examination categories, applicable components, examination methods, acceptance standards, and frequency of examination as specified in Tables IWB-2500-1, IWC-2500-1, and IWD-2500-1. The examination methods specified in Tables IWB-2500-1, IWC-2500-1 and IWD-2500-1 are based on approved industry standards for detecting age-related degradation of components. The program requires that indications and relevant conditions detected during examinations be evaluated in accordance with ASME Section XI, Articles IWB-3000 for Class 1, IWC-3000 for Class 2, and IWD-3000 for Class 3. The program directs that repair and replacement activities be performed in conformance with IWA-4000. This condition-monitoring program provides adequate monitoring methods that are effective in detecting the relevant aging effects and the frequency of monitoring is adequate to prevent significant age-related degradation.

In accordance with 10 CFR 50.55a(g)(4)(ii), the ISI program is updated each successive 120-month inspection interval to comply with the requirements of the latest edition of the ASME Code specified twelve months before the start of the inspection interval.

The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program includes all component inspection activities required by ASME Code, Section XI, Subsections IWB, IWC, and IWD in conjunction with component types that are covered by the following license renewal aging management programs as described within the referenced aging management program bases documents listed below:

- Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components, B.2.1.5
- Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS), B.2.1.6
- PWR Vessel Internals, B.2.1.7
- Steam Generators, B.2.1.10
- One-Time Inspection of ASME Code Class 1 Small-Bore Piping, B.2.1.22

NUREG-1801 Consistency

The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program is consistent with the ten elements of aging management program XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancement will be implemented in the following program element:

1. Conduct a visual inspection of the accessible portions of the ASME Class 2 reactor vessel flange leakage monitoring tube every other refueling outage. **Program Elements Affected: Scope of Program (Element 1)**

Operating Experience

The following examples of operating experience provide objective evidence that the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron and Braidwood Stations</u>

1. ASME Section XI is revised every three years and the addenda issued in the interim which allows the code to be updated to reflect industry experience. The ISI program at Byron and Braidwood is updated at the end of each inservice inspection ten-year interval to reference a newer edition of ASME Section XI. In this way, industry experience that has been incorporated into ASME Section XI is incorporated into the BBS ISI program.

<u>Byron Station</u>

1. In the Spring of 2007, during a refueling outage at Byron Unit 2, an indication was discovered during the volumetric examination of the Control Rod Drive Mechanism (CRDM) penetration nozzle 68. After discovery of the indication on CRDM penetration nozzle 68, a liquid penetrant test (PT) was performed to confirm the indication. This inspection was conducted based on the industry operating experience from NRC Information Notice 2001-05, “Through-wall Circumferential Cracking of Reactor Vessel Head Control Rod Drive Mechanism Penetration Nozzles at Oconee Nuclear Station, Unit 3” and NRC Bulletin 2002-02, “Reactor Pressure Vessel Head and Vessel Head Penetration Nozzle Inspection Programs.” The Byron reactor vessel heads were initially classified in the low susceptibility category for this type of cracking. The condition was entered into the corrective action program. The CRDM penetration indication was identified prior to any through-wall leakage. The root cause was determined to be lack of fusion during the initial construction that resulted in a weld defect. The weld defect allowed initiation of primary water stress corrosion cracking (PWSCC). The indication was repaired and the reactor vessel head was returned to service. As part of an extent of condition review, a bare-metal visual examination was completed on the remainder of the 78 reactor vessel head penetrations, and no evidence of boric acid was indicated on the Byron Unit 2 vessel head. As a result of this condition, the Byron Unit 2

reactor vessel head has been reclassified into the high susceptibility category with future inspections required every refueling outage.

This event demonstrates that the use of ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program is effective in identifying degrading conditions and that the corrective action program is utilized to evaluate degraded conditions and implement corrective actions to maintain component intended function.

2. During the Byron Station Unit 1 Spring 2011 refueling outage, ISI personnel performed volumetric and surface examinations of the Reactor Vessel Head Penetration (VHP) nozzles in accordance with 10 CFR 50.55a(g)(6)(ii)(D). Examination results identified a total of four recordable indications associated with nozzles 31, 43, 64, and 76 that did not meet the applicable acceptance criteria, and therefore, required repair prior to returning the reactor head to service. Some of the defects in nozzles 31 and 43 were located in the reactor coolant system pressure boundary region. The conditions were entered into the corrective action program. Corrective action consisted of repairing the nozzles and as part of extent of condition, a full bare metal visual reactor head inspection was performed and did not identify any additional indications. The defects were identified in a timely manner and repaired prior to through-wall leakage occurring. The defects were identified as part of the required periodic inspections performed in accordance with NRC Order EA-03-009.

   This event demonstrates that the use of ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program is effective in identifying age-related degradation and that the corrective action program is utilized to evaluate degraded conditions and implement corrective actions to maintain component intended function.

3. In August 2011, a focused area self-assessment of the Inservice Inspection (ISI) program was conducted at the Byron Station. The primary objective of the assessment was to verify that the ASME Section XI and augmented programs are effectively implemented and conform to the ASME Section XI Code, 10 CFR 50.55a, and the industry requirements as implemented through the Third Interval Inservice Inspection Plan and Exelon procedures. The conclusion was that the program was found to be in compliance with the regulatory requirements and aligned with industry standards.

This assessment included evaluations of the following areas: Inservice Inspection Programs, Pressure Tests, Snubber Testing, Repair/Replacement, Augmented Point of Contact activity for Alloy 600, and Containment Surfaces (CISI). The results of the assessment identified thirty-eight (38) items for improvement and eleven (11) deficiencies. The results of the assessment were entered into the corrective action program. Areas for improvement in the ISI area identified the need for several procedure revisions to ensure compliance with the new NRC Final Rule 10 CFR 50 on ASME Codes, "American Society of Mechanical Engineers (ASME) Codes and New and Revised ASME Code Cases," in the Federal Register (i.e., 76FR36232), as well as areas associated with new and revised Code Cases and personnel qualifications. In addition, revisions were made to the scheduling and ISI selection documents and database to reflect a more current status of ISI related activities. Assignments were entered into the corrective action program to track resolution of the document deficiencies and implementation of the improvement opportunities. All of the improvements have been completed to enhance the program implementing activities at the station.

This example provides objective evidence that the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program utilizes the industry and plant operating experience to continually improve the program. The example also demonstrates that deficiencies are entered into the corrective action program and appropriate actions are taken to evaluate and resolve the deficiencies.

Braidwood Station

1. In April, 2012, an indication was discovered at Braidwood Unit 1 in the upper reactor vessel head penetration number 69 during the scheduled refueling outage volumetric examination. The defect was located on the outside diameter of the penetration tube and was axially-oriented with a linear extent of 0.600" with a depth of 0.216" (approximately 33.5% through wall). The indication was characterized as a primary water stress corrosion cracking (PWSCC) type defect. In accordance with the 2004 Edition of ASME Section XI Acceptance Criteria in Table IWB-3663-1 General Note (a), "Linear surface flaws of any size in the partial penetration nozzle to vessel (J-groove weld) are not acceptable." The examinations were performed utilizing procedures and personnel qualified in accordance with the EPRI Performance Demonstration Program by the implementation of 10 CFR 50.55a and in accordance with ASME Section XI Code Case N-729-1 as amended by 10 CFR 50.55a(g)(6)(ii)(D). The examination results of penetration 69 were documented in the ultrasonic report data sheet and reported in the corrective action program.

   Corrective actions from the apparent cause evaluation included repairing the defect in penetration 69 and revising the frequency of the Unit 1 bare metal visual and volumetric examinations to every refueling outage. In addition as part of an extent of condition, a demonstrated volumetric leak path assessment was also performed on all the remaining 78 reactor vessel head penetrations in accordance with 10 CFR 50.55a(g)(6)(ii)(D), no indication of through wall leakage was observed. Also a bare metal visual examination of the exterior surfaces of the vessel head penetrations was also performed in accordance with ASME Section XI Code Case N-729-1, and no indication of through-wall leakage was observed during the bare metal visual examination.

This was the second volumetric examination performed on the Braidwood Unit 1 reactor vessel head penetrations. The first volumetric examination was performed during the refueling outage in April 2006. No evidence of PWSCC was identified during the previous examination.

This event demonstrates that the use of ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program is effective in identifying age-related degradation and that the corrective action program is utilized to evaluate degraded conditions and implement corrective actions to maintain component intended function.

2. During the April 2006 Refueling Outage, while removing insulation from the surge line of the Braidwood Unit 1 pressurizer, boric acid leakage was discovered on the insulation. The leakage was identified as originating from the number 52 pressurizer heater near the upper weld between the pressurizer heater sleeve and heater coupling. Technical Requirements Manual Limiting Condition for Operation (TLCO) 3.4.f Condition A was entered for one or more ASME components not in conformance due to pressure boundary leakage. The condition was entered into the corrective action program. The heater coupling and a portion of the sleeve was cut out of the system and the remaining portion of the heater sleeve was plugged and welded using an engineered ASME Section III repair procedure. Following the repair of the pressurizer, TLCO 3.4.f Condition A was exited.

   The root cause performed under the corrective action program concluded the observed boric acid leakage was the result of intergranular stress corrosion cracking (IGSCC) of the number 52 pressurizer heater sleeve in the heat affected zone weld through a locally sensitized section of the Type 316 stainless steel base material. The leak was identified during refueling outage inspection activities, not during plant operation. All 78 pressurizer heater sleeves and couplings were visually inspected during the same refueling outage as part of the extent of condition investigation. Pressurizer heater sleeve and coupling 52 was confirmed to be the only leakage source. Based on the amount of boric acid leakage present, the leak size was determined to be extremely small and the associated leak rate was too small to be captured by normal operation surveillance methods. Operating experience for this design of stainless steel heater sleeve indicates that the heater at location 52 of Braidwood Unit 1 represents the only occurrence of IGSCC-induced circumferential cracking in the industry for the pressurizer heater sleeves. The consequences of such an event are bounded by the results of existing small break loss of coolant accident (SBLOCA) emergency core cooling system performance analysis. Future corrective actions included inspection of all pressurizer heater sleeves during each refueling outage in accordance with the augmented ISI Program. The long-term recommendations to detect leakage are to perform bare metal examinations every refueling outage until further industry guidance was developed. An extent of condition investigation was conducted for both Byron Units under separate actions as well as for Braidwood Unit 2. These inspections were completed with no further indications found on the pressurizer heater sleeves.

This event demonstrates that the use of ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program is effective in identifying age-related degradation and that the corrective action program including root cause analysis and extent of condition analysis is utilized to evaluate degraded conditions and implement corrective actions to maintain component intended function.

3. In the April 2009 refueling outage, four welded attachments (lugs) were inspected on the main steam outlet line on the Braidwood Unit 1 C Steam Generator adjacent to the piping support located in containment outside the missile barrier. Nine indications were found during a magnetic particle examination. In accordance with the ASME Table IWB-3514-4, the allowable flaw length cannot exceed 0.42 inches. Five of the nine indications exceeded this acceptance criteria, therefore, three additional examination locations were required in accordance with IWC-2430 that are similar to the same material and service with the same type of flaws or relevant conditions. This condition was entered into the corrective action program. Engineering evaluation of the flaws concluded that the flaws were related to the original fabrication or construction welding. The evaluation concluded there is no design load that would cause the flaws to propagate. Even if the lug were to shear at the location of the flaw, the remaining portion of the lug weld would still perform its function. Therefore, no repair was required to be made on the welds.

   As part of the expanded scope inspections (extent of condition) on the similar welded attachments on the other steam generators, examinations of the attachment weld lugs on the Braidwood Unit 1 A, B, and D Steam Generators were performed during this refueling outage. Several indications were found on these lugs as well and were evaluated in accordance with the ISI program. These conditions were also entered into the corrective action program for evaluation. The final disposition determined that no repair was required to be performed on these welds. The corresponding welds on Unit 2 were also scheduled to be examined during the following Unit 2 refueling outage.

   This event demonstrates that the use of ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program is effective in identifying degradation and that the corrective action program is utilized to evaluate degraded conditions and implement corrective actions to maintain component intended function.

4. In May 2007 at Braidwood, an active through-wall leak was discovered on the service water return line from the 2A emergency diesel generator. The leak was identified on the top of the pipe at the location of the clamp for the seismic support. This portion of the service water (SX) system is stagnant during normal plant operation, since the emergency diesel generator is not normally in operation. An ultrasonic examination was performed on the SX line in the area of the through-wall leak, and was able to characterize the flaw as localized corrosion consistent with microbiologically-influenced corrosion (MIC). A calculation concluded that the structural integrity of the line was maintained, even considering a significantly larger flaw than the actual measured size of the flaw from the ultrasonic test (UT).

   Additional UT readings were taken at no more than 30-day intervals to ensure that the growth of the flaw did not invalidate the results of the structural integrity evaluation. Work orders were generated to perform inspections of the other train on Unit 2, and the corresponding piping on Unit 1. The SX piping on 2A emergency diesel generator was replaced in April 2008.

   This event demonstrates that the use of ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program is effective in identifying age-related degradation and that the corrective action program is utilized to evaluate degraded conditions and implement corrective actions to maintain component intended function.

The above examples provide objective evidence that the existing ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program for ASME Section XI components did not identify an adverse trend in performance. The examination methods being implemented by the program have been proven effective in detecting aging effects including cracking, loss of fracture toughness, and loss of material. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where age-related degradation is found. Assessments of the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that continued implementation of the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program will effectively identify age-related degradation prior to failure.

Conclusion

The existing ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program provides reasonable assurance that the identified aging effects of cracking, loss of material, and loss of fracture toughness are adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.2 Water Chemistry

Program Description

The Water Chemistry aging management program is an existing mitigative program whose activities mitigate the loss of material due to corrosion, cracking due to stress corrosion cracking (SCC) and related mechanisms, and reduction of heat transfer due to fouling. The program includes monitoring and control of known detrimental contaminants such as chloride, fluorides, dissolved oxygen, and sulfate concentrations below the levels known to result in loss of material, cracking, or reduction of heat transfer in accordance with EPRI 1014986, “PWR Primary Water Chemistry Guidelines,” Revision 6, and EPRI 1016555, “PWR Secondary Water Chemistry Guidelines,” Revision 7.

The Byron and Braidwood (BBS) Water Chemistry aging management program consists of monitoring and controlling the chemical environments of those systems that are exposed to reactor coolant, steam, treated borated water, and treated water, such that aging effects of system components are minimized in accordance with the guidance specified in EPRI 1014986, “PWR Primary Water Chemistry Guidelines,” Revision 6, and the EPRI 1016555, “PWR Secondary Water Chemistry Guidelines,” Revision 7. Major component types include the reactor vessel, reactor internals, pressurizer vessels, steam generator internals, heat exchangers, tanks, piping, piping elements, and piping components.

The primary system portion of the program is consistent with the EPRI PWR Primary Water Chemistry Guidelines and includes specific limits for pH, lithium, fluorides, chlorides, sulfates, sodium, dissolved oxygen, and other parameters. The chemistry control strategy for BBS primary systems is defined in the Byron and Braidwood primary strategic water chemistry plan. The program functions to maintain concentrations of known primary system detrimental contaminants below recommended levels in accordance with the EPRI guidelines. Additionally, limits are specified for chemistry parameters associated with PWR interfacing systems and components including the boric acid storage tanks, volume control tank, spent fuel pool, and other primary system interfacing components. Zinc injection is used to mitigate SCC in the primary systems. Control of reactor coolant and related interfacing system contaminants is maintained by using submicron filters and mixed bed demineralizers, which provide mechanical filtration and ion exchange functions to remove contaminants. Lithium hydroxide addition is used to control reactor coolant pH, while hydrogen addition is utilized for oxygen scavenging.

Similarly, chemical control of the secondary systems is consistent with the EPRI PWR Secondary Water Chemistry Guidelines and includes specific limits for chloride, sulfate, sodium, hydrazine, dissolved oxygen, total iron, pH, conductivity, and other parameters. Chemistry control for BBS secondary systems is defined in the Byron and Braidwood secondary water strategic chemistry plan. The program functions to maintain concentrations of known secondary system detrimental contaminants below recommended levels in accordance with the EPRI guidelines. The secondary systems scope of the program includes the secondary side of the steam generators and various secondary systems. Chemical control of the BBS secondary systems is established and maintained by removing contaminants with condensate demineralizers combined with steam generator blowdown. Chemical dispersants injection is used to mitigate SCC in the secondary systems. Chemical addition of approved amines, is utilized for pH control. Hydrazine is used to scavenge oxygen in secondary systems.

Routine primary and secondary system sampling frequencies and action limits for control parameters are specified in station procedures in accordance with EPRI guidelines. Corrective actions include consideration of increased sampling frequencies until the parameters are returned within specifications.

Water chemistry programs are generally effective in removing impurities from intermediate and high flow areas. However, industry experience has shown that water chemistry programs may not be effective in low flow or stagnant flow areas of plant systems. The Water Chemistry aging management program does not provide for detection of aging effects. However, components located in low and stagnant flow areas at Byron and Braidwood will receive a one-time inspection prior to the period of extended operation. This inspection will be performed as part of the One-Time Inspection aging management program (B.2.1.20). This program includes provisions specified by NUREG-1801 for the verification of proper chemistry control and aging management.

NUREG-1801 Consistency

The Water Chemistry aging management program is consistent with the ten elements of aging management program XI.M2, “Water Chemistry,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Water Chemistry program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

Byron and Braidwood Stations

1. In 2005, a representative from an international PWR reported in an industry operating experience meeting that elevated reactor coolant pH values greater than 7.2 were resulting in improved dose rates. Exelon chemistry

personnel recognized that elevated pH values would also improve PWSCC (primary water stress corrosion cracking) mitigation. At that time Byron and Braidwood maintained reactor coolant pH at a constant value of approximately 7.2. Exelon contracted Westinghouse to perform detailed evaluations for operation at Byron and Braidwood with elevated pH values greater than 7.2. In 2007, Westinghouse completed the evaluation and concluded that a variable pH program, which maintains primary system water in a pH range up to 7.4, was feasible and beneficial for dose reduction and aging management. The following strategy was implemented:

- From the beginning of the cycle until the boron concentrations peak, lithium concentrations will be coordinated with boron to achieve the highest possible constant pH without exceeding a pH target of 7.4;
- Once the boron concentrations peak lithium will be maintained constant at 3.5 ppm until the pH reaches the target value of 7.4; and
- Once the pH reaches the 7.4, lithium concentrations will be coordinated with boron to maintain pH at 7.4 for the remainder of the cycle.

The new variable pH program was implemented at Byron Unit 1 and Braidwood Unit 1 in 2008, at Byron Unit 2 in 2009, and at Braidwood Unit 2 in 2010.

This is example provides objective evidence that the water chemistry program proactively implements operating experience lessons learned to increase mitigation of known aging mechanisms.

2. Zinc injection into the reactor coolant system of pressurized water reactors has demonstrated benefits for mitigating stress corrosion cracking (SCC). Steam generator tube inspection data from non-destructive examination (NDE) at eight (8) plants injecting zinc indicate a reduction in the discovery of SCC, post zinc injection, by as much as 90%. This data is consistent with extensive laboratory testing, all of which show that zinc delays the initiation of SCC. In addition, the steam generator NDE data also show that zinc has reduced crack propagation from 17% to 60%. A maximum benefit was observed at 35 ppb, although some benefit was measured at levels as low as 5 ppb. Exelon and Westinghouse have performed evaluations and verified that proposed zinc injection programs will not adversely affect primary system performance while mitigating SCC. The zinc injection was implemented at Byron Unit 2 in 2005, Braidwood Unit 2 in 2006, and Byron Unit 1 and Braidwood Unit 1 in 2010. Presently all four units maintain an average zinc concentration target of 5 ppb. In addition actual dose rates have been reduced by approximately 50% after target zinc concentrations were established at each Unit. Exelon is currently investigating increasing the average zinc concentration target to 10 ppb.

This is example provides objective evidence that the water chemistry program proactively implements program improvements to increase mitigation of known aging mechanisms.

3. In 2010, Byron and Braidwood implemented the use of a chemical dispersants to increase secondary system side corrosion product removal from the steam generators. Byron and Braidwood have become industry leaders for this technology which injects dispersants into the feedwater system to minimize the propensity for corrosion products to deposit in the steam generators during power operation. The dispersants tend to keep the corrosion products in liquid solution which makes it easier for the steam generator blowdown system to remove the corrosion products from the steam generators. Dispersants have been shown to improve the capability of steam generator blowdown system to remove corrosion products by a factor of approximately 50%.

   Also, feedwater system iron concentration data from four Braidwood startups show that the amount of iron that is transported to the steam generators during start up and in the first few weeks of operation is about 25% of the total iron that is transported to the steam generators for the entire cycle. Therefore, Exelon implemented program controls designed to minimize the transport of corrosion products into the steam generators during startups and maximizes the removal of corrosion byproduct from the steam generators through use of dispersants. This is accomplished by injection of dispersants, performing thorough condensate and feedwater system flushing, and maximizing flush water pH and hydrazine concentration prior to forward feed to the steam generators.

   This example provides objective evidence that the water chemistry program proactively implements program improvements to decrease the concentrations of known detrimental contaminants to increase mitigation of known aging mechanisms.

Byron Station

1. In 2008, the Byron Unit 2 steam generator blowdown sodium analyzers began to indicate an increasing trend in sodium. Grab samples confirmed the in-line analyzer trend and also indicated increasing values for chlorides and sulfates. The condition was entered into the corrective action program. Byron Chemistry continued to monitor and identified a tube leak of approximately 0.01 gallons per hour (gph) in the “2D” condenser waterbox. Subsequently, the waterbox was removed from service, isolated, drained, the leaking condenser tubes were identified and plugged, and the waterbox was returned to service. A root cause determination was performed which included investigation of possible impingement sources, eddy current testing, and walkdown inside the condenser for signs of debris, foreign material, and loose or broken components which could have caused damage to the tubes. These activities found no credible cause for the tube leaks.

This example illustrates that the water chemistry program is effective in identifying even minor discrepancies in monitored parameters, as well as identifying and implementing corrective actions.

2. In 2010 Byron, implemented a mixed amine program, which simultaneously uses ethanolamine (ETA) and methoxypropylamine (MPA) for secondary systems pH control to improve mitigation of Flow Accelerated Corrosion (FAC). Some of the primary areas of concern for FAC are the moisture separators in the steam generators and various areas in the balance of plant steam piping and equipment, particularly where there is two phase flow. The implementation of this program was prompted by inspections of Unit 2 steam generator internal moisture separators which indicated accelerated wear rates since a recent power uprate. The mixed amine program consists of optimizing feedwater MPA and ETA target concentrations to ensure pH protection throughout the steam cycle and reduces FAC rates, including in the secondary system side of the steam generators.

   This is example provides objective evidence that the water chemistry program proactively implements program improvements to increase mitigation of known aging mechanisms.

Braidwood Station

1. In 2004 Exelon performed a Focus Area Self Assessment (FASA) to verify consistency between Braidwood chemistry procedures and the EPRI PWR Primary and Secondary Water Chemistry Guidelines. The FASA did not identify any deviations or exceptions from the EPRI guidelines. Water Chemistry program procedures are assessed and revised as appropriate, when the PWR Primary and Secondary Water Chemistry Guidelines are revised by EPRI. Therefore, the strategic water chemistry plans at Braidwood contain no exceptions to mandatory requirements or diagnostic parameters identified in the EPRI PWR Primary and Secondary Water Chemistry Guidelines.

   This example provides objective evidence that the water chemistry program performs self assessments to ensure the EPRI guidelines are effectively implemented.

2. In 2006, Braidwood placed into service a UV-peroxide system to reduce the total organic carbon (TOC) concentrations for water recycled to the Primary Water Storage Tanks (PWST). Presently, only the UV system and a carbon filter are in service. This action was prompted by a corrective action which documented that TOC concentrations in the PWST were greater than the Exelon goal of 100 ppb TOC. As a result of this modification, primary system makeup TOC concentrations were significantly reduced from approximately 500 ppb in December 2006 to less than 100 ppb in December 2007.

   This example provides objective evidence that the water chemistry program is effective in identifying discrepancies in monitored parameters and implements improvements to decrease the concentrations of known detrimental contaminants.

The operating experience relative to the Water Chemistry program did not identify an adverse trend in performance. The inspection methods implemented by the program have been proven effective in detecting aging effects including cracking, loss of material, reduction of heat transfer and wall thinning. Appropriate guidance for evaluation, repair, or replacement is provided for locations where degradation is found. Periodic self-assessments of the Water Chemistry program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that continued implementation of the Water Chemistry program will effectively identify degradation prior to failure or loss of intended function during the period of extended operation.

Conclusion

The existing Water Chemistry program provides reasonable assurance that the identified aging effects are adequately managed so that the intended functions components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.3 Reactor Head Closure Stud Bolting

Program Description

The Reactor Head Closure Stud Bolting aging management program is an existing preventive and condition monitoring program which credits ASME Code, Section XI inspections of reactor head closure studs and associated RPV head flange threads, nuts, and washers for cracking and loss of material. The Reactor Head Closure Stud Bolting aging management program manages aging effects of an air with borated water leakage environment. The program is based on the examination and inspection requirements specified in the ASME Section XI Code, Subsection IWB, Table IWB-2500-1, and preventive measures described in NRC NUREG-1339, "Resolution of Generic Safety Issue 29: Bolting Degradation or Failure of Nuclear Power Plants"; and NRC Regulatory Guide 1.65, “Materials and Inspection for Reactor Vessel Closure Studs.”

The current Byron and Braidwood ISI program plans for the third ten-year inspection interval are based on the 2001 Edition of the ASME Code, Section XI, through the 2003 addenda. The future 120-month inspection intervals will incorporate the requirements specified in the version of the ASME Code incorporated into 10 CFR 50.55a, 12 months before the start of the inspection interval. The Reactor Head Closure Stud Bolting aging management program implements ASME Code, Section XI inspection requirements through the ISI program plan. The inspections monitor for cracking, loss of material, and reactor coolant leakage. The program uses visual and volumetric examinations in accordance with the requirements of Section XI, Subsection IWA-2000. The Reactor Head Closure Stud Bolting aging management program was developed in accordance with the requirements detailed in the ASME Code, Section XI, Division 1, Subsection IWB, Table IWB-2500-1.

ASME Code, Section XI allows for a number of examination methods to be used for volumetric and visual inspections. The RPV head flange threads and studs receive a volumetric examination and the surfaces of nuts and washers are inspected using a VT-1 examination. All pressure-retaining boundary components in Examination Category B-P receive a visual VT-2 examination during the system leakage test and the system hydrostatic test. The extent and schedule for examining and testing the reactor head closure studs and associated RPV head flange threads, nuts, and washers is specified in Table IWB-2500-1 for Examination Category B-G-1 components, “Pressure Retaining Bolting Greater than 2 Inches in Diameter.”

Indications and relevant degraded conditions detected during examinations are evaluated in accordance with ASME Code, Section XI Subsection IWB-3100 for Class 1 components by comparing ISI results with the acceptance standards of IWB-3400 and IWB-3500. Specifically, flaw indications or relevant degraded conditions are evaluated in accordance with IWB-3515 or IWB-3517 as indicated in Table IWB-2500-1 and Table 3410-1 of ASME Code, Section XI. These monitoring methods are effective in detecting cracking and loss of materials and the frequency of monitoring is adequate to prevent significant age-related degradation.

The reactor head closure studs are constructed of ASME Code, SA540, Class 3, Grade B23 material, which has a maximum tensile strength of less than 170 ksi, which complied with Reg Guide 1.65, Revision 0 that was in effect during plant construction. The Reactor Head Closure Stud Bolting aging management program utilizes preventive measures to mitigate cracking described in Reg Guide 1.65, which includes the use of approved corrosion inhibitors and lubricants. The reactor head closure studs, nuts, and washers are fabricated with an acceptable phosphate coating to inhibit corrosion. In addition, a stable lubricant that does not contain molybdenum disulfide is applied to the threads prior to reactor vessel head re-installation.

In addition, the configuration of the reactor vessel in-service studs, nuts, and washers is designed to allow them to be completely removed during each refueling outage and placed in storage racks on the containment operating deck. The stud holes in the RPV head flange are sealed with special plugs before removing the reactor head. Thus, the bolting materials and stud holes are not exposed to the borated refueling cavity water.

NUREG-1801 Consistency

The Reactor Head Closure Stud Bolting aging management program will be consistent with the ten elements of aging management program XI.M3, “Reactor Head Closure Stud Bolting,” specified in NUREG-1801 with the following exception:

Exceptions to NUREG-1801

1. NUREG-1801 requires, as a preventive measure that can reduce the potential for SSC or IGSCC, using bolting material for the reactor head closure studs that have an actual measured yield strength limited to less than 1,034 megapascals (MPa) (150 kilo-pounds per square inch) (NUREG-1339). Site documentation indicates that some reactor head closure studs installed prior to commercial operation, or used as replacements, may have actual measured yield strength that is greater than 150 ksi. **Program Element Affected: Preventive Measures (Element 2)**

   #### Justification for Exception

   NUREG-1801 provides guidance to use bolting material for reactor head closure studs that has an actual measured yield strength limited to less than 150 ksi as delineated in NUREG-1339 and Reg Guide 1.65 Revision 1, which describes SA 540, Class 3, Grade B23 as high-strength, low alloy material that when tempered to a maximum tensile strength of less than 170 ksi, is relatively immune to stress corrosion cracking. However, Reg Guide 1.65, Revision 1 recommends that design conservatism should be exercised in determining the sizing of the studs so that the strength level of the material selected will not result in a measured yield strength exceeding 150 ksi. This design conservatism was not recommended in Reg Guide 1.65, Revision 0.

The Byron and Braidwood reactor vessel head closure studs were designed, fabricated, and examined in accordance with the requirements of ASME Boiler and Pressure Vessel Code, Section III, Summer 1973 Addenda and 10 CFR 50, Appendix G (July 1973, Paragraph IV.A.4). The reactor head closure studs were fabricated from SA 540, Class 3, Grade B23 alloy steel with a minimum yield strength of 130 ksi, a minimum tensile strength of 145 ksi, and a maximum tensile strength of 170 ksi. Relative to material strength, the studs are in compliance with Reg Guide 1.65, Revision 0, which was current during plant construction. The maximum reported measured yield strength documented in the UFSAR for Byron or Braidwood is 153 ksi which is slightly greater than NUREG-1801 criteria for actual measured yield strength of 150 ksi. Therefore, the installed studs were consistent with the existing regulatory guidance when installed (Reg Guide 1.65, Revision 0), and per the guidance in Reg Guide 1.65, Revision 1, are relatively immune to stress corrosion cracking.

In addition, the reactor vessel in-service studs, nuts, and washers are removed during each refueling outage and placed in storage racks on the containment operating deck. The stud holes in the RPV head flange are sealed with special plugs before removing the reactor head. Thus, the bolting materials and stud holes are not exposed to the borated refueling cavity water during refueling outages.

All other preventive measures listed in NUREG-1801 program XI.M3, "Reactor Head Closure Stud Bolting" that can reduce the potential for cracking are met by the Reactor Head Closure Stud Bolting aging management program. These include:

a) Metal-plated stud bolting is not used, which could cause degradation due to corrosion or hydrogen embrittlement.

b) A phosphate surface treatment was applied to the studs, nuts, and washers during fabrication to inhibit corrosion.

c) An approved stable lubricant is applied to the studs whenever the reactor head is reinstalled. The lubricant used does not contain molybdenum disulfide (MoS_2) which has been shown to be a potential contributor to SCC.

Since the actual measured yield strength of some installed studs may be greater than 150 ksi, the aging management review identified the stud material as “High Strength Low Alloy Steel Bolting with Yield Strength of 150 ksi or Greater” and identified cracking as an aging effect requiring management. The closure studs are volumetrically (UT) examined per ASME Code, Section XI, Table IWB-2500-1, Category B-G-1, which is appropriate for identifying cracking. There have been no recordable indications identified by ISI program examination of reactor head closure stud bolting components, indicating that the current program has been effective in managing cracking. An additional preventive measure has been implemented to revise the purchasing requirements for reactor head closure stud material to assure that any studs procured in the future will have measured yield strength of less than 150 ksi. Therefore, the Reactor Head Closure Stud Bolting aging management program will be effective in managing the cracking aging effect during the period of extended operation.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Revise the procurement requirements for reactor head closure stud material to assure that the maximum yield strength of replacement material is limited to a measured yield strength less than 150 ksi. **Program Element Affected: Preventive Measures (Element 2) and Corrective Actions (Element 7)**.

Operating Experience

The following examples of operating experience provide objective evidence that the Reactor Head Closure Stud Bolting aging management program will be effective in ensuring that component intended functions are maintained consistent with the current licensing basis during the period of extended operation:

<u>Byron Station</u>

1. ISI inspections of reactor head closure studs and associated RPV flange threads, nuts, and washers at Byron Unit 1 during the second and third ISI intervals have resulted in no recordable indications. During the 1999 refueling outage (ISI Interval 2, Period 1, Outage 1), all of the Byron Unit 1 RPV flange threads were inspected using the applicable ASME Code, Section XI UT methods, with no recordable indications. Also in the 1999 refueling outage one third of the reactor head closure studs, nuts, and washers were examined using the applicable ASME Code, Section XI UT and VT methods, with no recordable indications. During the 2005 outage (ISI Interval 2, Period 3, Outage 1), the remaining two thirds of the Byron Unit 1 reactor head closure studs, nuts, and washers were examined using the applicable ASME Code, Section XI UT and VT methods, with no recordable indications. As of the date of the license renewal application, ISI inspections in the third interval have resulted in no recordable indications.

   This example provides objective evidence that the Reactor Head Closure Stud Bolting aging management program implements examinations using methods and examinations frequency prescribed in the ASME Code, Section XI.

2. ISI inspections of reactor head closure studs and associated RPV flange threads, nuts, and washers at Byron Unit 2 during the second and third ISI intervals have resulted in no recordable indications. During the 2001 refueling outage (ISI Interval 2, Period 1, Outage 2), all of the Byron Unit 2 RPV flange threads were inspected using the applicable ASME Code, Section XI UT methods, with no recordable indications. In the 2004 (ISI Interval 2, Period 2, Outage 2) all the washers associated with reactor head closure studs were examined using the applicable ASME Code, Section XI UT and VT methods, with no recordable indications. During the 2007 outage (ISI Interval 3, Period 1, Outage 1), all 54 Byron Unit 2 reactor head closure studs and nuts were examined using the applicable ASME Code, Section XI UT and VT methods, with no recordable indications. As of the date of the license renewal application, ISI inspections in the third interval have resulted in no recordable indications.

   This example provides objective evidence that the Reactor Head Closure Stud Bolting aging management program implements examinations using methods and examinations frequency prescribed in ASME Code, Section XI.

Braidwood Station

1. ISI inspections of reactor head closure studs and associated RPV head flange threads, nuts, and washers at Braidwood Unit 1 during the second and third ISI intervals have resulted in no recordable indications. During the 2000 refueling outage (ISI Interval 2, Period 1, Outage 1), all of the Braidwood Unit 1 RPV flange threads were inspected using the applicable ASME Code, Section XI UT methods, with no recordable indications. Also in the 2000 refueling outage one third of the reactor head closure studs, nuts, and washers were examined using the applicable ASME Code, Section XI UT and VT methods, with no recordable indications. During the 2003 refueling outage (ISI Interval 2, Period 2, Outage 2), an additional one third of the Braidwood Unit 1 reactor head closure studs, nuts, and washers were examined using the applicable ASME Code, Section XI UT and VT methods, with no recordable indications. During the 2006 refueling outage (ISI Interval 2, Period 3, Outage 1), the last one third of the Braidwood Unit 1 reactor head closure studs, nuts, and washers were examined using the applicable ASME Code, Section XI UT and VT methods, with no recordable indications. As of the date of the license renewal application, ISI inspections in the third interval have resulted in no recordable indications.

   This example provides objective evidence that the Reactor Head Closure Stud Bolting aging management program implements examinations using methods and examinations frequency prescribed in the ASME Code, Section XI.

2. ISI inspections of reactor head closure studs and associated RPV head flange threads, nuts, and washers at Braidwood Unit 2 during the second and third ISI intervals have resulted in no recordable indications. During the 2000 refueling outage (ISI Interval 2, Period 1, Outage 1), one third of

the reactor head closure studs, nuts, and washers were examined using the applicable ASME Code, Section XI UT and VT methods, with no recordable indications. During the 2002 refueling outage (ISI Interval 2, Period 2, Outage 2), all of the Braidwood Unit 2 RPV head flange threads were inspected using the applicable ASME Code, Section XI UT methods with no recordable indications. In the 2003 refueling outage (ISI Interval 2, Period 2, Outage 2) an additional one third of the reactor head closure studs, nuts, and washers were examined using the applicable ASME Code, Section XI UT and VT methods, with no recordable indications. During the 2007 refueling outage (ISI Interval 2, Period 3, Outage 1), the last one third of the Braidwood Unit 2 reactor head closure studs, nuts, and washers were examined using the applicable ASME Code, Section XI UT and VT methods, with no recordable indications. As of the date of the license renewal application, ISI inspections in the third interval have resulted in no recordable indications. This example provides objective evidence that the Reactor Head Closure Stud Bolting aging management program implements examinations using methods and examinations frequency prescribed in ASME Code, Section XI.

The above examples provide objective evidence that the existing Reactor Head Closure Stud Bolting aging management program will effectively monitor and detect the aging effects of cracking and loss of material. A review of the operating experience examples showed that inspections have not identified any instances of significant age-related degradation. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where age-related degradation is found. Assessments of the Byron and Braidwood ISI programs, which implement the Reactor Head Closure Stud Bolting aging management programs, are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the Reactor Head Closure Stud Bolting aging management program will effectively identify aging-related degradation prior to failure.

Conclusion

The enhanced Reactor Head Closure Stud Bolting program will provide reasonable assurance that cracking or loss of material aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.4 Boric Acid Corrosion

Program Description

The Boric Acid Corrosion aging management program is an existing condition monitoring program that manages the aging effects of mechanical, electrical, and structural components within the scope of license renewal that are susceptible to boric acid corrosion from systems that contain borated water. The monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant age-related degradation. The Boric Acid Corrosion aging management program manages loss of material on piping, piping components, and piping elements, heat exchangers, ducting and components, containment liners, penetration bellows and sleeves, bolting, cabinets and enclosures, miscellaneous steel, and other structural components exposed to air with borated water leakage environments. The Boric Acid Corrosion aging management program manages loss of material and increased resistance of connection/corrosion of connector contact surfaces on connector contacts for electrical connectors exposed to air with borated water leakage. The program consists of visual examinations of external surfaces that are potentially exposed to borated water leakage. The program includes walkdowns to allow timely discovery of leak paths and requires the removal of boric acid residues. The identification of the leakage source and the adjacent mechanical, electrical, and structural components in the leakage pathway area is performed to assess the damage. Follow-up inspections are performed to ensure that the corrective actions were adequate and have addressed the identified age-related degradation. Additionally, the program includes examinations conducted during ISI pressure tests performed in accordance with the ASME Code, Section XI requirements. This program is implemented in response to NRC GL 88-05 and operating experience.

Borated water leakage from piping and components that are outside the scope of the program established in response to GL 88-05 may affect mechanical, electrical, and structural components that are subject to aging management review. Therefore, the scope of the monitoring and inspections of this program includes all components that contain borated water that are in proximity to mechanical, electrical, and structural components that are subject to aging management review. Components with leakage inside and outside of the containment buildings (Unit 1 & Unit 2) are monitored under the program.

Borated water leakage may be discovered by activities other than those established specifically to detect such leakage. Therefore, the program also includes provisions to perform an assessment when leakage is discovered during other activities.

Visual examinations by qualified personnel include the identification of the location where the leakage was detected, the leakage sources, and adjacent locations that may be affected by the observed leakage. Visual examinations can be conducted without insulation or obstruction removal. However, insulation or other visual obstructions must be removed if it is determined that a leak may be masked or for the examinations of bare metal surfaces in specified areas.

Evaluations are performed and corrective actions are implemented for inspection results that do not satisfy established provisions of NRC GL 88-05 in accordance with the requirements of 10 CFR Part 50, Appendix B. Any detected boric acid deposits or crystal buildups are addressed in the corrective action program. The corrective action program also ensures that conditions adverse to quality are promptly corrected. If the inspection results are assessed to be significantly adverse to quality, the cause of the condition is determined, and an action plan is developed to preclude recurrence of the boric acid corrosion age-related degradation. Corrective actions may include cleaning, repacking, gasket replacement, changes to operating procedures or modifications to the plant design including the use of corrosion resistant materials or protective coatings.

The Boric Acid Corrosion aging management program establishes the controls and expectations for monitoring reactor coolant leakage and timely repair of detected leakage. Boric acid leaks are monitored and leaks are repaired in a timely manner to prevent or mitigate boric acid corrosion. Modifications to prevent or mitigate boric acid corrosion damage also include procedure revisions and the use of corrosion resistant materials or protective coatings. Components and bolted connections that experience repeated boric acid leaks are considered for replacement in accordance with applicable Technical Specification and the ASME Code, Section XI requirements. Boric acid corrosion examinations inside containment are performed during each refueling outage in accordance with the requirements of NRC GL 88-05. Borated water systems outside of containment are periodically examined in accordance with the ASME Code, Section XI. ASME Class 1, 2, and 3 bolted connections are periodically examined in accordance with the ASME Code, Section XI. Preventive actions also include the pre-emptive replacement of components susceptible to small boric acid leakage that could result in boric acid degradation of contacted material.

NUREG-1801 Consistency

The Boric Acid Corrosion program is consistent with the ten elements of aging management program XI.M10, Boric Acid Corrosion, specified in NUREG 1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

Industry operating experience indicates that boric acid leakage can cause significant corrosion damage to susceptible plant structures and components. Boric acid corrosion has been observed in nuclear power plants and has resulted in significant impairment of component intended functions in areas that are difficult to access/observe.

NRC Generic Letter (GL) 88-05 describes several events where the reactor coolant pressure boundary suffered boric acid corrosion caused by small reactor coolant leaks. GL 88-05 includes the events in NRC Information Notice (IN) 86-108 (and supplements 1 through 3). The preventive measures implemented at Byron and Braidwood in response to GL 88-05, including the Boric Acid Corrosion aging management program, are sufficient to prevent repetition of the events described in NRC Information Notice (IN) 86-108 (and supplements 1 through 3).

NRC Bulletin 2002-01 requires licensees to implement reactor pressure vessel head inspections to ensure that degradation of the reactor pressure vessel head would not impact the reactor coolant pressure boundary. The necessary examinations are described in B.2.1.5, Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components aging management program as well as in the Boric Acid Corrosion aging management program.

Information Notice 2003-02 requires licensees to perform examinations of the RPV lower head penetrations. The RPV lower head penetration examinations performed by Byron and Braidwood are described separately in B.2.1.5, Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components aging management program

Demonstration that the effects of aging are effectively managed is achieved through objective evidence that shows that aging effects and mechanisms are being adequately managed. The following examples of operating experience provide objective evidence that the Boric Acid Corrosion Program will be effective in ensuring that intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron Station</u>

1. In March 2011, maintenance mechanics found evidence of a boric acid leak on the inlet and outlet flanges, associated studs, and nuts of the Byron Unit 1 chemical volume control letdown heat exchanger. The leak appeared to be coming from under the insulation on the end of the heat exchanger, and resulted in a significant buildup of dry boric acid crystals on the flanges but no trail to a floor drain. This issue was entered into the corrective action program. The boric acid deposits were quantified as heavy accumulation and labeled as tan with evidence of corrosion.

The insulation was removed to determine the source of the leakage. The leakage source was the end bell to tube sheet bolted connection. The end bell bolted connection was retorqued. The flange surfaces, associated studs, and nuts were cleaned of the boric acid crystal deposits. One of the 28 flange bolts was removed to determine if the bolt had degraded due to boric acid corrosion and needed to be replaced. It was determined that the flange bolt did not need to be replaced with a new bolt. The target piping materials in the area of the leakage contain greater than 10% chromium and are not susceptible to boric acid corrosion. The targets included tube side drains for the letdown heat exchanger. Once the heat exchanger was returned to service, post maintenance inspection indicated that the end bell was no longer leaking.

This example provides objective evidence that when leakage is discovered by activities other than those established specifically to detect boric acid leakage, the Boric Acid Corrosion program is implemented to perform evaluations and assessments to ensure the intended functions of affected components are maintained consistent with the design basis prior to continued service.

2. On January 7 2009, elevated tritium levels were identified in the Unit 1 containment by Radiation Protection personnel. Elevated tritium can be an indication of leakage from the reactor coolant system. A containment inspection outside of the missile barrier did not identify any leakage from the reactor coolant system. On January 15, 2009, a robotic crawler was used to inspect inside the missile barrier. A small steam leak was identified under the insulation of the Unit 1 reactor coolant loop drain valve. The extent of condition was limited to this valve. No other leakage inside the missile barrier was identified. A Boric Acid Corrosion qualified evaluator identified boric acid crystals that appeared to be on the body to bonnet bolted connection. The leak rate was estimated to be .002 gpm. The leakage was just above the floor and was contained in that general area. Most of the leakage was going to the atmosphere, explaining the detection of the elevated tritium levels. The boric acid crystals were white and amounted to more than a cup.

   The leakage was contained beneath the valve insulation and was not believed to be from a pressure boundary, but rather from the body to bonnet bolted connection. The Boric Acid Corrosion program screening process identified several recommended actions to address the issue. Corrective actions included removing the insulation to confirm that it was a body to bonnet leak, generating a work package to re-torque all of the bolting to stop the leakage, and submitting an engineering change request to allow for the highest allowable torque values to be used for the re-torque. During the next refueling outage, the body to bonnet gasket was replaced.

   This example provides objective evidence that the current Boric Acid Corrosion program evaluates any detected borated water leakage or crystal buildup to confirm the intended functions of affected mechanical, electrical, and structural components will be maintained consistent with the design basis prior to continued service. This example also provides evidence that proper interim actions are taken following the screening of affected components until repairs are made.

3. A Focused Area Self-Assessment (FASA) for the Byron Boric Acid Corrosion Control program was conducted in June 2010. The purpose of the FASA was to evaluate compliance of the program with the regulatory requirements of Generic Letter 88-05. Industry and plant operating experience was considered in performance of the assessment. The conclusion was that the program was found to be in compliance with the regulatory requirements and aligned with industry standards. Five deficiencies associated with procedure adherence and technical human performance as well as eight performance improvement recommendations were identified. The deficiencies included late screenings and evaluations of identified leaks; failure of some station personnel to complete the annual boric acid corrosion awareness training; failure to consistently include the boric acid leakage code in corrective action program issue reports; and two instances of providing weak documentation concerning active leaks when exiting an outage. Assignments were entered into the corrective action program to track resolution of the deficiencies and implementation of the recommendations. All assignments associated with the deficiencies and performance improvement recommendations have been completed.

   The FASA provides evidence that industry and plant operating experience reviews are performed and that continuous improvement opportunities are identified and entered into the corrective action program for resolution including procedure improvements.

<u>Braidwood Station</u>

1. In June of 2011, the Unit 1 Reactor Coolant System Water Inventory Balance Surveillance exceeded the action level for unidentified reactor coolant system (RCS) leak rate. This action level is calculated in accordance with the limits specified in the RCS Leakage Monitoring and Action Plan procedure. This procedure establishes the controls and expectations for monitoring RCS leakage under the current Exelon Nuclear Boric Acid Corrosion program.

   Parameters and data indicated a RCS leak into the containment sump, including increases in tritium airborne concentration and volume control tank level decrease. An inspection was performed inside the inner missile barrier, which indicated a borated water leak on one of the two pressurizer spray lines. The exact location of the leak could not be identified due to steaming in the area. Power was reduced to 20% to decrease the radiation field and allow further inspection. The cause of the leak was then identified to be coming from the valve yoke of a pressurizer spray bypass valve. The Boric Acid Corrosion program manager screened the leak in accordance with Boric Acid Corrosion program procedures. The targets were identified as mirror insulation, the pressurizer spray valve, stainless steel piping, structural steel supports, and the floor. No degradation was identified. The leaking valve was isolated and containment leakage rates returned to normal. As an extent of condition review inspections were performed and no leakage issues were identified for the second Unit 1 bypass valve or on the two Unit 2 pressurizer spray bypass valves. A review of the design of the pressurizer spray bypass valves at Byron revealed they had previously been replaced with valves of a different design and were not susceptible to similar leakage.

Both of the Unit 1 pressurizer spray bypass valves were replaced with valves with a more reliable design during the following refueling outage in the Spring of 2012. No leakage was identified during the mode 3 power ascension walkdown. The Unit 2 valves were subsequently replaced during the Fall of 2012 refueling outage. The cause of the valve leakage was due to the failure of an internal diaphragm in the valve resulting in valve stem leakage.

This example provides objective evidence that the Boric Acid Corrosion program evaluates increased RCS leakage when the action levels are exceeded. This example also provides objective evidence that when boric acid leakage is discovered, the Boric Acid Corrosion program is implemented to perform evaluations and assessments, as well as to modify the plant design to minimize the probability of recurrence.

2. In May 2004, during a Boric Acid Corrosion program owner quarterly walkdown inspection, boric acid leakage was identified at the body to bonnet interface on the Unit 1 containment spray pump suction valve. The leakage was dry and no targets were impacted. The issue was entered into the corrective action program. The cause of the leakage was due to a degraded gasket seal on the valve. The Boric Acid Corrosion program screening process identified two actions to address the issue. The first action was to clean the boric acid crystals from the affected area and remove the body to bonnet bolts one at a time to inspect for degradation. The second action was to replace the body to bonnet gasket. The boric acid crystals were characterized as dry, fresh, and white in color. The total accumulation was quantified as approximately 0.5 cup. A minor accumulation existed on the floor and piping. The area was cleaned and one bolt was removed for inspection. No degradation was identified during the inspection of the bolt. The bolt was re-installed and torqued. Therefore, no additional bolts were removed based on the lack of degradation identified on the first bolt removed. In December of 2005, the body to bonnet gasket was replaced. At the time of the gasket replacement, the body-to-bonnet bolts were covered with surface rust. The body to bonnet bolts were replaced and retorqued. The post maintenance test verified that there was no leakage.

   This example provides objective evidence that the Boric Acid Corrosion Control program manager performs walkdowns and identifies and evaluates any detected borated water leakage or crystal buildup to confirm the intended functions of affected mechanical, electrical, and structural components will be maintained consistent with the design basis prior to continued service. This example also provides evidence that proper interim actions are taken following the screening of affected components until repairs are made.

3. A Focused Area Self-Assessment (FASA) for the Braidwood Boric Acid Corrosion Control program was conducted in March 2010. The purpose of the FASA was to evaluate compliance of the program with the regulatory requirements of Generic Letter 88-05. Industry and plant operating experience was considered in performance of the assessment. The conclusion was that the program was found to be in compliance with the regulatory requirements and aligned with industry standards. The self assessment identified ten deficiencies associated with procedure adherence and technical human performance as well as twelve performance improvement recommendations. Deficiencies included: failure to schedule the repair of active leaks in forced outage plans; failure to complete the annual boric acid corrective maintenance effectiveness review in a timely manner; two instances of boric acid leakage were not entered into the corrective action program by the station group which identified the leaks; failure of some station personnel to complete the annual boric acid corrosion awareness training; the system notebook was not in full compliance with the requirements of the corporate procedure; and the procedure describing the online scheduling process did not contain criteria or requirements for obtaining the boric acid corrosion program manager's review and approval prior to deferring or deleting corrective actions. Activities were entered into the corrective action program to track resolution of the deficiencies and implementation of the recommendations. All assignments associated with the deficiencies and performance improvement recommendations are complete.

   The FASA provides objective evidence that industry and plant operating experience reviews are performed and that continuous improvement opportunities are identified and entered into the corrective action program for resolution including procedure improvements.

The above examples provide objective evidence that the Boric Acid Corrosion aging management program is capable of both detecting and monitoring the aging effects of boric acid corrosion. Problems are identified, evaluated, and are shown not to cause significant impact to the safe operation of the plant, and adequate corrective actions are taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Boric Acid Corrosion program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that continued implementation of the Boric Acid Corrosion aging management program will effectively identify degradation prior to failure.

Conclusion

The existing Boric Acid Corrosion program provides reasonable assurance that the aging effects of loss of material are adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.5 Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components

Program Description

The Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components aging management program is an existing condition monitoring program that manages the aging effects of primary water stress corrosion cracking (PWSCC) of nickel alloy-based components and associated welds, as well as loss of material due to boric acid-induced corrosion in susceptible components in the vicinity of nickel-alloy reactor coolant pressure boundary components in a reactor coolant or air with borated water leakage environment.

This condition monitoring program includes periodic bare-metal visual, surface, and/or volumetric examinations of nickel alloy-based components, associated welds, and components in the vicinity of nickel alloy-based reactor coolant pressure boundary components that are susceptible to loss of material due to boric acid-induced corrosion, such as reactor pressure vessel components, steam generator primary side components, pressurizer components, and reactor coolant system pressure boundary piping and welds. This program also includes inspection requirements for reactor pressure vessel upper heads.

This condition monitoring program provides adequate examination methods to detect PWSCC on susceptible components. The frequency of examining the PWSCC susceptible components is adequate to prevent significant age-related degradation. The long-term inspection requirements are consistent with ASME Section XI Code Case N-722-1, Additional Examinations for PWR Pressure Retaining Welds in Class 1 Components Fabricated with Alloy 600/82/182 Materials, subject to the conditions listed in 10 CFR 50.55a(g)(6)(ii)(E); Code Case N-729-1, Alternative Examination Requirements for PWR Reactor Vessel Upper Heads with Nozzles Having Pressure-Retaining Partial-Penetration Welds, subject to the conditions specified in 10 CFR 50.55a(g)(6)(ii)(D); and Code Case N-770-1, Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated with UNS N06082 or UNS W86182 Weld Filler Material With or Without Application of Listed Mitigation Activities, subject to the conditions specified in 10 CFR 50.55a(g)(6)(ii)(F).

Reactor coolant pressure boundary leakage is monitored by using instrumentation located inside containment for evidence of elevated reactor coolant system leakage. The instrumentation includes the containment atmosphere radiation monitor particulate channel, containment sump level, containment pressure indicators, and containment temperature indicators.

The impacts of all boric acid leakage from non-nickel-alloy reactor coolant pressure boundary components, provisions for identifying and evaluating leakage, and initiating corrective actions for boric acid leakage are managed by the Boric Acid Corrosion aging management program (B.2.1.4). The Water

Chemistry aging management program (B.2.1.2) monitors and controls water environments in accordance with industry guidelines to ensure the reactor coolant water environments are favorable to mitigate PWSCC in nickel-alloy components.

NUREG-1801 Consistency

The Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components aging management program is consistent with the ten elements of aging management program XI.M11B, "Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components aging management program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron Station</u>

1. During the Byron Unit 2 Spring 2007 Refueling Outage, the Byron Unit 2 Reactor Pressure Vessel (RPV) head was inspected per the requirements of NRC Order EA-03-009. The entire head surface was visually inspected. All of the RPV head penetrations were volumetrically examined for cracks. The RPV head volumetric inspection identified cracking on the #68 penetration. This issue was entered into the corrective action program. The cracking was confirmed using dye penetrant. There was no evidence of RPV head leakage on or near the #68 penetration. No cracks were found on the other RPV head penetrations and there was no evidence of RPV head leakage on or near the other RPV head penetrations. The #68 penetration was permanently repaired with a NRC approved alternate welding method. The cracking on the #68 penetration was attributed to a weld defect from initial construction. The weld defect allowed initiation of PWSCC. Per ASME Section XI Code Case N-729-1 as amended by 10 CFR 50.55a(g)(6)(ii)(D), the crack on the #68 penetration on the Byron Unit 2 RPV head required the RPV head penetration volumetric examination frequency to be increased from every fourth refueling outage to every refueling outage. The Byron Unit 2 RPV head is visually examined

during every refueling outage. The Byron Unit 2 RPV head was examined during the Fall 2008 refueling outage, including the #68 penetration. No cracks were found and there was no evidence of leakage on the RPV head surface. A relief request was submitted and approved that allows the #68 penetration be volumetrically examined every refueling outage and the remainder of the Byron Unit 2 RPV head penetrations be volumetrically examined every other outage. During the Spring 2010 refueling outage, the entire RPV head surface was visually examined, and the #68 penetration was volumetrically examined per the requirements of 10 CFR 50.55a and ASME Section XI Code Case N-729-1 as amended by 10 CFR 50.55a(g)(6)(ii)(D). There was no evidence of leakage on the RPV head surface and no cracks were found on the #68 penetration. During the Fall 2011 refueling outage, the Byron Unit 2 RPV head surface was visually examined, and the all of the head penetrations were volumetrically examined per 10 CFR 50.55a and ASME Section XI Code Case N-729-1 as amended by 10 CFR 50.55a(g)(6)(ii)(D). There was no evidence of leakage on the RPV head surface and no cracks were found on any penetration on the RPV head.

This example provides objective evidence that the Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components program and the corrective action program are effective in providing measures for monitoring, repairing, and providing appropriate follow up inspections for PWSCC susceptible components prior to loss of intended function.

2. During the Byron Unit 1 Spring 2011 Refueling Outage, a visual examination was performed on the Byron Unit 1 Reactor Pressure Vessel (RPV) head surface and a volumetric examination was performed on the RPV penetrations per the requirements of 10 CFR 50.55a and ASME Section XI Code Case N-729-1 as amended by 10 CFR 50.55a(g)(6)(ii)(D). The volumetric examination revealed indications of cracking on four (4) penetrations, penetrations #31, #43, #64, and #76. This issue was entered into the corrective action program. There was no evidence of leakage on any of the four (4) penetrations and there was no evidence of RPV head leakage on or near the other RPV head penetrations. The four (4) penetrations were permanently repaired with a NRC approved alternate welding method. The cracking on the four (4) penetrations (#31, #43, #64, and #76) was attributed to primary water stress corrosion cracking (PWSCC). Per ASME Section XI Code Case N-729-1, as amended by 10 CFR 50.55a(g)(6)(ii)(D), the cracks on the Byron Unit 1 RPV head penetrations required the RPV head penetration volumetric examination frequency to be increased from every fourth refueling outage to every refueling outage. During the Fall 2012 refueling outage, the Byron Unit 1 RPV head surface was visually examined and the RPV head penetrations were volumetrically examined, including penetrations #31, #43, #64, and #76, per the requirements of 10 CFR 50.55a and ASME Section XI Code Case N-729-1 as amended by 10 CFR 50.55a(g)(6)(ii)(D). There was no evidence of leakage on the RPV head surface and no cracks were found on any penetrations on the RPV head.

This example provides objective evidence that the Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components program and the corrective action program are effective in providing measures for monitoring, repairing, and providing appropriate follow up inspection for PWSCC susceptible components prior to loss of intended function.

3. During the Byron Unit 1 Fall 2006 Refueling Outage, a bare metal visual examination was performed on all five of the Byron Unit 1 pressurizer steam space penetrations, the surge line penetration, and the adjacent pressurizer shell surfaces. The examination of the six penetrations and adjacent pressurizer vessel surfaces identified no evidence of any boric acid deposits associated with reactor coolant leakage. After the bare metal visual examinations were complete, Byron preemptively installed PWSCC resistant full structural weld overlays on the six Unit 1 pressurizer penetrations, thus making these components no longer susceptible to PWSCC degradation. The weld overlays were re-inspected during the Fall 2009 refueling outage and no cracks were found.

   During the Byron Unit 2 Spring 2007 refueling outage, a bare metal visual examination was performed on all five of the Byron Unit 2 pressurizer steam space penetrations, the surge line penetration, and the adjacent pressurizer shell surfaces. The examination of the six penetrations and adjacent pressurizer vessel surfaces identified no evidence of any boric acid deposits associated with reactor coolant leakage. After the bare metal visual examinations were complete, Byron preemptively installed PWSCC resistant full structural weld overlays on the six Unit 2 pressurizer penetrations, thus making these components no longer susceptible to PWSCC degradation. The weld overlays were re-inspected during the Spring 2010 refueling outage.

   This example provides objective evidence that the Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components program is effective in providing measures for monitoring, detecting, and providing appropriate follow up inspections for PWSCC susceptible components prior to loss of intended function.

4. During the Byron Unit 1 Fall 2009 Refueling Outage, a bare metal visual examination was performed on all eight of the Byron Unit 1 reactor pressure vessel nozzles and safe ends and adjacent piping surfaces in accordance with ASME Section XI Code Case N-722-1, as amended by 10 CFR 50.55a(g)(6)(ii)(E). The examination of the eight nozzles, safe-ends, and adjacent surfaces identified no evidence of any boric acid deposits associated with reactor coolant leakage. During the Byron Unit 1 Spring 2011 Refueling Outage, Byron performed the mechanical stress improvement process on all eight Unit 1 RPV nozzles and safe-ends, thus making these components no longer susceptible to PWSCC degradation.

During the Byron Unit 2 Fall 2011 Refueling Outages, bare metal visual examinations were performed on all eight of the Byron Unit 2 reactor pressure vessel nozzles, safe ends, and adjacent piping surfaces in accordance with ASME Section XI Code Case N-722-1, as amended by 10 CFR 50.55a(g)(6)(ii)(E). The examination of the eight nozzles, safe-ends and adjacent surfaces identified no evidence of any boric acid deposits associated with reactor coolant leakage. Byron plans on performing the mechanical stress improvement process on all eight Unit 2 RPV nozzles and safe-ends during the Byron Unit 2 Spring 2013 Refueling Outage to make these components no longer susceptible to PWSCC degradation.

This example provides objective evidence that the Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components program is effective in providing measures for monitoring, detecting, and providing appropriate follow up inspections for PWSCC susceptible components prior to loss of intended function.

5. During the Byron Unit 1 Fall 2003 Refueling Outage, the Byron Unit 1 Reactor Pressure Vessel (RPV) Bottom Mounted Instrument (BMI) nozzles and the RPV lower head surface was visually inspected in response to NRC Bulletin 2003-02, “Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity.” No evidence of leakage was found on the BMI nozzles or the RPV lower head surface. However, it was apparent that the refueling cavity boot seals had leaked borated water down the side of the RPV during previous refueling outages. This condition was entered into the corrective action program. The RPV lower head and the BMI nozzle to RPV lower head interface regions were cleaned to ensure a crisp demarcation between the BMI nozzle and the RPV lower head for future inspections. Subsequent bare metal visual examinations of the BMI nozzles were completed during the Fall 2009 refueling outage in accordance with ASME Section XI Code Case N-722-1, as amended by 10 CFR 50.55a(g)(6)(ii)(E). No evidence of leakage was found on the BMI nozzles or on the RPV lower head surface.

   During the Byron Unit 2 Spring 2004 Refueling Outage, the Byron Unit 2 Reactor Pressure Vessel (RPV) Bottom Mounted Instrument (BMI) nozzles and the RPV lower head was visually inspected in response to NRC Bulletin 2003-02, “Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity.” No evidence of leakage was found on the BMI nozzles or the RPV lower head surface. Subsequent bare metal visual examinations of the BMI nozzles were completed in the Spring of 2010 in accordance with ASME Section XI Code Case N-722-1, as amended by 10 CFR 50.55a(g)(6)(ii)(E). No evidence of leakage was found on the BMI nozzles or on the RPV lower head surface.

   This example provides objective evidence that the Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components program is effective in providing measures for monitoring PWSCC susceptible components to detect age-related degradation and providing appropriate follow up inspections for PWSCC susceptible components prior to loss of intended function.

Braidwood Station

1. During the Braidwood Unit 1 Spring 2012 Refueling Outage, the entire Braidwood Unit 1 Reactor Pressure Vessel (RPV) head surface was visually examined, and all the RPV head penetrations were volumetrically examined per the requirements of 10 CFR 50.55a and ASME Section XI Code Case N-729-1 as amended by 10 CFR 50.55a(g)(6)(ii)(D). The examination revealed indications of cracking on the #69 penetration. This issue was entered into the corrective action program. The cracking was confirmed using dye penetrant. There was no evidence of leakage on or near the #69 penetration. No other cracks were found on the other Braidwood Unit 1 RPV head penetrations and there was no evidence of RPV head leakage on or near the other RPV head penetrations. The #69 penetration was permanently repaired with a NRC approved alternate welding method. The cracking on the #69 penetration was attributed to primary water stress corrosion cracking (PWSCC). Per ASME Section XI Code Case N-729-1 as amended by 10 CFR 50.55a(g)(6)(ii)(D), the crack on the #69 penetration on the Braidwood Unit 1 RPV head required the RPV head penetration volumetric examination frequency to be increased from every fourth refueling outage to every refueling outage. The Braidwood Unit 1 RPV head is scheduled to be inspected by both visual and volumetric examination techniques in the Fall of 2013 (A1R17).

   During the Braidwood Unit 2 Spring 2011 Refueling Outage, the Braidwood Unit 2 Reactor Pressure Vessel (RPV) head surface was visually examined, and all the RPV head penetrations were volumetrically examined per the requirements of 10 CFR 50.55a and ASME Section XI Code Case N-729-1 as amended by 10 CFR 50.55a(g)(6)(ii)(D). There was no evidence of leakage on the RPV head surface and no cracks were found on any penetration on the Braidwood Unit 2 RPV head.

   This example provides objective evidence that the Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components program and the corrective action program are effective in providing measures for monitoring, repairing, and providing appropriate follow up inspection for PWSCC susceptible components prior to loss of intended function.

2. During the Braidwood Unit 1 Fall 2007 Refueling Outage, a bare metal visual examination was performed on all five of the Braidwood Unit 1 pressurizer steam space penetrations, the surge line penetration, and the adjacent pressurizer shell surfaces. The examination of the six penetrations and adjacent pressurizer vessel surfaces identified no evidence of any boric acid deposits associated with reactor coolant leakage. After the bare metal visual examinations were complete,

Braidwood preemptively installed PWSCC resistant full structural weld overlays on the six Unit 1 pressurizer penetrations, thus making these components no longer susceptible to PWSCC degradation. The weld overlays were re-inspected during the Fall 2010 refueling outage and no cracks were found on the weld overlays.

During the Braidwood Unit 2 Spring 2008 Refueling Outage, a bare metal visual examination was performed on all five of the Braidwood Unit 2 pressurizer steam space penetrations, the surge line penetration, and the adjacent pressurizer shell surfaces. The examination of the six penetrations and adjacent pressurizer vessel surfaces identified no evidence of any boric acid deposits associated with reactor coolant leakage. After the bare metal visual examinations were complete, Braidwood preemptively installed PWSCC resistant full structural weld overlays on the six Unit 2 pressurizer penetrations, thus making these components no longer susceptible to PWSCC degradation. The weld overlays were re-inspected during the Spring 2011 refueling outage and no cracks were found on the weld overlays.

This example provides objective evidence that the Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components program is effective in providing measures for monitoring and providing appropriate follow up inspection for PWSCC susceptible components prior to loss of intended function.

3. During the Braidwood Unit 1 Fall 2010 Refueling Outage, a bare metal visual examination was performed on all eight of the Braidwood Unit 1 reactor pressure vessel nozzles, safe ends, and adjacent piping surfaces in accordance with ASME Section XI Code Case N-722-1, as amended by 10 CFR 50.55a(g)(6)(ii)(E). The examination of the eight nozzles, safe-ends, and adjacent surfaces identified no evidence of any boric acid deposits associated with reactor coolant leakage. During the Braidwood Unit 1 Spring 2012 Refueling Outage, Braidwood performed the mechanical stress improvement process on all eight Unit 1 RPV nozzles and safe-ends, thus making these components no longer susceptible to PWSCC degradation.

   During the Braidwood Unit 2 Spring 2011 Refueling Outage, a bare metal visual examination was performed on all eight of the Braidwood Unit 2 reactor pressure vessel nozzles, safe ends, and adjacent piping surfaces in accordance with ASME Section XI Code Case N-722-1, as amended by 10 CFR 50.55a(g)(6)(ii)(E). The examination of the eight nozzles, safe-ends and adjacent surfaces identified no evidence of any boric acid deposits associated with reactor coolant leakage. During the Braidwood Unit 2 Fall 2012 Refueling Outage, Braidwood performed the mechanical stress improvement process on all eight Unit 2 RPV nozzles and safe-ends, thus making these components no longer susceptible to PWSCC degradation.

   This example provides objective evidence that the Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in

Reactor Coolant Pressure Boundary Components program is effective in providing measures for monitoring, repairing, and providing appropriate follow up inspection for PWSCC susceptible components prior to loss of intended function.

4. During the Braidwood Unit 1 Fall 2004 Refueling Outage, the Braidwood Unit 1 Reactor Pressure Vessel (RPV) Bottom Mounted Instrument (BMI) nozzles and the RPV lower head was visually inspected in response to NRC Bulletin 2003-02, “Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity.” No evidence of leakage was found on the BMI nozzles or the RPV lower head surface.

   Although not required by ASME Section XI or regulation, Braidwood Station performed non-visual NDE (time of flight ultrasonic (UT) and eddy current) examinations of the Unit 1 BMI penetrations during the Fall 2007 refueling outage. This examination was completed in conjunction with the ten-year RPV inservice inspection. No indications of cracking were found on the BMI penetrations.

   A bare metal visual examination of the Unit 1 BMI nozzles was completed during the Fall 2010 refueling outage in accordance with ASME Section XI Code Case N-722-1, as amended by 10 CFR 50.55a(g)(6)(ii)(E). No evidence of leakage was found on the BMI nozzles or the RPV lower head surface.

   During the Braidwood Unit 2 Fall 2003 Refueling Outage, the Braidwood Unit 2 Reactor Pressure Vessel (RPV) Bottom Mounted Instrument (BMI) nozzles and the RPV lower head was visually inspected in response to NRC Bulletin 2003-02, “Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity.” No evidence of leakage was found on the BMI nozzles or the RPV lower head surface.

   Although not required by ASME Section XI or regulation, Braidwood Station performed non-visual NDE (time of flight ultrasonic (UT) and eddy current) examinations of the Unit 2 BMI penetrations during the Spring 2008 refueling outage. This examination was completed in conjunction with the ten-year RPV inservice inspection. No indications of cracking were found on the BMI penetrations.

   A bare metal visual examination of the Unit 2 BMI nozzles was completed during the Spring 2011 refueling outage in accordance with ASME Section XI Code Case N-722-1, as amended by 10 CFR 50.55a(g)(6)(ii)(E). No evidence of leakage was found on the BMI nozzles or the RPV lower head surface.

   This example provides objective evidence that the Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components program is effective in providing measures for monitoring PWSCC susceptible components to detect degradation prior to loss of intended function.

The above examples provide objective evidence that the Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components aging management program is capable of managing the aging effects of primary water stress corrosion cracking (PWSCC) of nickel alloy-based components and associated welds, as well as loss of material due to boric acid-induced corrosion in susceptible components in the vicinity of nickel alloy-based reactor coolant pressure boundary components. The examination methods being implemented by the program have been proven effective in detecting aging effects including cracking and loss of material. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that the continued implementation of the Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components aging management program will effectively identify age-related degradation prior to failure.

Conclusion

The existing Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components aging management program provides reasonable assurance that the primary water stress corrosion cracking (PWSCC) and loss of material aging effects are adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.6 Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)

Program Description

The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) aging management program is a new condition monitoring program that provides assurance that reactor coolant pressure boundary CASS components (i.e., Class 1 piping and control rod assembly pressure boundary components) susceptible to thermal aging embrittlement meet the specified intended functions. The reactor coolant system ASME Code Class 1 CASS components are maintained by inspecting and evaluating the extent of thermal aging embrittlement in accordance with the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI. The Byron and Braidwood ASME Section XI Inservice Inspection, Subsection IWB program is augmented by the implementation of the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) aging management program which monitors the aging effect of loss of fracture toughness due to thermal aging embrittlement of ASME Code Class 1 CASS components with service conditions above 250 degrees Celsius (482 degrees Fahrenheit).

The Thermal Aging Embrittlement of CASS program will include a screening methodology to determine component susceptibility to thermal aging embrittlement based on casting method, molybdenum content, and percent ferrite. For “potentially susceptible” components, aging management is accomplished through either, qualified visual inspections, such as enhanced visual examination, qualified ultrasonic testing methodology, or component-specific flaw tolerance evaluation in accordance with ASME Code, Section XI. Additional inspections or evaluations are not required for components that are determined not to be susceptible to thermal aging embrittlement. Screening for ASME Code Class 1 CASS components susceptible to thermal aging embrittlement is not required for pump casings and valve bodies. The existing ASME Section XI inspection requirements are adequate for managing the aging effects of Class 1 pump casings and valve bodies.

The program will provide for either, enhanced visual inspections, qualified ultrasonic testing methodology, or flaw tolerance evaluations of susceptible components; it will not provide guidance on methods to mitigate thermal aging embrittlement. The flaw tolerance evaluation will be based on specific geometry and stress information to verify that the thermally-embrittled material has adequate toughness throughout the period of extended operation.

Inspection schedules for the ASME Section XI program are completed during the inspection interval in accordance with the schedule and extent of Table IWB-2412-1. There are no ASME Class 2 components within this program, therefore, Table IWC-2412-1 does not apply. The Byron and Braidwood ASME Section XI program plans direct the inspection schedules and the extent of the inspections in the program planning documents as required to provide timely detection of flaws.

Flaws detected in reactor coolant pressure boundary ASME Code Class 1

CASS components are evaluated in accordance with the applicable procedures of IWB-3500. Flaw tolerance evaluation for components with ferrite content up to 25 percent is performed according to the principles associated with IWB-3640 procedures for submerged arc welds (SAW).

Ferrite content is calculated by using the Hull's equivalent factors (described in NUREG/CR-4513, Rev. 1).

Repairs and Replacements are performed in accordance with the ASME Section XI Code, which specify the requirements in IWA-4000, per the Byron and Braidwood ISI program.

The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) aging management program will be a condition monitoring program whose methods will effectively detect and monitor the applicable aging effects and the frequency will be adequate to prevent significant age-related degradation.

This new program will be implemented prior to the period of extended operation.

NUREG-1801 Consistency

The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) aging management program will be consistent with the ten elements of aging management program XI.M12, Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS), specified in NUREG 1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel program will be effective in ensuring that component intended functions are maintained consistent with the current licensing basis during the period of extended operation:

<u>Byron Station</u>

1. The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel is a new program to be implemented prior to the period of extended operation. Therefore, there is no existing program-specific operating experience to validate the effectiveness of this program at Byron Station. The program is based on the program description in NUREG-1801, which in turn is based on industry operating experience. As such, operating experience assures that implementation of the Thermal Aging Embrittlement of Cast Austenitic

Stainless Steel program will manage the effects of aging such that applicable components will continue to perform their intended functions consistent with the current licensing basis through the period of extended operation.

2. In September 2005, during a surface examination of the seismic lug attachment to the Unit 2 pressurizer vessel wall, 0.2-inch and 0.8-inch long indications were identified on the toe surface of the fillet weld. The issue was entered into the corrective action program. A flaw tolerance evaluation was performed by the vendor in accordance with ASME Code Section XI flaw evaluation guidelines. The flaw tolerance tables and charts showed that the as-found indications were acceptable for continued operation without repair for an operational period of 30 years. Actions were taken per IWB-2420 of ASME Section XI to ensure future monitoring of the indications in accordance with the inspection periods listed in the schedule of the IWB-2400 inspection program. Additional examinations were performed on other attachment welds of similar materials and service per the requirements of ASME XI. These additional examinations were acceptable and other no code related actions were required.

   Although not related to thermal embrittlement of cast austenitic stainless steel, this example provides objective evidence that the ASME Section XI Inservice Inspection (ISI) program is effectively utilized and issues are addressed with the station’s corrective action program.

3. The Byron Unit 1 and 2 ASME Section XI ISI examinations of reactor coolant system piping and welds performed during the Unit 1 Spring 2011 Refueling Outage and Unit 2 Fall 2011 Refueling Outage did not identify any conditions that required repair or replacement. Cracks were found on four (4) control rod drive RPV head penetrations at Byron Unit 1 in 2011 and one (1) control rod drive RPV head penetration at Byron Unit 2 in 2007. The conditions were entered into the corrective action program. The cause of the cracks on the Unit 1 penetrations was determined to be primary water stress corrosion cracking. The cause of the crack on the Unit 2 penetration was determined to be due to a weld defect from initial construction. The cracks were repaired using an approved repair method.

   Although not related to thermal embrittlement of cast austenitic stainless steel, this example provides objective evidence that the ASME Section XI Inservice Inspection (ISI) program implements examinations using methods and examination frequency recommended in the appropriate ASME Code.

<u>Braidwood Station</u>

1. The Thermal Aging Embrittlement of Cast Austenitic Stainless Steel is a new program to be implemented prior to the period of extended operation. Therefore, there is no existing program-specific operating experience to validate the effectiveness of this program at Braidwood Station. The program is based on the program description in NUREG-1801, which in turn is based on industry operating experience. As such, operating

experience assures that implementation of the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel program will manage the effects of aging such that applicable components will continue to perform their intended functions consistent with the current licensing basis through the period of extended operation.

2. In April 2012, during examination of new welds on a 4-inch austenitic stainless steel Safety Injection pipe, a planar indication was identified by ultrasonic testing (UT) measuring approximately 0.35 inches circumferential around a weld that extended from ID to 0.33 inches into the weld. The issue was entered into the corrective action program. It was subsequently determined that the flaw exceeded acceptable flaw sizes for austenitic stainless steel piping according to Table IWB-3514.3 of ASME Section XI inspection requirements and the weld was rejected, even though the weld passed visual and radiography testing. The weld was repaired and ultimately passed UT.

   Although not related to thermal embrittlement of cast austenitic stainless steel, this example provides objective evidence that the ASME Section XI Inservice Inspection (ISI) program is effectively utilized at Braidwood Station and issues are addressed with the station’s corrective action program.

3. The Braidwood Unit 1 and 2 ASME Section XI ISI examinations of reactor coolant system piping and welds performed during the Unit 1 Fall 2010 Refueling Outage and Unit 2 Fall 2009 Refueling Outage did not identify any conditions that required repair or replacement. A crack was found on one (1) control rod drive RPV head penetration at Braidwood Unit 1 in 2012. The cause of the crack was determined to be due to primary water stress corrosion cracking. The crack was repaired using a code approved repair method.

   Although not related to thermal embrittlement of cast austenitic stainless steel, this example provides objective evidence that the ASME Section XI Inservice Inspection (ISI) program implements examinations using methods and examination frequency recommended in the appropriate ASME Code.

While the above examples are not specifically related to the thermal embrittlement of cast austenitic stainless steel, they demonstrate the BBS ASME Section XI Inservice Inspection program is capable of both monitoring and detecting the aging effect of thermal aging embrittlement. A review of the operating examples showed that flaws were detected and repaired prior to a loss of function. Problems identified were entered into the corrective action program and appropriate corrective actions were taken. Appropriate guidance for re-evaluation, repair, or replacement will be provided for locations where degradation is found. Assessments of the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel program will be performed to identify the areas needing improvement to maintain the quality performance of the program. There is sufficient confidence that the implementation of the new Thermal Aging Embrittlement of Cast Austenitic Stainless Steel program will effectively evaluate ASME Code Class 1 CASS components and identify degradation prior to failure through the screening of component for susceptibility, continued effectiveness of the ASME Section XI Inservice Inspection, Subsections IWB program, and flaw tolerance evaluations.

Conclusion

The new Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) program will provide reasonable assurance that the loss of fracture toughness aging effect will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.7 PWR Vessel Internals

Program Description

The PWR Vessel Internals aging management program is a new condition monitoring program that implements the guidance of Electric Power Research Institute (EPRI) 1022863 (MRP-227-A), “PWR Internals Inspection and Evaluation Guideline” and EPRI 1016609 (MRP-228), “Inspection Standard for PWR Internals” to manage the aging effects of reactor vessel internal (RVI) components.

The program is a condition monitoring program designed to manage the effects of age-related degradation for aging effects that are applicable to PWR RVI components in a reactor coolant with neutron flux environment. The monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant age-related degradation prior to the loss of intended function. These aging effects include (a) various forms of cracking, including stress corrosion cracking (SCC), primary water stress corrosion cracking (PWSCC), irradiation-assisted stress corrosion cracking (IASCC), and cracking due to fatigue/cyclical loading; (b) loss of material induced by wear; (c) loss of fracture toughness due to neutron irradiation embrittlement; (d) changes in dimension due to void swelling and irradiation growth; and (e) loss of preload due to thermal and irradiation-enhanced stress relaxation or creep. The program also mitigates these aging effects by managing water chemistry per the Water Chemistry (B.2.1.2) aging management program.

The RVI components were evaluated and classified as one of four inspection sample groups based on the guidance of MRP-227-A, “PWR Internals Inspection and Evaluation Guideline.” The four (4) inspection sample groups are; Primary, Expansion, Existing Programs, and No Additional Measures. The Primary group component inspections manage age-related degradation consistent with MRP-227-A, Table 4.3 (Westinghouse components), and are expected to show the leading indications of age-related degradation. The Expansion group component inspections manage age-related degradation consistent with MRP-227-A, Table 4.6 (Westinghouse components), and are inspected if Primary group component inspections find age-related degradation to be more severe than anticipated. RVI components in the Existing Programs group are adequately managed by existing programs, such as ASME Code, Section XI, Examination B-N-3 examinations of core support structures. The No Additional Measures group are those RVI components for which the effects of the aging mechanisms were below the screening criteria and no further action is required per MRP-227-A.

There are no Primary, Expansion, or Existing Programs RVI components made of susceptible cast austenitic stainless steel, martensitic stainless steel, or precipitation-hardened stainless steel at the Byron and Braidwood Stations, therefore, the aging effect of loss of fracture toughness due to thermal aging does not apply.

Program examination methods include visual examination, enhanced visual examination, volumetric examination, and direct physical measurements are effective in detecting applicable aging effects. Visual examinations, volumetric examinations, and direct physical measurements will be performed consistent with the guidance of MRP-227-A and MRP-228 to prevent significant age-related degradation.

The program does not include:

1. Fuel assemblies and control rods which are considered short lived components.
2. Welded attachments to the internal surface of the reactor vessel. These components are managed by the ASME Section XI Inservice Inspection, subsections IWB, IWC, and IWD aging management program (B.2.1.1).

The PWR Vessel Internals aging management program is a new program and will be implemented no later than the date that the renewed operating licenses are issued.

NUREG-1801 Consistency

The PWR Vessel Internals aging management program will be consistent with the ten elements of aging management program XI.M16A, “PWR Vessel Internals,” specified in NUREG-1801 with the following exceptions:

Exceptions to NUREG-1801

1. NUREG-1801 describes an aging management program for the PWR vessel internals in Chapter XI: XI.M16A, “PWR Vessel Internals.” An NRC and industry effort is in progress, working towards the issuance of a revision to XI.M16A, via the Interim Staff Guidance (ISG) process. The latest draft revision of this ISG was presented for public comment in the March 20, 2012, Vol. 77, No. 54 issue of the Federal Register as: Updated Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors. The exception for this aging management program is that the “PWR Vessel Internals” aging management program is consistent with NUREG-1801 as modified by the March 20, 2012 draft of LR-ISG-2011-04. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored/Inspected (Element 3), Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5), Acceptance Criteria (Element 6), Corrective Actions (Element 7), Confirmation Process (Element 8), Administrative Controls (Element 9)**

   Justification for Exception

   An NRC and industry effort to issue a revision to XI.M16A is currently in progress. The development of this basis document is based on the latest guidance from the NRC which is contained in the March 20, 2012 draft of LR-ISG-2011-04 to limit the impact of the issuance of the final ISG.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the PWR Vessel Internals program will be effective in ensuring that intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation:

Byron and Braidwood Stations

1. Based on industry operating experience, Byron and Braidwood Stations Units 1 and 2 replaced the original equipment Alloy X-750 control rod guide tube (CRGT) support pins (split pins) with strained hardened (cold worked) 316 stainless steel split pins to reduce the susceptibility for stress corrosion cracking in the CRGT split pins. The Byron Unit 1 CRGT split pins were replaced in 2005, the Byron Unit 2 CRGT split pins were replaced in 2007, the Braidwood Unit 1 CRGT split pins were replaced in 2007, and the Braidwood Unit 2 CRGT split pins were replaced in 2008. Five (5) Alloy X-750 CRGT split pins were identified as being broken at Braidwood Unit 1 during the split pin replacement effort. No Alloy X-750 split pins were reported as being cracked or broken at Braidwood Unit 2 and Byron Units 1 and 2. The replacement split pins were designed for a 40 year life, with a 100% capacity factor and were installed after each of the reactors had operated for at least 20 years. Therefore, the current design life is through the end of the period of extended operation.

   This example provides objective evidence that Byron and Braidwood Stations are utilizing industry OE and implementing the industry specified actions. This example also illustrates that deficiencies (e.g., cracked split pins) are entered into the corrective action program and appropriate actions are taken to evaluate deficiencies.

2. The previously performed ASME Section XI In-Service Inspection (ISI), Examination Category B-N-3 examinations of the core support structure reactor vessel internal (RVI) components did not identify any conditions that required repair or replacement. This was verified by performing a corrective action program review in 2013. Examinations are performed on a ten-year interval.

   This example provides objective evidence that Byron and Braidwood Stations are implementing examination requirements using the methods and evaluation frequency recommended in the appropriate industry guidelines.

3. The Byron and Braidwood Stations, Units 1 and 2 PWR Vessel Internals aging management program will be a new program, with the exception of the existing program RVI components managed by the ASME Section XI ISI program. As part of a corrective action program review performed in 2013 it was verified that a key element of the program defined in MRP-227-A is the requirement to report PWR RVI inspection results and operating experience as part of the NEI 03-08 implementation process. The NEI 03-08 implementation process imposes documentation and administrative controls, such as notifying the NRC of any deviation from the inspection and examination methodology specified in MRP-227-A and justifying the deviation no later than 45 days after approval of a licensee executive. Byron and Braidwood Stations, through their participation in PWR Owner Group and EPRI-MRP activities, will continue to benefit from the industry-wide collaboration of results from PWR vessel internals inspections. Based on these criteria, a sufficient level of documentation and administrative controls exist to ensure effective long-term implementation of the Byron and Braidwood Stations, Units 1 and 2 PWR Vessel Internals aging management program.

   This example provides objective evidence that the Byron and Braidwood Stations participate in the industry groups and that the PWR Vessel Internals aging management program will have the documentation and administrative controls to ensure long-term effective implementation of the PWR Vessel Internals aging management program.

The above examples provide objective evidence that the new PWR Vessel Internals aging management program is capable of both monitoring and detecting any age-related degradation of the PWR vessel internals due to aging effects such as; cracking, loss of material, loss of fracture toughness, loss of preload, and changes in dimensions. A review of the operating examples showed that the core support structure inspections, performed in accordance with ASME Section XI ISI Examination Category B-N-3, have occurred and no instances of significant age-related deficiencies were documented. In addition, timely implementation of industry specified guidance concerning the control rod guide tube (CRGT) split pins implemented appropriate corrective actions to prevent a loss of function. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the PWR Vessel Internals aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the PWR Vessel Internals aging management program will effectively identify degradation prior to failure.

Conclusion

The new PWR Vessel Internals program will provide reasonable assurance that the identified aging effects and mechanisms will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.8 Flow-Accelerated Corrosion

Program Description

The Flow-Accelerated Corrosion (FAC) aging management program is an existing condition monitoring program based on implementation of EPRI guidelines in NSAC-202L-R3, “Recommendations for an Effective Flow Accelerated Corrosion Program.” Program activities include analyses to determine critical locations, baseline inspections to determine the extent of wall thinning at these critical locations, and follow-up inspections to confirm or quantify the predictions, and take long term corrective actions. Repairs and replacements are performed as necessary. Inspections are performed using ultrasonic, visual, or other approved testing techniques capable of detecting wall thinning. The program provides guidance for prediction, detection, and monitoring wall thinning in piping, piping components, and piping elements, and heat exchangers due to FAC in closed cycle cooling water, treated water, and steam environments. The monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant age-related degradation.

Where applicable, analyses to determine critical locations in piping and other components susceptible to FAC are performed utilizing CHECWORKS, a predictive code that uses the implementation guidance of NSAC-202L-R3 to satisfy the criteria specified in 10 CFR Part 50, Appendix B for development of procedures and control of special processes. For each examined component, a verified and validated web-based computer program, such as FAC Manager, is utilized in conjunction with CHECWORKS to calculate component wear, wear rate, projected thickness, and remaining life. If a component’s remaining life cannot be demonstrated to be more than one operating cycle, then corrective action is required, such as repair, replacement, or re-evaluation.

FAC is only applicable to carbon steel piping and components. Field measurement results are used to confirm the predicted wear rate. The CHECWORKS model is evaluated and updated as required to reflect any significant changes in plant operating parameters such as power uprates. The CHECWORKS model is also refined by importing actual UT inspection data thickness measurements and re-running the wear rate analysis, thereby, improving the predictive capability of the model. The FAC program relies on industry and in-house operating experience including CHECWORKS Users Group (CHUG) Notices, Plant Event databases, Significant Operating Event Reports, Nuclear Operation Notices, Information Notices, and plant experience.

No preventive attributes are directly associated with the Flow-Accelerated Corrosion program. However, water chemistry monitoring is used to control pH and dissolved oxygen content and is effective in reducing FAC. The program considers water treatment changes that may affect the FAC rates (e.g., water treatment amines, hydrogen water chemistry, hydrazine addition, or any other change that affects the pH or dissolved oxygen concentration).

The Flow-Accelerated Corrosion program, which was originally outlined in NUREG-1344, is implemented as required by NRC Generic Letter 89-08, “Erosion/Corrosion-Induced Pipe Wall Thinning.” As noted above, the Flow-Accelerated Corrosion program is based on the EPRI guidelines in NSAC-202L-R3.

NUREG-1801 Consistency

The Flow-Accelerated Corrosion aging management program is consistent with the ten elements of aging management program XI.M17, “Flow-Accelerated Corrosion,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Flow-Accelerated Corrosion program will be effective in ensuring that component intended functions are maintained consistent with the current licensing basis during the period of extended operation:

<u>Byron Station</u>

1. During the Spring of 2007, at Byron Station Unit 2, a three (3) inch pipe elbow on the 2A second stage reheater vent line failed its acceptance criteria based on ultrasonic testing during a scheduled FAC examination. The condition was entered into the corrective action program. Based on this test result the pipe elbow, one (1) foot of upstream piping, and two (2) feet of downstream piping were replaced with FAC resistant chrome moly material. In accordance with the FAC program guidelines, the inspection scope was expanded to include an additional 3 inch elbow on the 2A Moisture Separator Reheater second stage vent line with a similar piping configuration. This 3 inch elbow also failed its acceptance criteria. The pipe elbow, one (1) foot of upstream piping, and two (2) feet of downstream piping were replaced with FAC resistant chrome moly material. In accordance with the FAC program guidelines, the inspection scope was further expanded to include two (2) additional 3 inch elbows on the 2A Moisture Separator Reheater second stage vent lines. Both of these ultrasonic test inspections were completed with satisfactory results. As a result of these FAC program inspections, replacement of all 2A Moisture Separator Reheater second stage vent lines with FAC resistant chrome moly material was performed in the Fall of 2008.

   This example provides objective evidence that the FAC aging management program effectively monitors and trends the aging effects of FAC on piping and piping components. In addition, the program takes corrective actions prior to loss of component intended function and addresses extent of condition.

2. In preparation for the Byron Station Unit 1 refuel outage in the Spring of 2011, Engineering reviewed, evaluated, and documented the potential impact of several industry operating experience events related to flow-accelerated corrosion (FAC). Additionally, in accordance with the "Byron Flow-Accelerated Corrosion Program Long Range Plan for Repairs and Replacements," Engineering identified specific piping and components susceptible to FAC, and Maintenance planned the proactive replacement of the identified components. These proactive replacements targeted the gland steam, feedwater, and main steam plant systems. The six (6) pipe lines and one (1) piping component that had been identified by Engineering were replaced with FAC resistant chrome moly material. Additionally, two (2) overlay pads were proactively welded onto the external surface of the discharge piping on the 1B and 1C Feedwater Pumps as a result of previous FAC inspections.

   Also during the refueling outage in the Spring of 2011, FAC examinations were performed on fifty-three (53) components. Radiography was performed on eleven (11) components, and ultrasonic testing was performed on forty-two (42) components. Based on the results of these examinations, all of the components examined were evaluated as acceptable to return to service.

   This example provides objective evidence that the FAC program is proactive in reviewing and evaluating industry operating experience. Additionally, this example provides objective evidence that the FAC program is used to proactively identify and repair or replace piping and piping components with FAC resistant material prior to loss of component intended function.

3. Measurement Uncertainty Recapture Power Uprate (MUR) at Byron Station is planned for the near future. In advance of the power uprate, Byron performed a FAC evaluation on CHECWORKS. Comparing the predicted CHECWORKS wear rates at MUR with wear rates at normal power, this evaluation revealed that the power uprate operating conditions would have a minimal impact on FAC wear rates, resulting in a limited number of inspections being moved up in the schedule due to the predicted increases in wear rates. Also, the results indicated that the average predicted wear rates would not require modifications and would not increase the need for component replacements in systems that are vulnerable to FAC. In 2012, the CHECWORKS model at Byron was revised to reflect the power uprate conditions in compliance with the EPRI NSAC 202L-R3 Guidelines.

   Byron has benefited from FAC related experience of other nuclear plants that have completed MUR. Byron actively participates in the CHECWORKS User Group (CHUG) and stays informed of the industry experience on FAC. To date, no industry experience has indicated any FAC related issues because of MUR that would have any impact on risk ranking by CHECWORKS. Byron, Units 1 and 2, will enter their period of extended operation in 2025 and 2027, respectively. This provides for a significant number of years of additional plant experience at MUR conditions. In addition, it allows for monitoring experiences at other nuclear plants that have operated with MUR conditions.

This example provides objective evidence that operating experience is being used effectively to improve the program and lessons learned are implemented to assure the FAC program is effective at Byron.

Braidwood Station

1. During the Spring of 2011, at Braidwood Station Unit 2, three (3) 42-inch cross-under pipes between the high pressure turbine and the 2B Moisture Separator Reheater were visually inspected as required by the FAC program. Cross-under pipes are inspected every refueling outage as part of the station's FAC program, alternating between the pipes to A and B Moisture Separator Reheaters. During this inspection, personnel identified areas in one in-scope pipe that were undercut and required repair. The undercutting of this pipe occurred at the interface between the pipe (elliptical ring portion of turning vane assembly) and twenty-one (21) vanes on two turning vane assemblies within the line. The undercut areas were weld repaired by maintenance personnel prior to Unit startup. The other two (2) cross-under pipes were also inspected and found to be in acceptable condition. These three cross-under pipes (B-train) will be re-inspected in the Spring of 2014.

   This example provides objective evidence that the FAC program inspection activities are effective in identification of susceptible locations and that the FAC program takes effective corrective measures prior to loss of intended component intended function.

2. The Braidwood FAC Program implemented a proactive material upgrade process in 2001 to mitigate wall thinning by upgrading to FAC resistant materials. Upgrading piping to a FAC resistant material is an industry best practice. EPRI's NSAC-202L-R3, "Recommendations for an Effective Flow-Accelerated Corrosion Program," states that upgrading the carbon steel piping to material containing chrome should alleviate FAC damage. Braidwood has experienced FAC induced through-wall leaks with carbon steel piping. As a result of this operating experience, Braidwood has taken on a proactive replacement plan to upgrade the FAC susceptible carbon steel components with FAC resistant materials. Using plant and industry experience the FAC program engineer determines what plant systems should be upgraded with FAC resistant materials.

   During the Spring of 2009, portions of the 1st stage high pressure turbine extraction steam lines to the 1A and 1B Moisture Separator Reheaters were replaced as part of the material upgrade process. This piping had been previously examined numerous times, and included several piece-meal replacements. The replacement of these portions of the 1st stage high pressure turbine extraction steam lines to the 1A and 1B Moisture Separator Reheaters were performed as proactive replacements to assure that these steam lines would not violate minimum wall requirements. The existing piping was replaced with FAC resistant piping. Additional piping replacements with FAC resistant piping material have been planned for each refueling outage through 2024 which includes feedwater, extraction steam, and feedwater heater miscellaneous drains and vents systems.

This example provides objective evidence that the FAC aging management program effectively monitors the aging effects of FAC on piping and components. In addition, the program has taken corrective action to implement a proactive replacement plan to upgrade various susceptible carbon steel components with FAC resistant material.

3. Measurement Uncertainty Recapture Power Uprate (MUR) at Braidwood Station is planned for the near future. In advance of the power uprate, Braidwood performed a FAC evaluation on CHECWORKS. Comparing the predicted CHECWORKS wear rates at MUR with wear rates at normal power, this evaluation revealed that the power uprate operating conditions would have a minimal impact on FAC wear rates, resulting in a limited number of inspections being moved up in the schedule due to the predicted increases in wear rates. In addition, the results indicated that the average predicted wear rates would not require modifications and would not increase the need for component replacements in systems that are vulnerable to FAC. In 2012, the CHECWORKS model at Braidwood was revised to reflect the power uprate conditions in compliance with the EPRI NSAC 202L-R3 Guidelines.

   Braidwood has benefited from FAC related experience of other nuclear plants that have completed MUR. Braidwood actively participates in the CHECWORKS User Group (CHUG) and stays informed of the industry experience on FAC. To date no industry experience has indicated any FAC related issues because of MUR that would have any impact on risk ranking by CHECWORKS. Braidwood, Units 1 and 2, will enter their periods of extended operation in 2026 and 2027, respectively. This provides for a significant number of years of additional plant experience at MUR conditions. In addition, it allows for monitoring experiences at other nuclear plants that have operated with MUR conditions.

   This example provides objective evidence that operating experience is being used effectively to improve the program and lessons learned are implemented to assure the FAC program is effective at Braidwood.

The above examples provide objective evidence that the Flow-Accelerated Corrosion aging management program is capable of both detecting and trending the aging effects of wall thinning. A review of the operating experience examples showed that inspections have not identified any instances of significant age-related deficiencies. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Flow-Accelerated Corrosion aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that continued implementation of the Flow-Accelerated Corrosion aging management program will effectively identify degradation prior to failure.

Conclusion

The existing Flow-Accelerated Corrosion program provides reasonable assurance that wall thinning aging effects are adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.9 Bolting Integrity

Program Description

The Bolting Integrity aging management program is an existing condition monitoring program. The program provides for aging management for loss of preload, cracking, and loss of material due to corrosion of closure bolting on pressure retaining joints within the scope of license renewal. The program includes closure bolting on pressure retaining joints in indoor air, outdoor air, air with borated water leakage, condensation, raw water, and soil. The Bolting Integrity program incorporates NRC and industry recommendations delineated in NUREG-1339, “Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants,” EPRI TR-104213, “Bolted Joint Maintenance & Applications Guide,” and EPRI NP-5769, “Degradation and Failure of Bolting in Nuclear Power Plants.”

The program generally includes periodic inspection of closure bolting, at least once per refueling cycle, for indications of loss of preload, cracking, and loss of material. The program credits visual inspection of pressure retaining bolted joints in ASME Class 1, 2, and 3 systems for leakage and age-related degradation during system pressure tests performed in accordance with ASME Section XI, 2001 Edition through the 2003 Addenda. In addition, the Bolting Integrity aging management program credits volumetric, surface, and visual inspections of ASME Class 1, 2, and 3 bolts, nuts, washers, and other associated bolting components performed in accordance with ASME Section XI, Subsections IWB, IWC, and IWD. The integrity of non-ASME (nonsafety-related) pressure retaining bolted joints (in non-ASME Class 1, 2, 3 and MC systems) is monitored by detection of visible leakage, evidence of past leakage, or other age-related degradation during maintenance activities and walkdowns in plant areas that contain systems within scope of license renewal. Inspection activities of closure bolting on pressure retaining joints within the scope of license renewal in submerged environments will be performed in conjunction with associated component maintenance activities. These monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant age-related degradation.

When pressure retaining bolted joint leakage or other age-related degradation is identified the condition is evaluated and entered into the corrective action program. The corrective action program is used to document and manage those components where leakage or age-related degradation is identified during routine observations, including walkdowns and maintenance activities. The leakage may be monitored for a change, repaired immediately or scheduled for repair based on the severity of the leak, the potential impact on plant operations, nuclear safety, or industrial safety. If leakage monitoring is required, the frequency will be based on the severity of the leak, personnel safety, impact on plant operations, nuclear safety, radiation exposure, and other factors. If the leak rate changes, the monitoring frequency is re-evaluated and may be revised.

ASME Class 1, 2 and 3 pressure retaining bolted joint repairs are performed in accordance with the Exelon ASME Section XI Repair/Replacement Program. Flanged joint welding repairs and closure bolting replacements on pressure retaining joints are implemented in accordance with IWA-4000. Non-ASME pressure retaining bolting replacements and repairs follow the EPRI bolting guidelines (EPRI TR-104213), which includes proper bolt torquing and checking for uniformity of gasket compression after assembly.

High strength bolts (actual measured yield strength equal to or greater than 150 ksi) are not used on pressure retaining bolted joints within the scope of the Bolting Integrity program. The Bolting Integrity aging management program will be enhanced to include preventive measures to preclude or minimize stress corrosion cracking, by prohibiting the use of lubricants that contain molybdenum disulfide (MoS2) and prohibiting use of bolting material that has an actual measured yield strength of 150 ksi or greater in portions of systems that are within the scope of the Bolting Integrity program.

The Bolting Integrity aging management program is supplemented by the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD (B.2.1.1) program, for inspection of safety-related closure bolting on pressure retaining joints. Inspection activities for closure bolting on pressure retaining joints in buried and underground environments are performed by the Buried and Underground Piping (B.2.1.28) program when closure bolting on pressure retaining joints are exposed by excavation.

The Primary Containment (MC) pressure bolting is managed as part of the ASME Section XI, Subsection IWE (B.2.1.29) program. The ASME Section XI, Subsection IWF (B.2.1.31) program manages ASME Class 1, 2, 3 and MC piping and component supports bolting. Structural bolting, other than ASME Class 1, 2, 3, and MC piping and component supports is managed as part of the Structures Monitoring (B.2.1.34) program and R.G. 1.127, Inspection of Water Control Structures Associated With Nuclear Power Plants (B.2.1.35) program. Crane and hoist bolting is managed by the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.2.1.13) program. The heating and ventilation system bolting is managed by the External Surfaces Monitoring of Mechanical Components (B.2.1.23) program. Reactor head closure bolting is managed by the Reactor Head Closure Stud Bolting (B.2.1.3) program. The above bolting is not included in the Bolting Integrity Program.

NUREG-1801 Consistency

The Bolting Integrity aging management program will be consistent with the ten elements of aging management program XI.M18, “Bolting Integrity,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Prohibit the use of lubricants containing molybdenum disulfide on pressure retaining bolted joints. **Program Elements Affected: Preventive Actions (Element 2), Parameters Monitored/Affected (Element 3), Detection of Aging Effects (Element 4), Corrective Actions (Element 7)**
2. Prohibit the use of high strength bolting (actual measured yield strength equal to or greater than 150 ksi) for pressure retaining bolted joints in portions of systems within the scope of the Bolting Integrity program. **Program Elements Affected: Preventive Actions (Element 2), Parameters Monitored/Affected (Element 3), Detection of Aging Effects (Element 4), Corrective Actions (Element 7)**
3. Perform visual inspection of submerged bolting on fire protection system pumps (Byron only) and well water system deep well pumps (Byron only) when submerged portions of the pumps are overhauled or replaced during maintenance activities. **Program Elements Affected: Scope of Program (Element 1), Parameters Monitored/Affected (Element 3) Detection of Aging Effects (Element 4)**

Operating Experience

The following examples of operating experience provide objective evidence that the Bolting Integrity program will be effective in ensuring that intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. In September 2002, with Byron Unit 2 operating at 100% power, the control room was informed that a leak was observed on a Containment Ventilation System flange inside the Unit 2 containment emergency hatch. The leak was observed during containment entries for scaffolding erection and insulation work during pre-refueling outage preparations. The flange is located on Containment Ventilation System piping that allows outside air to enter the Unit 2 emergency hatch to equalize pressure. Since the condition had the potential to jeopardize primary containment, operations conservatively declared the emergency hatch as inoperable and placed Unit in a 24 hour shutdown limiting condition of operability (LCO). The issue was entered into the corrective action program, immediate corrective action was taken to tighten the flange, and an apparent cause evaluation was performed. The LCO was exited following successful performance of the emergency hatch local leakage rate test (LLRT). Follow up investigation of the configuration determined that the flange gasket was a soft neoprene

material and the flange bolting torque had loosened over time due to vibration and cyclic operation of an upstream equalizing valve. Corrective actions were implemented to replace the soft neoprene material gasket with spiral wound gasket on similar flanges on both units.

This example demonstrates that degraded pressure retaining bolted joints are identified during routine maintenance activities and walkdowns, and are entered into the corrective action program. As part of the corrective action program apparent cause evaluations and extent of condition assessments are performed, and corrective actions are implemented to prevent recurrence.

2. In 2002, Byron Station reported to the industry, through INPO, the results of a foreign material intrusion event investigation. Both Byron units had experienced forced outages to repair steam generator tube leaks caused by foreign material intrusion involving spiral wound gaskets. The station identified occurrences where gasket material had been retrieved from the steam generators. The condition was entered into the corrective action program to determine the cause and appropriate corrective actions. Investigation into the cause of the failures revealed that the bolt torque values specified in procedures for high-pressure systems were too high causing the inner wire weld of the spiral wound gaskets to fail. Once the inner wire weld failed, the gasket was free to unwind and pieces of wire entered plant systems. As corrective action, the station revised its general bolting procedures to comply with Electric Power Research Institute (EPRI) guidelines that factor system operating pressure and gasket sealing force into the bolt torque requirements. This corrective action will prevent similar events from occurring in the future.

   Although not age-related, this example demonstrates that generic issues associated with bolted joints are identified during maintenance activities and are entered into the corrective action program. This example also shows that once entered in the corrective action program, issues are thoroughly investigated utilizing industry guidance and corrective actions, including extent of condition assessments, and are implemented to prevent recurrence.

3. In August 2005, during a system walkdown, minor leakage was observed on the flange of the Byron Unit 1 "A" Closed Cooling Heat Exchanger. The condition was entered into the corrective action program. The as found leakage was one (1) drop per hour. The flange was re-torqued and the heat exchanger was verified 24 hours later to be leak tight.

   This example demonstrates that minor leakage is identified during routine walkdowns, entered into the corrective action program, and appropriate corrective actions are taken.

Braidwood Station

1. In March 2006, while working in the common spent fuel pool demineralizer area, mechanics noticed that one flange bolt on the fill line to the "D" spent

fuel pool demineralizer did not have full thread engagement. No leakage was observed on this pressure retaining bolted joint, however, this condition was entered into the corrective action program. Evaluation by engineering concluded the as found condition was acceptable in the short term and that additional tightening of bolts was required to achieve gasket compression for a long-term leak tight connection. A work order was planned and scheduled to correct the condition. Mechanics later isolated and drained the system, disassembled the flange, inspected and cleaned mating surfaces, replaced the gasket, replaced the short bolt, and torqued the flange in accordance with approved procedures. Following the work, the demineralizer was returned to service and leak tested with satisfactory results. No further issues were reported.

This example demonstrates that, regardless of severity, non-conforming pressure retaining bolted joints are identified during routine maintenance activities and are entered into the corrective action program. This example also demonstrates that appropriate evaluations and corrective actions are implemented to correct even minor discrepancies on bolted joints.

2. In March 2011, during scheduled maintenance on the Unit 1, "C" heater drain pump, several pump casing nuts were discovered loose. The loose nuts were present on multiple pump stages. In addition, five nuts and four studs that attach the suction bell to the first stage casing were missing. The condition was entered into the corrective action program. This pump was installed as a new pump in 2007. The pump was removed, quarantined, and disassembled by an independent facility. Foreign material inspections found one nut and one stud from the suction head located in the pump can. The remaining pieces were not located and a foreign material evaluation was performed prior to start-up of the replacement pump. Review of the specified studs, nuts, and lubricants showed that the specified torque values, had they been achieved, were appropriate. However, no vendor documentation was found for the as-left torque values of the pump casing or suction bell studs and nuts. There was no evidence of undue vibration during the pump run-times. Therefore, it was concluded that the apparent root cause was that the closure bolts and nuts were not tightened properly at the vendor's facility.

   An additional contributing cause was identified when laboratory analysis noted that the major diameters of studs that were found loose had class 3A threads, while the major diameters of studs that were found tight had class 2A threads. Since the class 3A threads have a larger major diameter than the class 2A threads, it is possible the reduced clearances of the class 2A threads may have resulted in more resistance to installation torquing. This could have resulted in less clamping force and stud preloading of the class 3A studs, while the class 2A studs maintained the majority of the joint clamping force and stud preloading. The vendor indicated that the studs and nuts should have all been class 3A studs and nuts. Extent of condition actions included verifying proper torque values and correct studs on the newly installed pump as well as the installed redundant heater drain pumps on both units. The newly installed pump was successfully run for post maintenance testing. The correct thread design information was also added to the component part numbers for future reference.

Although not age-related, this example demonstrates that degraded pressure retaining bolted joints are identified during routine maintenance activities and are entered into the corrective action program. This example also demonstrates that thorough and rigorous apparent root cause evaluations and extent of condition assessments are performed, and corrective actions are implemented to prevent recurrence.

3. In February 2012, during maintenance activities on Unit 1, a steam leak was observed on a steam line low point level controller. This condition was entered into the corrective action program. A work order was planned and scheduled to correct the condition during the upcoming Spring 2012 refueling outage. Mechanics isolated and drained the system, disassembled the flange, inspected and cleaned the flange, replaced the gasket, and torqued the flange in accordance with approved procedures.

   This example demonstrates that degraded pressure retaining bolted joints are identified during routine maintenance activities, are entered into the corrective action program, and corrective actions are implemented to correct the deficiency.

The above examples provide objective evidence that the enhanced Bolting Integrity aging management program is capable of effectively monitoring and detecting the aging effects of loss of preload, cracking, and loss of material due to corrosion. A review of the operating experience examples showed that implementation of the Bolting Integrity aging management program has effectively identified and corrected age-related degradation. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions are taken to prevent recurrence. Appropriate guidance for evaluation, repair, or replacement is provided for components where age-related degradation is found. Assessments of the Bolting Integrity aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the Bolting Integrity aging management program will effectively identify age-related degradation prior to failure.

Conclusion

The enhanced Bolting Integrity program will provide reasonable assurance that the aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.10 Steam Generators

Program Description

The Steam Generators aging management program is an existing preventive, mitigative, condition monitoring, and performance monitoring program that provides for managing aging of the steam generator tubes, plugs, and secondary side components that are contained within the steam generator (i.e., secondary side internals). The program implements NEI 97-06, “Steam Generator Program Guidelines.” Aging is managed through assessment of potential degradation mechanisms, inspections, tube integrity assessments, tube plugging and repairs, primary to secondary leakage monitoring, maintenance of secondary side internal component integrity, primary and secondary side water chemistry, and foreign material exclusion. Station procedural guidance implements the performance criteria for steam generator tube integrity, condition monitoring requirements, inspection scope and frequency, acceptance criteria for the plugging or repair of flawed tubes, acceptable tube repair methods, leakage monitoring requirements, operational leakage and accident induced leakage requirements specified in plant technical specifications.

The program reporting requirements, inspection scope and frequency, assessments, tube plugging criteria, primary to secondary leak rate monitoring, and monitoring/controlling primary and secondary side water chemistry are consistent with the requirements of the plant technical specifications, the Maintenance Rule (10 CFR 50.65), ASME Code, and EPRI steam generator guidelines EPRI 1019038, “Steam Generator Integrity Assessment Guidelines”, EPRI 1013706, “Steam Generator Examination Guidelines”, EPRI 1022832, “PWR Primary-to-Secondary Leak Guidelines”, and EPRI 1014983, “Steam Generator In-Situ Pressure Test Guidelines.” The EPRI guidelines provide a generic industry program to implement NEI 97-06, “Steam Generator Program Guidelines.”

The Steam Generators program includes preventive measures to mitigate age-related degradation through foreign material exclusion as a means to inhibit wear degradation and secondary side maintenance activities, such as sludge lancing, for removing deposits that may contribute to degradation. The Water Chemistry program (B.2.1.2) monitors and controls primary side and secondary side water chemistry for the steam generators consistent with the EPRI guidelines EPRI 1014986, “Pressurized Water Reactor Primary Water Chemistry Guidelines” and EPRI 1016555, “Pressurized Water Reactor Secondary Water Chemistry Guidelines” applicable to primary water chemistry and secondary water chemistry as a preventative measure.

The Steam Generators program detects flaws in steam generator tubes, plugs, and tube supports needed to maintain tube integrity. Nondestructive examination (NDE) techniques are used to inspect all steam generator tubes to identify tubes that may need to be removed from service or repaired in accordance with plant technical specifications. The program provides criteria for the qualification of personnel, specific inspection techniques, and the associated acquisition and analysis of data, including procedures, analysis protocols, and reporting criteria. Assessment of steam generator tube integrity and plugging and repair criteria of flawed tubes is in accordance with plant technical specifications and the program implementing procedures. Steam generator tube structural integrity limits consistent with Regulatory Guide 1.121, “Bases for Plugging Degraded PWR Steam Generator Tubes,” are applied as detailed in the plant technical specifications. Tubes, plugs, and secondary side internal components with age-related degradation are evaluated for corrective actions in accordance with the station’s corrective action program. Condition monitoring assessments are performed to determine whether structural and accident leakage criteria have been satisfied during the previous operating cycle(s). Operational assessments are performed after inspections to verify that structural and leakage integrity will be maintained for the operating interval between inspections, which is selected in accordance with plant technical specifications and NEI 97-06 guidelines. Comparison of the results of the condition monitoring assessment with the predictions of the previous operational assessment provides feedback for evaluation of the adequacy of the operational assessment and additional insights that can be incorporated into the next operational assessment. The condition monitoring and performance monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant age-related degradation.

The original equipment Byron and Braidwood Unit 1 Westinghouse Model D-4 steam generators were replaced in 1998. The replacement steam generators incorporate features designed to improve reliability and minimize age-related degradation. Industry experience and laboratory testing have shown the materials used in fabricating the new steam generators to be more resistant to aging effects than those used in the original steam generators.

Tube sleeve repair is currently not allowed by plant technical specifications for Byron and Braidwood Stations, Unit 1 and Unit 2 nor are there any sleeves currently installed. If BBS were to implement sleeving repair methods in the future, a Technical Specification change would be required and the sleeving would be incorporated into the Steam Generators aging management program.

NUREG-1801 Consistency

The Steam Generators aging management program will be consistent with the ten elements of aging management program XI.M19, “Steam Generators,” specified in NUREG-1801 as modified by LR-ISG-2011-02, Aging Management Program for Steam Generators, with the following exception.

Exceptions to NUREG-1801

1. NUREG-1801 specifies the use of EPRI 1008219, “Steam Generator Primary-to-Secondary Leakage Guidelines,” Revision 3 for monitoring primary to secondary leakage, however the Byron and Braidwood Stations existing Steam Generators aging management program

specifies the use of EPRI 1022832, “Steam Generator Primary-to-Secondary Leakage Guidelines,” Revision 4 for monitoring primary to secondary leakage. **Program Element Affected: Parameters Monitored/Inspected (Element 3)**

Justification of Exception

EPRI 1022832, EPRI “Steam Generator Primary-to-Secondary Leakage Guidelines,” is a mandatory guideline per NEI 97-06, “Steam Generator Program Guidelines.” EPRI 1022832 contains mandatory, needed, and recommended requirements on how the plant is to monitor, trend, sample, and respond to primary-to-secondary leakage. EPRI reports such as Steam Generator Primary-to-Secondary Leakage Guidelines are industry reports, which are periodically reviewed and revised by industry experts to incorporate recent industry operating experience and technology improvements. Updated guidelines are required to be fully implemented within six (6) months of issuance. The focus of Revision 4 was on updating the technical bases and clarifying the monitoring and action-level requirements for implementation, based on lessons learned. Revision 4 major changes included: 1. Clearly identifying the use of two methodologies: leakage rate-of-change methodology and constant leakage methodology; 2. The definition of continuous radiation monitor was clarified to include continuous operation with an alarm function in the Control Room; 3. The frequency of grab samples was updated based on leak rate; and 4. Actions with and without radiation monitors were clarified. These recommended changes were intended to clarify implementation of the guidelines and to ensure that the likelihood of propagation of flaws to tube rupture is minimized under both normal and faulted conditions. These improvements are designed to aid utilities in the implementation of the guidelines. EPRI 1022832, “Steam Generator Primary-to-Secondary Leakage Guidelines,” Revision 4, provides the latest industry guidance for the monitoring of primary to secondary leakage and did not reduce the level of monitoring for leakage.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Validate that primary water stress corrosion cracking of the divider plate welds to the primary head and tubesheet cladding is not occurring. BBS commits to perform one (1) of the following three (3) resolution options for Units 1 and 2:

   Option 1: Inspection

   Perform a one-time inspection, under the Steam Generators (B.2.1.10) program, of each steam generator to assess the condition of the divider plate welds and the effectiveness of the Water

Chemistry (B.2.1.2) program. For the Byron and Braidwood, Unit 1 steam generators which were replaced in 1998, the inspection will be performed between 2018 and the start of the period of extended operation to allow the steam generators to acquire at least twenty years of service. For the Byron and Braidwood, Unit 2 steam generators, which currently have at least twenty years of service, the inspection will be performed prior to entering the period of extended operation. The examination technique(s) will be capable of detecting primary water stress corrosion cracking (PWSCC) in the divider plate assemblies and associated welds.

or

<u>Option 2: Analysis</u>

Perform an analytical evaluation of the steam generator divider plate welds in order to establish a technical basis which concludes that the steam generator reactor coolant pressure boundary is adequately maintained with the presence of steam generator divider plate weld cracking. The analytical evaluation will be submitted to the NRC for review and approval prior to entering associated period of extended operation.

or

<u>Option 3: Industry/NRC Studies</u>

If results of industry and NRC studies and operating experience document that potential failure of the steam generator reactor coolant pressure boundary due to PWSCC of the steam generator divider plate welds is not a credible concern, this commitment will be revised to reflect that conclusion.

Program Element Affected: Parameters Monitored/Inspected (Element 3)

2. Validate that primary water stress corrosion cracking of the tube-to-tubesheet welds is not occurring on BBS Unit 1. BBS commit to perform one (1) of the following three (3) resolution options for Unit 1:

<u>Option 1: Inspection</u>

Perform a one-time inspection, under the Steam Generator (B.2.1.10) program, of a representative number of tube-to-tubesheet welds in each steam generator to determine if PWSCC cracking is present. Since the Byron and Braidwood, Unit 1 steam generators were replaced in 1998, the inspection will be performed between 2018 and the start of the period of extended operation to allow the steam generators to acquire at least twenty years of service. The examination technique(s) will be capable of detecting primary water stress corrosion cracking (PWSCC) in the tube-to-tubesheet welds. If cracking is identified, the condition will be resolved through repair or engineering evaluation to justify continued service, as appropriate, and a periodic monitoring program will be established to perform routine tube-to-tubesheet weld inspections for the remaining life of the steam generators.

or

Option 2: Analysis - Susceptibility

Perform an analytical evaluation of the steam generator tube-to-tubesheet welds to determine that the welds are not susceptible to primary water stress corrosion cracking. The evaluation for determining that the tube-to-tubesheet welds are not susceptible to primary water stress corrosion cracking will be submitted to the NRC for review and approval prior to entering the associated period of extended operation.

or

Option 3: Analysis – Pressure Boundary

Perform an analytical evaluation of the steam generator tube-to-tubesheet welds redefining the reactor coolant pressure boundary of the tubes, where the steam generator tube-to-tubesheet welds are not required to perform a reactor coolant pressure boundary function. The redefinition of the reactor coolant pressure boundary will be submitted to the NRC for review and approval prior to entering the associated period of extended operation.

Program Element Affected: Parameters Monitored/Inspected (Element 3)

A license amendment (Adams Accession Number: ML12262A360), approved by the NRC for BBS Unit 2, redefined the pressure boundary in which the tube-to-tubesheet weld is no longer included; therefore a plant specific program to verify the effectiveness of the Water Chemistry (B.2.1.2) program is not required.

Operating Experience

The following examples of operating experience provide objective evidence that the Steam Generators program will be effective in ensuring that intended functions will be maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. The four (4) Byron Unit 1 original equipment Westinghouse Model D-4 steam generators were replaced with Babcock and Wilcox (B&W) re-circulating feedring replacement steam generators during the Byron Station,

Unit 1 Fall 1997 through Spring 1998 Refueling Outage. Each Unit 1 steam generator contains 6,633 thermally treated Alloy 690 U-tubes. Based on steam generator inspections up to and including the Byron Station, Unit 1 Spring 2011 Refueling Outage a total of 21 tubes out of 26,532 tubes (0.08%) have been removed from service by plugging. Of the 21 plugged tubes, one (1) tube was plugged during initial construction and 20 tubes were plugged due to wear from foreign objects.

This example illustrates that steam generator tube examinations by qualified personnel are capable of detecting flaws and other indications of possible age-related degradation of steam generator components.

2. The four (4) Byron Unit 2 original equipment Westinghouse D-5 steam generators are currently in service. Each Unit 2 steam generator contains 4,570 thermally treated Alloy 600 U-tubes. Based on steam generator inspections up to and including the Byron Station, Unit 2 Fall 2011 Refueling Outage a total of 408 tubes out of 18,280 tubes (2.23%) have been removed from service by plugging. Of the 408 plugged tubes, 29 tubes were plugged due to top of tubesheet circumferential indications, 138 tubes were plugged due to anti-vibration bar wear, five (5) tubes were plugged due to outside diameter volumetric indications near tube support plates, 68 tubes were plugged due to wear from foreign material, and 168 tubes were plugged due to other reasons such as preventive plugging due to un-retrieved foreign objects and pre-heater wear.

   This example illustrates that steam generator tube examinations by qualified personnel are capable of detecting flaws and other indications of possible age-related degradation of steam generator components.

3. During the Byron Station, Unit 2 Fall 2008 Refueling Outage, steam generator eddy current testing identified indications of stress corrosion cracking in the bottom quarter of the tubesheet on all four (4) steam generators. The inspection scope was expanded to 100 percent of the hot leg tube ends and 20 percent of the cold leg tube ends. Sixty five (65) hot leg tube ends were identified as having indications of cracking and none of the cold leg tube ends inspected had indication of cracking. Based on the NRC approved interim alternate repair criteria, none of the 65 tubes with indications of cracking required plugging. No indications of circumferential cracking were found. Tube end cracking was identified as a potential degradation mechanism in the degradation assessment performed prior to the refueling outage. It should be noted that due to license amendment (Adams Accession Number: ML12262A360), approved by the NRC on October 5, 2012 for Unit 2, the pressure boundary was redefined in which the tube-to-tubesheet weld is no longer included and inspection for tube end cracking is no longer required.

   This example demonstrates that deficiencies are entered into the corrective action program and appropriate corrective actions are taken to evaluate and correct deficiencies. This example illustrates that steam generator tube examinations by qualified personnel are capable of detecting flaws and other indications of possible age-related degradation of steam generator components.

4. During the Byron Station, Unit 2 Fall 2011 Refueling Outage, visual inspections of the 2A and 2B steam generator moisture separator region were performed to allow tracking and trending of erosion of the moisture separator swirl vane regions and tangential nozzles. The Byron Station, Unit 2 Fall 2011 Refueling Outage inspections were prompted by previous inspections performed during the Byron Station, Unit 2 Fall 2007 Refueling Outage. Ultrasonic (UT) measurements were taken on the eroded area for trending purposes during both inspections. No through wall erosion was identified and no repairs were required during the Byron Station, Unit 2 Fall 2011 Refueling Outage. The condition was evaluated and it was determined the 2A and 2B steam generators could be operated until 2014 without repairs. Similar degradation has been observed in the other Byron Unit 2 steam generators. Long term plans for possible mitigation and repair of the Byron Unit 2 steam generator moisture separator regions are currently being developed.

   Also during the Byron Station, Unit 2 Fall 2011 Refueling Outage, in response to NRC Information Notice (IN) 2002-02: Recent Events with Plugged Steam Generator Tubes, all active tubes adjacent to plugged tubes were eddy current tested. IN 2002-02 highlighted recent operating experience where a plugged tube expanded into the tube support plate, became susceptible to flow induced vibration fatigue, and caused a tube failure that damaged active tubes. No indications were found that were attributable to plugged tubes being in contact with active tubes. In addition, the Byron Unit 2 tubes were determined to be not susceptible to flow induced vibration in the event of the tubes becoming locked in the tube support plate.

   This example provides objective evidence that inspections are performed, collected data is analyzed and trended, and operational decisions are based on inspection results. This example provides objective evidence that industry operating experience is being utilized to identify potential degradation mechanisms and determine inspection scope.

<u>Braidwood Station</u>

1. The four (4) Braidwood Unit 1 original equipment Westinghouse Model D-4 steam generators were replaced with Babcock and Wilcox (B&W) re-circulating feedring replacement steam generators during the Braidwood Station, Unit 1 Fall 1998 Refueling Outage. Each Unit 1 steam generator contains 6,633 thermally treated Alloy 690 U-tubes. Based on steam generator inspections up to and including the Braidwood Station, Unit 1 Spring 2012 Refueling Outage a total of 85 tubes out of 26,532 tubes (0.3%) have been removed from service by plugging. Of the 85 plugged tubes three (3) tubes were plugged pre-service, one (1) tube was plugged due to fan bar wear, 26 tubes were plugged due to wear from foreign

objects, and 55 tubes were preventatively plugged due to un-retrieved foreign objects.

This example illustrates that steam generator tube examinations by qualified personnel are capable of detecting flaws and other indications of possible age-related degradation of steam generator components.

2. The four (4) Braidwood Unit 2 original equipment Westinghouse D-5 steam generators are currently in service. Each Unit 2 steam generator contains 4,570 thermally treated Alloy 600 U-tubes. Based on steam generator inspections up to and including the Braidwood Station, Unit 2 Spring 2011 Refueling Outage a total of 259 tubes out of 18,280 tubes (1.42%) have been removed from service by plugging. Of the 259 plugged tubes four (4) tubes were plugged due to tube support plate axial outside diameter stress corrosion cracking, one (1) tube was plugged due to a tube geometric anomaly, 16 tubes were plugged due to lower tube sheet primary water stress corrosion cracking, 15 tubes were plugged due to top of tubesheet circumferential indications, 131 tubes were plugged due to anti-vibration bar wear, four (4) tubes were plugged due to outside diameter volumetric indications near tube support plates, 71 tubes were plugged due to wear from foreign material, two (2) tubes were plugged due to tube support plate wear, and 15 tubes were plugged due to other reasons such as preventive plugging due to un-retrieved foreign objects and pre-heater wear.

   This example illustrates that steam generator tube examinations by qualified personnel are capable of detecting flaws and other indications of possible age-related degradation of steam generator components.

3. During the Braidwood Station, Unit 2 Spring 2011 Refueling Outage, full length Bobbin Coil Eddy Current inspections were performed on the 2D steam generator. A distorted support indication (DSI) was identified at the hot leg ninth quatrefoil broached hole support plate on tube row 2 column 35. Subsequent Plus Point inspection confirmed the presence of axial outside diameter stress corrosion cracking (ODSCC). Additional less severe indications were also detected at the third and fourth support plates. The affected tube was removed from service by plugging. Full Bobbin Coil Eddy Current inspection of all in service tubes was performed with no additional indications of ODSCC being identified. ODSCC is a degradation mechanism inspected for during scheduled eddy current test.

   Also during the Braidwood Station, Unit 2 Spring 2011 Refueling Outage, all active tight radius (tubes in rows one (1) and two (2)) in each steam generator (39 total) were inspected in response to NRC Information Notice (IN) 2010-021: Crack-Like Indication in the U-Bend Region of a Thermally Treated Alloy 600 Steam Generator Tube. IN 2010-021 highlighted recent operating experience with the detection of a crack-like indication in the U-bend region of a thermally treated Alloy 600 steam generator tube. Cracking in the U-bend region had previously been associated with milled-annealed Alloy 600 tubes. No indications of primary water stress corrosion cracking was identified in the inspected tubes.

This example demonstrates that deficiencies are entered into the corrective action program and appropriate corrective actions are taken to evaluate and correct deficiencies. This example illustrates that steam generator tube examinations by qualified personnel are capable of detecting flaws and other indications of possible age-related degradation of steam generator components. This example provides objective evidence that industry operating experience is being utilized to identify potential degradation mechanisms and determine inspection scope.

4. During the Braidwood Station, Unit 2 Spring 2008 Refueling Outage, visual inspections of the 2C steam generator moisture separator region identified erosion of the moisture separator swirl vane regions and tangential nozzles. The 2C steam generator moisture separator region was inspected again during the Unit 2 Fall 2009 Refueling Outage. Ultrasonic (UT) measurements were taken on the eroded area for trending purposes during both inspections. No through wall erosion was identified and no repairs were required during the Braidwood Station, Unit 2 Fall 2009 Refueling Outage. The condition was evaluated and it was determined the steam generator could be operated until the next planned inspection without repair. Similar degradation has been observed in the other Braidwood Unit 2 steam generators. Long term plans for possible mitigation and repair of the Unit 2 steam generator moisture separator regions are currently being developed.

   This example provides objective evidence that inspections are performed, collected data is analyzed and trended, and operational decisions are based on inspection results.

The above examples provide objective evidence that the existing Steam Generators aging management program is capable of both monitoring and detecting the aging effects of cracking, loss of material, reduction of heat transfer, and wall thinning. A review of the operating examples showed that inspections are being performed at a sufficient frequency and scope to detect and evaluate degradation prior to the loss of function. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where age-related degradation is found. Assessments of the Steam Generators aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the Steam Generators aging management program will effectively identify age-related degradation prior to failure.

Conclusion

The enhanced Steam Generators program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.11 Open-Cycle Cooling Water System

Program Description

The Open-Cycle Cooling Water System (OCCWS) aging management program is an existing preventive, mitigative, condition monitoring, and performance monitoring program that manages heat exchangers, piping, piping elements, and piping components in safety-related and nonsafety-related raw water systems that are exposed to a raw water environment for loss of material and reduction of heat transfer. The activities for this program are consistent with the site commitments to the requirements of GL 89-13 and provide for management of aging effects in raw water cooling systems through tests, inspections, and component cleaning. System and component testing, visual inspections, non-destructive examination (NDE) (i.e., ultrasonic testing and eddy current testing), and biocide and chemical treatment are conducted to ensure that identified aging effects are managed such that system and component intended functions are maintained.

The OCCWS includes those systems that transfer heat from safety-related systems, structures, and components to the ultimate heat sink as defined in GL 89-13 as well as those raw water systems which are in scope for license renewal for potential spatial interaction but have no safety-related heat transfer function.

The guidelines of GL 89-13 are utilized for the surveillance and control of bio-fouling for the OCCWS aging management program. Procedures provide instructions and controls for chemical and biocide injection. Periodic inspections are performed for the presence of Asiatic clams, bryozoa (Braidwood only), and mollusks and biocide treatments are applied as necessary.

Periodic heat transfer testing, visual inspection, and cleaning of safety-related heat exchangers with a heat transfer intended function is performed in accordance with the site commitments to GL 89-13 to verify heat transfer capabilities. Additionally, safety-related piping segments are tested periodically to ensure that there is no significant loss of material, which could cause a loss of intended function. Nonsafety-related piping segments have potential for spatial interactions with safety-related equipment, and will be NDE tested periodically as delineated in the enhancement described below.

Routine inspections and maintenance ensure that corrosion, erosion, sediment deposition (silting), scaling (Braidwood only), and bio-fouling do not degrade the performance of safety-related systems serviced by OCCWS aging management program. No credit is taken for protective coatings on safety-related components in the OCCWS aging management program in determining potential aging effects. However, this program is used to assure the lining/coating integrity. Protective coatings on the selected heat exchangers (i.e., control room refrigeration unit condensers and emergency diesel generator jacket water coolers on the endbells, channel heads, cover plates, and tubesheets) are periodically inspected and repaired, as necessary.

Additionally, at Byron only, there are coatings on the reactor containment fan cooler channel heads and the essential service water makeup pump jacket water and gear oil coolers.

The Buried and Underground Piping (B.2.1.28) aging management program activities are adequate for managing the aging effects of external surfaces of buried and underground piping and components. The external surface of the aboveground raw water piping and heat exchangers is managed by the External Surfaces Monitoring of Mechanical Components (B.2.1.23) aging management program. However, the internal and external surfaces of the piping exposed to raw water in the Essential Service Water Cooling Tower (Byron only) will be managed by the Open-Cycle Cooling Water System program.

Examination of polymeric materials in systems serviced by the Open-Cycle Cooling Water System program will be consistent with examinations described in the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B.2.1.25) aging management program.

NUREG-1801 Consistency

The Open-Cycle Cooling Water System aging management program will be consistent with the ten elements of aging management program XI.M20, "Open-Cycle Cooling Water System," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancement will be implemented in the following program elements:

1. Perform periodic volumetric inspections for loss of material in the non-essential service water system piping at a minimum of two (2) locations on each unit in both the auxiliary building and the turbine building for a total of four (4) periodic inspections per unit every refueling cycle. **Program Elements Affected: Parameters Monitored/Inspected (Element 3), Detection of Aging Effects (Element 4)**

Operating Experience

The following examples of operating experience provide objective evidence that the Open-Cycle Cooling Water System aging management program will be effective in ensuring that the intended functions are maintained consistent with the current licensing basis during the period of extended operation:

Byron Station

1. In October 2004, at Byron Unit 2, inspections were performed as part of the GL 89-13 program on the essential service water (SX) pump lube oil cooler for the 2B SX pump. The inspection revealed the flanged surfaces on both the inlet and outlet piping for the oil cooler were degraded due to corrosion. The condition was entered into the corrective action program. The GL 89-13 program manager and the system manager evaluated the condition and determined the condition of the flanged surfaces was adequate for operation of the 2B SX pump lube oil cooler until the next inspection period. As part of the corrective action the flanges, which were constructed of carbon steel were recommended for replacement in the next inspection window for the oil cooler. An extent of condition evaluation determined the 2A and Unit 1 SX pump oil coolers could potentially face the same situation. The condition of the 2A and Unit 1 SX pump oil coolers are also monitored annually and corrective actions would be generated, if necessary, during the future scheduled inspection windows. As follow up to the extent of condition review all of the essential service water pump oil coolers were replaced with stainless steel coolers.

   This event demonstrates that the use of GL 89-13 guidelines for heat exchangers is effective in identifying degrading conditions before loss of intended function and that the corrective action program is utilized to evaluate degraded conditions and implement corrective actions to maintain component intended function.

2. In July 2006, during performance of the 0B essential service water (SX) makeup pump monthly operability test, the operator noted a through-wall leak downstream of the 0B SX makeup pump water jacket cooling outlet valve. The condition was entered into the corrective action program. The leak was a pinhole in the two-inch piping on the bottom side of pipe directly in front of engine. The degraded line was a two-inch, Class 3, moderate-energy (i.e., less than 200 degrees and less than 275 psig) pipe. An ultrasonic test (UT) examination was performed in the area around the hole. Measurements were taken at four locations, 90 degrees apart, on a 1/2-inch diameter circle around the hole. The lowest measured wall thickness of these four locations was 0.09 inches. Once the pipe was removed, it became evident that the source of the through-wall leak was due to microbiologically-induced corrosion. The localized areas of corrosion observed were limited to the bottom of the horizontal pipe, the sides and top of the pipe had surface corrosion but no pitting. The environment used in this cooling application is untreated raw water. Raw water is flushed through and replenished in the pipe approximately monthly during operability runs.

   An immediate extent of condition review was conducted on the remaining horizontal runs of the 0B train pipe on the cooler discharge. In addition, UT measurements were also performed on the supply cooling lines on the 0B train, and the 0A train discharge piping below the upper floor. Based on 0B train findings and degraded 0A piping observations, further UT exams were performed on the supply and discharge cooling lines for the 0A train. These activities would be used to determine if a new predefined task was warranted to have UT thickness exams performed on the potentially impacted sections of pipe on a periodic basis. Corrective actions consisted of replacing the degraded 0B SX pump cooler outlet segment of piping and establishing a new preventive maintenance task to UT the affected piping segments at a frequency of every ten years.

This example demonstrates the effectiveness of ultrasonic testing in identifying degraded piping prior to loss of intended function and taking appropriate action as part of the corrective action program.

3. In July 2008, a non-destructive examination (NDE) was performed on essential service water cooling tower basin blowdown lines. The results of the examination indicated a wall thickness of 0.150” versus the nominal value of 0.280”. The condition was entered into the corrective action program for evaluation. Evaluation of the condition determined the minimum design wall thickness for this line was 0.100”. The actual measured wall thickness was 0.150” resulting in a 0.050” margin between the existing wall thickness and the minimum required design wall thickness. This section of piping is nonsafety-related, but it is located in a vault with safety-related equipment, so flooding of the vault could be a potential spatial interaction concern. The piping still had adequate wall thickness, so the piping did not require replacement at that time. The cause of the degradation was internal corrosion, therefore as part of the corrective action subsequent ultrasonic testing measurement of wall thickness was performed six months later to determine if this was an active MIC cell. As a result of monitoring and trending, this piping is planned for replacement in June 2013.

   This example demonstrates the effectiveness of the periodic piping NDE in identifying degraded piping prior to loss of intended function and taking appropriate action in the corrective action program.

Braidwood Station

1. In February 2007 on Unit 1, during the performance of the regularly scheduled ultrasonic testing of the essential service water safety injection bearing oil heat exchanger inlet piping line, a low reading of 0.184" was found. This reading was below the screening criteria of 0.191". The screening criterion is based on 87.5% of Tnominal. The condition was entered into the corrective action program. The line is a two-inch, carbon steel, schedule 80 piping with a nominal wall thickness of 0.218". Portions of the essential service water (SX) system, as well as portions of other raw water systems, are monitored for corrosion concerns in accordance with NRC GL 89-13. If this criterion is exceeded, a formal calculation must be performed to document the actual calculated Tminimum for the particular inspection point. This calculation was completed and Tminimum was determined to be 0.100”. The corrosion found on the piping line was therefore determined to be acceptable and will continue to be monitored as

part of the GL 89-13 program.

As part of the review, previous inspection data from the monitoring of this piping segment since 2003 indicated no significant increase in the degradation rate since monitoring was implemented. Extent of condition review on the corresponding piping line on Unit 2 revealed that in January 2009, some corrosion was observed during the periodic inspection (0.197”), but the wall thickness was still above the screening acceptance criterion of 0.191 inches. Based on the initial Tnominal value of 0.218" and a current “as found” reading of 0.197", a conservative degradation rate of approximately 3 mils/year (0.003"/year) had been established. Therefore, based on this degradation rate and the established minimum wall thickness requirement of 0.100", a remaining life of approximately twenty-six (26) years was calculated. It was noted during the review that the degradation mechanisms for raw water system do not always demonstrate degradation rates that are linear in nature. The location is currently inspected at an 18-month periodicity as part of the regular raw water piping NRC GL 89-13 inspections. Based on the currently trended projections and the calculated remaining life, no additional actions were required beyond the periodic monitoring at the time.

This example demonstrates the effectiveness of the periodic piping NDE in identifying degraded piping prior to loss of intended function and that appropriate actions are taken in the corrective action program.

2. On September 2, 2008, the 1A essential service water (SX) pump discharge strainer differential pressure increased significantly during a pump surveillance. The 1A SX train was declared inoperable due to strainer fouling. On September 4, 2008, the 2A SX train was declared inoperable due to the inability to manually backwash the 2A SX strainer due to fouling. Subsequent visual inspections identified the presence of live bryozoa in the circulating water (CW) forebays, which is the point of suction for the SX pumps. The condition was entered into the corrective action program. Immediate corrective action consisted of cleaning the forebays and strainers, and returning the 1A SX train and the 2A SX train to an operable status.

   Extent of condition corrective action consisted of additional CW forebay inspections in accordance with GL 89-13, which identified live bryozoa colonies in all six CW forebays (1A/B/C and 2A/B/C). The inspection results indicated that significant bryozoa mass existed in the Unit 1 forebays immediately upstream of the intakes that supply the 1A and 2A SX pumps. The bryozoa mass in the Unit 2 forebays immediately upstream of the intakes that supply the 1B and 2B SX pumps was approximately 30% less than the Unit 1 side.

   Live bryozoa was discovered previously in the CW forebays in September 2002 and again in October 2005. During the previous events, all forebays indicated the presence of bryozoan colonies to varying degrees. In those instances, however, the amount of bryozoa present did not result in failure of flow rate surveillances, or a declaration of system inoperability. The corrective actions following the 2005 bryozoa event included mechanical cleaning of the forebays every eighteen months and additional forebay inspections prior to and after the summer months.

Following the events of September 2008, a root cause evaluation was performed. This evaluation determined two causes that contributed to the 2008 event: first, the site organization did not understand the bryozoa life cycle including the bryozoa deposition and growth mechanism downstream of the CW forebay traveling screens, and second, there was a lack of recognition of the potential impact of the bryozoa regarding the SX strainer design to operate with rapid fouling challenges. Previous reviews for re-affirming the SX strainer design basis did not fully consider what could occur to cause rapid strainer fouling events or how these events could negate the compensatory actions that the station could take to restore the strainers. The corrective actions included development and implementation of a lake macro-biological program, which resulted in a change to the forebay inspection PM frequency from eighteen months to annually. In addition, the PM would be performed between April 20th and June 1st which is the optimum time to remove the bryozoa.

This event demonstrates that the use of GL 89-13 program for intake sources is effective in addressing unusual degrading conditions before system loss of intended function and that the corrective action program is utilized to evaluate degraded conditions and implement corrective actions to maintain component intended function.

3. On May 9, 2011, during GL 89-13 inspections at Braidwood Unit 2, Asiatic clam shells were found in 2A essential service water (SX) suction piping between the cross-tie valves. These valves provide a backup SX water source for the 2A train of the Auxiliary Feedwater (AFW) System in the event the normal water source (condensate storage tank) for the AFW system becomes unavailable. The condition was entered into the corrective action program where it was concluded the 2A train of the Auxiliary Feedwater System was not operable with this quantity of Asiatic clam shells. The clam shells, which were identified in the suction piping between the cross-tie valves, had the potential to be transported through the 2A AFW system, and block essential service water flow to the AFW pump.

   An extent of condition review was performed and actions included a full borescope inspection of the 2B AFW suction piping between the associated cross-tie valves. The inspection confirmed there were no Asiatic clam shells in the section of piping. In addition, the Braidwood Unit 1 piping configuration was reviewed for potential impact. The 1A and 1B AFW suction line configurations between the cross-tie valves are significantly shorter in length than the Unit 2 AFW train, and do not contain bends or low points in the piping, and therefore are not susceptible to similar issues.

   A root cause performed on this event identified two contributing causes. First, there was inadequate chemical feed biocide treatment of the essential service water system (SX), which prevented the elimination of Asiatic clam larvae, thus allowing Asiatic clams to grow in the low flow section of the SX header to 2A AFW suction; and second there was ineffective problem identification and resolution associated with previous discoveries of Asiatic clam shells in the 2A AF suction, which allowed the condition to remain unanalyzed and uncorrected.

Immediate corrective actions included flushing the line between the cross-tie valves to remove the shells. Additional corrective actions included revising the service water heat exchanger inspection guide to incorporate additional guidance on actions to be taken upon the discovery of macro-fouling and biological fouling of NRC Generic Letter 89-13 systems, and revising the AFW valve stroke surveillance to clarify where and how to document the discovery of debris in the system.

This event demonstrates that the use of GL 89-13 guidelines for periodic inspection and flushing of infrequently used piping lines is effective in identifying degrading conditions and that the corrective action program is utilized to evaluate degraded conditions and implement corrective actions to maintain component intended function.

The operating experience relative to the Open-Cycle Cooling Water System program did not identify an adverse trend in performance. The inspection methods being implemented by the program have been proven effective in detecting aging effects including loss of material and reduction of heat transfer. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions are taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where age-related degradation is found. Assessments of the Open-Cycle Cooling Water System aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that the implementation of the Open-Cycle Cooling Water System aging management program will effectively identify age-related degradation prior to failure.

Conclusion

The enhanced Open-Cycle Cooling Water System program will provide reasonable assurance that the loss of material and reduction of heat transfer aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.12 Closed Treated Water Systems

Program Description

The Closed Treated Water Systems program is an existing mitigative and condition monitoring program that includes (a) nitrite-based and glycol-based water treatment, including pH control and the use of corrosion inhibitors for aluminum, carbon steel, carbon steel lined with nickel alloy cladding, and copper alloys, ductile cast iron, gray cast iron, and stainless steel to modify the chemical composition of the water such that the function of the equipment is maintained and such that the effects of corrosion are minimized; (b) chemical testing of the water to ensure that the water treatment program maintains the water chemistry within acceptable guidelines; and (c) inspections to determine the presence or extent of corrosion and/or cracking. The Closed Treated Water Systems program manages the loss of material, the reduction of heat transfer, and cracking in piping, piping components, piping elements, tanks, and heat exchangers exposed to a closed treated water environment.

The Closed Treated Water Systems program is a mitigative program which also provides condition monitoring activities that are implemented through station procedures. Mitigative activities include utilizing nitrite-based and glycol-based chemistry controls to minimize the age-related degradation of components exposed to a closed treated water environment. The performance of sample analyses assures water chemistry parameters are maintained within the goal ranges specified by procedure and based on EPRI 1007820, Closed Cooling Water Chemistry Guideline. Monitoring of water chemistry parameters also assures contaminants are kept below applicable limits to prevent or limit corrosion. Condition monitoring activities provide for opportunistic visual inspections and nondestructive examinations which are effective in detecting applicable aging effects, and the frequency of monitoring is adequate to prevent significant age-related degradation.

The Closed Treated Water Systems program is also utilized to verify the effectiveness of the Water Chemistry (B.2.1.2) program in managing cracking due to stress corrosion cracking and cyclic loading for stainless steel non-regenerative heat exchangers exposed to treated borated water greater than 140 degrees Fahrenheit in the Chemical & Volume Control System. The Closed Treated Water Systems program provides for temperature and radioactivity monitoring of the shell side water of the non-regenerative heat exchangers.

The program will be enhanced, as noted below, to provide reasonable assurance that the Closed Treated Water Systems program aging effects of loss of material, reduction of heat transfer, and cracking will be managed during the period of extended operation.

NUREG-1801 Consistency

The Closed Treated Water Systems aging management program will be consistent with the ten elements of aging management program XI.M21A, "Closed Treated Water Systems," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Perform condition monitoring, including periodic visual inspections and non-destructive examinations, to verify the effectiveness of water chemistry control at mitigating aging effects. A representative sample of piping and components will be selected based on likelihood of corrosion, fouling, or cracking and inspected at an interval not to exceed once in 10 years during the period of extended operation. The selection of components to be inspected will focus on locations which are most susceptible to age-related degradation, where practical. **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4)**
2. Perform periodic sampling, analysis, and trending of water chemistry for the essential service water makeup pump engine glycol-based jacket water system to verify the effectiveness of water chemistry control at mitigating aging effects (Byron only). **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Monitoring and Trending (Element 5)**

Operating Experience

The following examples of operating experience provide objective evidence that the Closed Treated Water Systems program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. In 2009, Byron implemented the new LIMS (Laboratory Information System) system with Labware. Byron was the lead station in the Exelon fleet in development of the Labware chemistry tool, which is a database tool, designed to schedule sampling and lab analysis, allow for data entry and review, and provide notifications of exceeding any system limits (goals, limits, and action levels). One feature of the Labware tool is it has the capability to give instant feedback to members of the Chemistry Department on out-of-specification results. The Labware tool also provides the

chemistry technician which procedures are impacted, and automatically notifies the system manager and the Chemistry Manager in the event of out-of- specification results. The Labware tool was cited as an INPO strength at Byron in 2010.

This example and the subsequent implementation of the Labware tool at Byron provides objective evidence that closed cooling water chemistry program performs assessments and strives for continuous improvement to maintain the quality of the program.

2. In February 2008, chemistry sampling and analysis of the common station heat system identified the need to enter Action Level 2 due to low nitrite concentration. The station heat system nitrite concentration was 163 ppm, less than the 300 ppm Action Level 2 threshold. The cause of the low nitrite concentration in the station heat system was attributed to significant station heat system leakage. As an immediate corrective action, Chemistry submitted an emergent chemical addition request, and notified the appropriate station personnel to expedite the performance of the chemical addition. Subsequent to the chemical addition, the station heat system was sampled and the nitrite concentration allowed for exiting all action levels. The follow-up corrective actions identified the leak in the station heat system at the Fuel Handing Building train shed station heat pump seal. The leaking component was isolated until repairs could be planned and performed. Repairs were performed and the pump was returned to service without leaks.

   This operating experience example provides objective evidence that the closed cooling water chemistry program adequately samples, analyzes, and monitors for age-related degradation prior to loss of intended function, and that potentially adverse component conditions are identified and addressed in the corrective action program.

3. In December 2009, the weekly chemistry sample for the unit common B control room chiller indicated that the nitrite concentration was below the Action Level 2 threshold of 300 ppm. An additional sample confirmed that the nitrite concentration was below the Action Level 2 threshold, and Chemistry notified Operations. The nitrite concentration for the B control room chiller the previous week was 1550 ppm with significant margin to any chemistry Action Level threshold. The suspected cause of the significant decrease in nitrite concentration in the B control room chiller system was a system leak.

   As an immediate corrective action, Chemistry submitted a chemical addition request, and Operations performed the chemical addition. Chemistry also initiated a corrective action report citing a system leak as a potential cause of the deceased nitrite concentration.

   As a follow-up corrective action, the System Manager performed a thorough walkdown of the B control room chiller system and identified significant leakage at a normally closed drain valve off the B control room chiller closed treated water side of the evaporator. The System Manager notified Operations of this condition, Operations closed the drain valve, and the leakage stopped. Since this drain valve is near the floor and in a congested piping area, the most probable cause of this configuration issue is that the valve may have been inadvertently bumped and throttled opened.

This operating experience example provides objective evidence that the closed cooling water chemistry program adequately samples, analyzes, and monitors for age-related degradation prior to loss of component intended function, and that potentially adverse component conditions are identified and addressed in the corrective action program.

<u>Braidwood Station</u>

1. In June 2005, during testing of the Unit 1 B emergency diesel generator, a jacket water leak was identified. The jacket water closed cooling loop was drained and repaired, and a chemical addition of corrosion inhibitor to the jacket water closed cooling loop was performed. However, neither the shaft-driven main jacket water pump nor the motor-driven jacket water recirculation pump were started and sampled after the chemical addition. Days later, when Chemistry sampled the jacket water the nitrite concentration was lower than expected and below the Action Level 2 limit for nitrite concentration. After a second sample confirmed the low nitrite concentration, Action Level 2 was entered. Additional corrosion inhibitor was added, and after the motor-driven jacket water recirculation pump was operated for approximately twenty (20) hours the jacket water closed cooling loop samples confirmed acceptable nitrite concentration. The cause of this issue was insufficient mixing time between the initial chemical addition and sample collection. The corrective actions included revising all diesel generator PMs to ensure that the diesel generator or the motor-driven jacket water recirculation pump is operated after chemical additions to ensure proper chemical mixing. Additionally, Chemistry ensures that at least twenty (20) hours of jacket water recirculation occurs before sampling. There have been no repeat events of this issue with emergency diesel generator jacket water loops.

   This operating experience example provides objective evidence that the closed cooling water chemistry program adequately samples, analyzes, and monitors for age-related degradation prior to loss of component intended function, and that potentially adverse component conditions are identified and addressed in the corrective action program.

2. In December 2009, during preventive maintenance work on the Unit 2 B primary containment chiller, eddy current testing identified one tube in the evaporator that had inside surface wall thinning greater than 40%, which is the threshold for preventive tube plugging. The purpose of eddy current testing is to identify at-risk tubes and to preventive action to plug them prior to failure. Eddy current test data indicated no additional tube plugging was required in the condenser. The one tube identified with wall thinning in the evaporator was plugged, and updated tube maps for both the evaporator

and condenser tube sheets were generated. After this evaporator tube was plugged, the evaporator had 67 of the original 992 tubes plugged. By 1998, 57 evaporator tubes along the bottom rows were plugged, and the most probable cause was attributed to improper layups of the primary containment chiller evaporator. Over the past fourteen years, only 10 additional evaporator tubes have been plugged.

The current closed treated water chemistry program monitors the chilled water systems to assure that chemistry parameters are maintained within procedurally specified limits. The Heat Exchanger Program Manager tracks the location of tube plugs, the number of tubes plugged, and the percentage of tubes plugged to assure each heat exchanger meets its acceptance criteria of maximum allowable plugged tubes. Additionally, the Heat Exchanger Program Manager trends eddy current data to ensure that no tube leaks will occur prior to the next preventive maintenance task. By maintaining chemistry parameters and setting the acceptance criteria for plugging primary containment chiller evaporator and condenser tubes with wall thinning greater than 40%, the result has been no primary containment chiller heat exchanger tubes leaks during operation.

This operating experience example provides objective evidence that the current closed treated water chemistry program and the preventive maintenance program for the station chillers adequately monitors for age-related degradation prior to loss of component intended function, and that potentially adverse component conditions are identified and addressed in the corrective action program.

3. From 2009 to 2012, multiple corrective action reports have noted jacket water leaks at the weep holes of the sacrificial anodes of the emergency diesel generator fuel oil coolers. Maintenance performed work order activities to either clean the threads and re-install the anodes or replace the anodes. However, leaks would recur at the jacket water anodes of the emergency diesel generator fuel oil coolers.

   Under the corrective action program, Engineering evaluated the impact of jacket water system leaks on the operability of the emergency diesel generators. The station also implemented an adverse condition monitoring plan to track and trend emergency diesel generator jacket water leakage. Additionally, as an extent of condition corrective action, engineering developed a modification to remove the anodes of the emergency diesel generator fuel oil coolers and replace the anodes with stainless steel pipe plugs for the four site emergency diesel generators.

   This operating experience provides objective evidence that walkdowns by Operations and the System Manager monitor and document degraded conditions prior to loss of component intended function, and that potentially adverse component conditions are identified and addressed in the corrective action program.

The above examples provide objective evidence that the existing Closed

Treated Water Systems program is capable of both monitoring and detecting the aging effects associated with closed treated water environments. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions are taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where age-related degradation is found. Assessments of the Closed Treated Water Systems aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the Closed Treated Water Systems program will effectively identify age-related degradation prior to failure.

Conclusion

The enhanced Closed Treated Water Systems program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.13 Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems

Program Description

The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems aging management program is an existing condition monitoring program that evaluates the effectiveness of maintenance monitoring activities for cranes and hoists that are within the scope of license renewal. The existing activities consist of periodic visual inspections for loss of material on the structural components of the bridge, trolley, girders, bolting, and rails in the rail system. The program also manages loss of preload of associated bolted connections. The components are in air indoor, air outdoor, air with borated water leakage, and treated borated water environments.

The extent of cranes, hoists, monorails, and rigging beams within the scope of license renewal includes those previously evaluated as part of Byron and Braidwood Stations' compliance with NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," as well as other equipment handling systems operating over safety-related equipment. Also within the scope of license renewal are fuel and equipment handing systems that handle 'light' loads over fuel and safety-related equipment within the spent fuel pool and refueling cavity.

The aging management program is implemented through station procedures that are based on the ASME B30 series standards, and rely upon visual inspections to manage loss of material. Structural bolting is also monitored for loss of preload by inspecting for loose or missing bolts, or nuts. Inspection frequencies are consistent with the recommendations within the ASME B30 series of standards. For handling systems that are infrequently in service, such as those only used during refueling outages, periodic annual inspections may be deferred until just prior to use. The inspection methods are effective in detecting loss of material and evidence of loss of preload, and the inspection frequencies are adequate to prevent significant age-related degradation from occurring.

The program will be enhanced to ensure implementing documents address periodic inspections of all cranes, hoists, monorails, and rigging beams within the scope of license renewal, including those that are infrequently in use. The program will also be enhanced to ensure implementing documents consistently include inspection of structural components and bolting for loss of material due to corrosion, rails for loss of material due to wear and corrosion, and bolting for evidence of loss of preload.

NUREG-1801 Consistency

The Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems aging management program will be consistent with the ten elements of aging management program XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Consistently include inspections of structural components and bolting for loss of material due to corrosion, rails for loss of material due to wear and corrosion, and bolted connections for evidence of loss of preload. **Program Elements Affected: Scope of Program (Element 1), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4)**
2. Ensure periodic inspections are performed on all cranes, hoists, monorails, and rigging beams within the scope of license renewal, including those that are infrequently in use. **Program Elements Affected: Scope Detection of Aging Effects (Element 4)**

Operating Experience

The following examples of operating experience provide objective evidence that the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems aging management program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis during the period of extended operation:

<u>Byron Station</u>

1. In the Fall of 2003, loose bolts on a main girder rail connector plate were discovered during routine periodic inspections of a refueling cavity maintenance crane. Upon discovery of the loose bolts, the condition was promptly entered into the corrective action program and the bolts retightened prior to use of the crane. As part of the extent of condition for this finding, preventive maintenance activity schedules were reviewed to ensure other cranes were planned for inspection prior to being used.

   This example provides objective evidence that periodic inspections performed at Byron Station are capable of detecting adverse conditions, and when conditions are found, they are promptly entered into the corrective action program and resolved.

2. A review of over 1500 Byron Station corrective action reports since 2001 did not identify any history of significant loss of material due to corrosion in cranes and hoists structural members, loss of material due to wear in the rail system, or loss of preload of associated bolting (with the exception of the single instance described above). All cranes, hoists, monorails, rigging

beams, and equipment handling systems related to refueling operations that are within the scope of license renewal are either periodically inspected or inspected prior to use, as recommended by the applicable ASME B30 series standards. Periodic inspections of the passive structural components to be inspected under the program have been performed for several years with no reported indication of significant loss of material due to corrosion or wear, or loss of preload of associated bolting.

Braidwood Station

1. In 2009, Braidwood Station identified a discrepancy involving inspection practices of the containment polar cranes compared to standard industry guidance. Specifically, the discrepancy involved a lack of explicit guidance and acceptance criteria for inspecting the crane structural elements, including the rails and girders. Generally, the condition of these components were inspected from a distance while operating the crane and any deficiencies documented within the work order package and corrective action program.

   The issue of a lack of explicit procedural inspection guidance was entered into the corrective action program for resolution. As a result, actions were initiated to revise the annual inspection procedures for the containment building polar crane. As part of the extent of condition review, other overhead heavy load crane procedures, such as the turbine building cranes and fuel handling building crane, were reviewed and actions initiated to incorporate specific guidance and direction to inspect crane structural components, including rails and girders, for loss of material, cracking, and deformation. Furthermore, during the next subsequent refueling outage and performance of the polar crane inspection, directions were provided to the on-site crane inspection vendor to perform more detailed inspections of the condition of the polar crane rails and girders. No age-related degradations were identified relative to the conditions of the crane rails, girders, and other structural elements.

   This example provides objective evidence that the periodic inspections of overhead heavy load systems are performed in accordance with ASME B30.2, and other standards in the ASME B30 series. Furthermore, oversight and performance of required inspections by qualified and trained personnel has resulted in identification of program discrepancies and areas for improvement. When these areas for improvement are identified, they are entered into the corrective action program for resolution and extent of condition evaluation, where appropriate actions are taken.

2. A review of over 900 Braidwood Station corrective action reports since 2001 did not identify any history of significant loss of material due to corrosion in cranes and hoists structural members, loss of material due to wear in the rail system or loss of preload of associated bolting. All cranes, hoists, monorails, rigging beams, and equipment handling systems related to refueling operations that are within the scope of license renewal are either periodically inspected or inspected prior to use, as recommended by the

applicable ASME B30 series standards. Periodic inspections of the passive structural components to be inspected under the program have been performed for several years with no reported indication of significant loss of material due to corrosion or wear, or loss of preload of associated bolting.

The operating experience relative to the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems program did not identify an adverse trend in performance. The inspection methods being implemented by the program have been proven effective in detecting aging effects including loss of material and loss of preload. Appropriate guidance for evaluation, repair, or replacement is provided for locations where age-related degradation is found. Therefore, there is sufficient confidence that continued implementation of the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems aging management program will effectively identify age-related degradation prior to failure or loss of intended function during the period of extended operation.

Conclusion

The enhanced Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems program will provide reasonable assurance that the loss of material and loss of preload aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.14 Compressed Air Monitoring

Program Description

The Compressed Air Monitoring aging management program is an existing condition and performance monitoring program that manages the loss of material of piping, piping components, and piping elements for loss of material aging effects in the compressed air systems in a condensation environment. The Compressed Air Monitoring aging management program includes monitoring of moisture content and contaminants such that specified limits are maintained and inspection of components for indications of loss of material.

The Compressed Air Monitoring aging management program is based on Byron and Braidwood Stations' response to NRC Generic Letter 88-14, "Instrument Air Supply Problems" and utilizes guidance and standards provided by ANSI/ISA-S7.3-1975, "Quality Standard for Instrument Air"; INPO SOER 88-01, "Instrument Air System Failures"; and ASME OM-S/G-1998, Part 17, "Performance Testing of Instrument Air Systems in Light-Water Reactor Power Plants." The Compressed Air Monitoring aging management program activities implement the moisture content and contaminant criteria of ANSI/ISA-S7.3 (incorporated into ANSI/ISA-S7.0.01-1996). Program activities include air quality checks at various locations to ensure that dew point, particulates, and hydrocarbons are maintained within the specified limits and periodic inspections of select compressed air system component internal surfaces for signs of loss of material due to corrosion.

The program includes testing and inspection of the air systems within the scope of license renewal. The effects of corrosion and presence of contaminants are detected during system manager walkdowns, weekly surveillances, and preventive maintenance inspections of compressors, filters, dryers, and specific compressed air system components. The procedures and maintenance activities for these inspections include specific inspection acceptance criteria. The periodic inspections of accessible internal surfaces of components provide assurance that the systems within the scope of license renewal will perform their intended function.

Results from the periodic inspections are compared with established acceptance criteria to provide for timely detection of aging effects. The monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant age-related degradation. Deficiencies are documented in the corrective action program and evaluations are performed for test or inspection results that do not satisfy established criteria. The corrective action program ensures that the conditions adverse to quality are promptly corrected. The site corrective action program is implemented in accordance with the requirements of the Byron and Braidwood Stations 10 CFR Part 50, Appendix B quality assurance program.

NUREG-1801 Consistency

The Compressed Air Monitoring aging management program will be consistent with the ten elements of aging management program XI.M24, “Compressed Air Monitoring,” specified in NUREG-1801 with the following exception:

Exceptions to NUREG-1801

1. NUREG-1801 states that daily readings of system dew point are recorded and trended. As per ANSI/ISA-7.0.01-1996 Section 5.1, ”a monitored alarm is preferred; however if a monitored alarm is unavailable, per shift monitoring is recommended.” Byron and Braidwood Stations’ instrument air system dryer outlet dew points are continuously monitored utilizing in line detectors with automatic alarms in the main control room should limits be exceeded. On a quarterly basis, samples are taken from representative locations, that are analyzed and trended for dew point as well as particulates and hydrocarbons, which validates the dew point in line detectors. **Program Elements Affected: Monitoring and Trending(Element 5)**

   Justification for Exception

   NUREG-1801 provides guidance that the Compressed Air Monitoring aging management program is based on the results of the plant owner’s response to Nuclear Regulatory Commission (NRC) Generic Letter (GL) 88-14 (as applicable to license renewal). ANSI/ISA-7.0.01-1996, Section 5.1 and Annex C 3.1, identifies continuous monitoring as the preferred method for monitoring dew point. In addition, per NUREG-1801, XI.M24, Element 4 “Detection of Aging Effects,” two different methods of monitoring dew point are identified that are acceptable, one of which includes utilizing continuous monitoring equipment with automatic alarm capability or daily checks of dew point values. The monitoring equipment is validated quarterly when samples are taken from various locations of the compressed air system and are analyzed and trended for moisture content as well as particulate and hydrocarbons. The plant operating experience has shown that the original design, along with quarterly sampling and continuous automatic alarms, to be an effective method to monitor the compressed air system dryer outlet dew points to provide reasonable assurance that the components in the compressed air system will continue to perform the specified intended functions.

Enhancements

Prior to the period of extended operation, the following enhancement will be implemented in the following program element:

1. Inspect critical component internal surfaces for signs of loss of material due to corrosion and document deficiencies in the corrective action program. **Program Elements Affected: Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5), Acceptance Criteria (Element 6)**

Operating Experience

The following examples of operating experience provide objective evidence that the Compressed Air Monitoring aging management program will be effective in ensuring that intended function are maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. In December 2007, during operator rounds of air dryers and filters, it was identified that the differential pressure across the pre-filter of the Unit 1 Air Dryer exceeded the weekly surveillance limit of 5 psid by 1 psid. The issue was communicated to supervision and entered into the corrective action program. A work order request was generated and the filters were replaced.

   This example provides objective evidence that routine monitoring is sufficient in detecting degradation in a timely manner, that deficiencies are entered into the corrective action program with appropriate action taken.

2. Air quality testing was performed in December 2007 with unsatisfactory results for dew point temperatures with the Unit Common and Unit 2 air dryers in service. Due to recent acceptable dryer test results, it was thought that the unsatisfactory results were due to a measurement error and, therefore, a retest was requested. The issue was placed into the corrective action program and retesting tracked. Subsequent testing found header sample points, as well as the dryers, all reading less than -80 degrees Fahrenheit, which was well within the acceptable range.

   This example provides objective evidence that testing identifies adverse conditions and issues are documented in and addressed through the corrective action program.

3. In 2001, air compressor availability was noted to be declining. A study was performed in January 2002, which identified age-related degradation, parts obsolescence, and heat exchanger fouling due to silt as primary causes of out of service time and increased maintenance cost. This led to the design change modification of the three original water cooled centrifugal air compressors with four air cooled rotary compressors in 2005 at Byron Station.

   This example illustrates that system performance is monitored, age-related degradation is identified and corrective actions are taken to correct deficiencies.

Braidwood Station

1. In July 2011, during performance of the weekly surveillance of the instrument air dryer, a small amount of moisture was noted at the Unit 1 air dryer after-filter drain valve. The moisture was determined to be due to the dryer desiccant starting to break down and replacement was required. The

issue was placed in the corrective action program which directed the replacement of dryer desiccant and after filters.

This example provides objective evidence that performance monitoring, directed through surveillance procedures, is adequate in detecting deficiencies and that findings are placed into the corrective action program with appropriate actions taken.

2. In June 2009, quarterly air quality testing was performed on air samples taken from the instrument air header and air dryer discharge resulting in unsatisfactory results for dew point temperatures. Acceptance criteria of less than -25 degrees Fahrenheit was not met at the outlet of the Unit 2 instrument air dryer (-22 degrees Fahrenheit) and at header locations in the Auxiliary Building (-25 degrees Fahrenheit) and the Turbine Building (-25 degrees Fahrenheit). An elevated particulate count was also noted in the Turbine Building instrument air header. An extended blowdown of the system was requested by Engineering to remove the particulates, along with a change of desiccant to improve the dew point temperatures during the upcoming Unit 2 dryer maintenance window.

   This example provides objective evidence that air quality monitoring activities detect degrading performance trends, that adverse conditions are entered into the corrective action program with actions taken to correct the deficiencies.

3. In June 2007, during quarterly air quality testing, the Unit 1 air dryer and Unit 0 air compressor seal air failed to meet test acceptance criteria for particulate count (< 5 particles per cubic foot). Direction was provided to Operations to swap to the alternate filter bank with a retest performed the following day. The second test also resulted in elevated particulate results. Additional direction was given to swap to an alternate air dryer and schedule replacement of filters on the Unit 1 air dryer. The sample for the air dryer is taken prior to the after-filter so the elevated particulate level does not impact the downstream system due to the after-filter being in the flowpath.

   This example provides objective evidence that air quality monitoring activities detect degrading performance trends, that adverse conditions are entered into the corrective action program with actions taken to correct the deficiencies.

The above examples provide objective evidence that the enhanced Compressed Air Monitoring aging management program will effectively monitor and detect the aging effects of loss of material. The operating experience review relative to the Compressed Air Monitoring aging management program did not identify an adverse trend in performance or any instances of significant age-related degradation. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions are taken. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where age-related degradation is found. Assessments of the Compressed Air Monitoring aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the Compressed Air Monitoring aging management program will effectively identify age-related degradation prior to failure.

Conclusion

The enhanced Compressed Air Monitoring aging management program will provide reasonable assurance that the loss of material aging effect will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.15 Fire Protection

Program Description

The Fire Protection aging management program is an existing condition and performance monitoring program that manages the aging of components performing a fire barrier intended function and for the Halon and low-pressure carbon dioxide fire suppression systems and associated components. This is achieved through the use of periodic inspections and functional testing to detect age-related degradation prior to loss of intended functions. System functional testing and inspections are performed in accordance with guidance from National Fire Protection Association Codes and Standards. The program applies to the piping, piping components, piping elements, and tanks associated with the Halon and low-pressure carbon dioxide fire suppression systems. The program also applies to components that perform a fire barrier intended function such as fire rated doors, dampers, penetration seals, walls, ceilings, floors, insulations and wraps, and combustible fluid retaining berms and curbs. This program manages the age-related degradation of these components caused by long term exposure to indoor air, air with borated water leakage, outdoor air, and condensation environments.

The Fire Protection program is a condition and performance monitoring program. The monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant degradation such that intended functions are maintained. The Fire Protection program provides for visual inspections of fire barrier penetration seals for signs of degradation such as cracking, hardening, loss of bond (e.g., seal separation, separation of layers), loss of material, loss of strength, and physical damage (e.g., rupture or puncture of seals). The program requires the performance of visual inspections of not less than 10 percent of each type of penetration seal at least once per refueling cycle (18-month). The program specifies the visual examination of fire barrier walls, ceilings, and floors separating safety-related fire areas or separating portions of redundant systems important to safe shutdown within a fire area. Periodic visual inspections and functional tests are used to manage the aging effects of fire doors. Each fire door is visually inspected and the required closing mechanisms and latches are functionally tested on a frequency of at least once per six (6) months. The program provides for visual inspections of all fire dampers that penetrate fire barriers within the scope of this program at least once per 18 months.

The Fire Protection aging management program also provides for the management of age-related degradation of the external surfaces of the Halon and low-pressure carbon dioxide fire suppression systems components through periodic testing and visual inspections for any signs of loss of material.

The inspections and tests directed by the Fire Protection aging management program are implemented through station procedures and predefined tasks.

The Fire Protection aging management program is under the direction of a fire protection qualified engineer. Personnel performing inspections are qualified and trained to perform the inspection activities. Unacceptable conditions are entered into the corrective action program for disposition.

The Fire Protection aging management program will be enhanced, as noted below, to provide reasonable assurance that aging effects will be adequately managed during the period of extended operation.

NUREG-1801 Consistency

The Fire Protection aging management program will be consistent with the ten elements of aging management program XI.M26, “Fire Protection,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements

1. Include visual inspections of the earthen berm enclosing the outdoor fuel oil storage tanks for signs of age-related degradation such as loss of material and loss of form that could affect the intended function of the berm. **Program Elements Affected: Scope of Program (Element 1)**
2. Provide additional inspection guidance to identify age-related degradation of fire barrier walls, ceilings, and floors or aging effects such as cracking, spalling, and loss of material. **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Acceptance Criteria (Element 6)**
3. Include visual inspection of halon and low-pressure carbon dioxide fire suppression system piping and component external surfaces for signs of corrosion or other age-related degradation. **Program Elements Affected: Scope of Program (Element 1), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Acceptance Criteria (Element 6)**

Operating Experience

The following examples of operating experience provide objective evidence that the Fire Protection aging management program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. In February 2012, damage was identified on a section of structural steel fireproofing in the Unit 2 Auxiliary Building while performing cable installation activities. An 18x20 inch section of Thermafiber insulation protecting a beam was damaged. The foil enclosing the section of Thermafiber insulation was also found removed and damaged. An evaluation was performed by engineering and it was determined that the fireproofing was degraded but operable and needed to be repaired. As part of the evaluation, engineering personnel performed a walkdown of the area. While performing the walkdown, engineering personnel identified an exposed reinforcing plate on an otherwise fireproofed beam. Since the reinforcing plate serves a structural purpose it is also requires protective fireproofing. Due to the exposed reinforcing plate the beam was declared inoperable and an hourly firewatch was initiated. The fireproofing for these two locations was repaired to acceptable conditions in accordance with applicable design documents.

   This example provides objective evidence that the visual inspections performed in accordance with the Fire Protection aging management program are adequate to identify deficient conditions and that adequate compensatory measures are taken when deficient conditions are identified. This example also demonstrates that the corrective action program will be effective in correcting deficient conditions when identified.

2. In September 2011, during the completion of a 100 percent inspection (performed semi-annually) of all technical requirements manual (TRM) fire doors, minor deficiencies were identified on several of the 175 fire doors inspected. The minor deficiencies included improper operation of the latching mechanism; interference in the ability to properly close and seal; a degraded hinge; loose and missing parts, and improper alignment of a door in a frame. All of the identified deficiencies were evaluated in accordance with plant procedures and it was determined that there were no operability issues. All required repairs were performed to correct the identified deficiencies and to prevent any further degradation that could affect operability.

   This example provides objective evidence that the visual inspections performed in accordance with the Fire Protection aging management program are adequate to identify deficient conditions prior to loss of intended function.

3. The 18-month visual inspection surveillance of ten (10) percent of the fire barrier penetrations was completed in December 2011. As part of this inspection, ten (10) percent of each type of fire seals was inspected. A total of 412 fire barrier penetrations were inspected. Each of the inspected fire seals met the acceptance criteria and no seal failures were identified. However, during the completion of the inspection, two (2) fire seals were identified as having minor deficiencies. The deficiencies were identified on two adjacent gypsum electrical penetration fire seals on elevation 426' of the Auxiliary Building. The degradation was limited to minor chipping, less than ¼", and some surface cracking. The degraded conditions were evaluated as acceptable for operability and entered into the corrective action program for repair to prevent any further degradation. Since no seal failures were identified, the inspection scope was not increased.

   This example provides objective evidence demonstrating the overall material condition of the penetration seals and that when degradation occurs, the deficiencies are identified and entered into the corrective action program.

<u>Braidwood Station</u>

1. As part of the 18-month surveillance of all fire rated assemblies, a visual inspection of the unit-common fire rated assemblies was completed in February 2010. During the completion of this surveillance, minor deficiencies (due to both age-related and non-age-related degradation) in the fire rated assemblies were identified. Included in these deficiencies were degradation of Pyrocrete fireproofing (due to cracking and voids) and areas with missing grout or fireproofing. Degraded conditions were entered into the corrective action program and plant barrier impairment tags were issued, as required. Degraded fire barriers were repaired in accordance with governing design documents. No deficiencies were identified associated with these degraded fire barriers during follow up inspections performed during the next 18-month surveillance period.

   This example provides objective evidence that the visual inspections performed in accordance with this program are capable of identifying degraded fire barriers prior to loss of function. This example also shows that when degraded conditions are identified appropriate corrective actions are taken.

2. As part of the 18-month surveillance of all fire dampers installed in fire assemblies, a visual inspection of the Auxiliary Building Ventilation System non-electro thermal link fire dampers was completed in March 2011. Forty-three fire dampers were inspected. No signs of age-related degradation were identified during the performance of these inspections and the material condition of all forty-three fire dampers was found to be satisfactory. However, during the performance of this inspection it was identified that the fan blade assembly had fallen off the motor shaft of the Auxiliary Building control panel room vent fan. The degraded condition was entered into the corrective action program for repair.

This example provides objective evidence that the visual inspections performed in accordance with this program are capable of detecting unusual or degraded conditions.

3. During the performance of the upper cable spreading room Halon fire suppression system cylinder weight and pressure testing, performed in December 2006, minor leakage was identified on the pressure gauge line fittings for four (4) of the extended discharge Halon cylinders. Initial attempts to tighten the fittings did not stop the leakage so the identified leakage was entered into the corrective action program. The leaking fittings were loosened to allow the threads to be cleaned and coated with pipe thread sealant. The fittings were then re-tightened and inspected for leakage. No leakage was detected on the repaired fittings. In addition, minor surface corrosion was identified on the internal surface of portions of the discharge line on all eight (8) extended discharge cylinders. Engineering determined that the minor surface corrosion present on the internal surface of the discharge tubing was acceptable.

   This example provides objective evidence that the functional testing invoked by this program is capable of detecting age-related degradation and that when deficiencies are identified they are entered into the corrective action program and appropriate corrective actions are taken to evaluate and correct deficiencies.

The operating experience relative to the Fire Protection program did not identify an adverse trend in performance. The inspection methods being implemented by the program have been proven effective in detecting aging effects including concrete cracking and spalling, loss of bond, loss of form, loss of material, and hardening and loss of strength of elastomers. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Fire Protection aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the Fire Protection program will effectively identify degradation prior to failure or loss of intended function during the period of extended operation.

Conclusion

The enhanced Fire Protection program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.16 Fire Water System

Program Description

The Fire Water System aging management program is an existing condition monitoring program that manages the loss of material aging effect for the water-based fire protection system and associated components, through the use of system pressure monitoring, system header flushing, buried ring header flow testing, pump performance testing, hydrant full flow flushing and full flow verification, sprinkler and deluge system flushing and flow testing, hydrostatic testing, and inspection activities.

The program applies to water-based fire protection systems that consist of sprinklers, fittings, valves, hydrants, hose stations, standpipes, tanks, pumps, and aboveground and buried piping and components. The program manages aging of fire protection components exposed to outdoor air and raw water. There are no underground (i.e., below grade but contained within a tunnel or vault) piping and components within the scope of the Fire Water System aging management program at Byron and Braidwood Stations. Aging of the external surfaces of buried fire main piping is managed as described in the Buried and Underground Piping (B.2.1.28) aging management program.

The fire water system is maintained at the required normal operating pressure and monitored such that a loss of system pressure is immediately detected and corrective actions initiated. The program ensures that testing and inspection activities are performed and the results are documented and reviewed by the Fire Protection system manager for analysis and trending. These monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant age-related degradation.

Opportunistic visual inspections, performed when the internal surface is made accessible due to normal plant maintenance activities, and existing volumetric non-destructive examinations of piping will be credited to ensure age related degradation is identified prior to loss of system intended function. Selected portions of the fire protection system piping located aboveground and exposed to water will be inspected by non-intrusive volumetric examinations, to ensure that aging effects are managed and that pipe wall thickness is within acceptable limits. Pipe wall thickness inspections will be performed before the end of the current operating term and continued at a frequency of at least once every 3 years during the period of extended operation. These inspections will be capable of evaluating (1) pipe wall thickness to ensure against loss of system intended function and (2) the inner diameter of the piping as it applies to the flow requirements of the fire protection system.

Buried ring header flow tests measure hydraulic resistance and compare results with previous testing as a means of evaluating the internal piping conditions. Monitoring system piping flow characteristics ensures that signs of loss of material will be detected in a timely manner.

50-year sprinkler head testing will be conducted using the guidance provided in NFPA 25. Performance of the initial 50-year tests will be determined based on the date of the sprinkler system installation. Subsequent inspections will be performed every 10 years after the initial 50-year testing.

At Byron only, as a result of operating experience, an enhancement to allow for chemical addition, accompanied with system flushing to allow for adequate dispersal of the chemicals throughout the system, to prevent or minimize microbiologically induced corrosion has been included in the Fire Water System aging management program.

System functional tests, flow tests, flushes, and inspections are performed in accordance with the applicable guidance from National Fire Protection Association (NFPA) codes and standards. These activities are performed periodically to ensure that the loss of material due to corrosion aging effect is managed such that the system and component intended functions are maintained.

NUREG-1801 Consistency

The Fire Water System aging management program will be consistent with the ten elements of aging management program XI.M27, “Fire Water System,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Replace sprinkler heads or perform 50-year sprinkler head testing using the guidance of NFPA 25 “Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems” (2002 Edition), Section 5.3.1.1.1. This testing will be performed at the 50-year in-service date and every 10 years thereafter. **Program Elements Effected: Parameters Monitored/Inspected (Element 3), Detection of Aging Effects (Element 4)**

2. Provide for chemical addition, accompanied with system flushing to allow for adequate dispersal of the chemicals throughout the system, to prevent or minimize microbiologically induced corrosion (Byron only). **Program Elements Effected: Preventive Actions (Element 2)**

Operating Experience

The Fire Water System tests and procedures that are performed at the plant are based on NFPA standards to ensure that the Fire Protection System and associated components will have reliable performance when required to function. The following examples of operating experience provide objective evidence that the Fire Water System program will be effective in ensuring that intended function(s) are maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. In March 2007, a common cause analysis was performed to identify any commonalities between through-wall leaks in the site Fire Protection System. The common cause analysis evaluated corrective action reports related to Fire Protection System leakage generated between January 2002 and January 2007. A total of fourteen (14) through-wall leakage events were identified over this time period on Fire Protection System carbon steel piping. The identified leaks were all classified as minor in nature and no failures of system piping occurred that resulted in a loss of the system intended function. One (1) of the fourteen (14) segments of piping where leakage was identified was sent for failure analysis. The cause of the leak was determined to be microbiologically induced corrosion (MIC). MIC was the suspected cause of the other thirteen (13) leakage events due to the location of the leaks and the presence of sediment in the piping. Ultrasonic testing was performed on eleven (11) of the leak locations, and all inspections identified localized corrosion consistent with microbiologically-influenced corrosion. Due to the presence of stagnant water and sediment in the piping, the location of the leaks, and the presence of localized corrosion consistent with microbiologically-influenced corrosion; the most likely cause for eleven (11) of the thirteen (13) leaks was MIC.

   Corrective actions have been taken to prevent the reoccurrence of through-wall leakage of Fire Protection System piping due to MIC. The corrective actions have included a rigorous inspection plan that consists of guided wave inspections of all water-filled Fire Protection System piping. The guided wave inspections are used to identify locations of potential wall-thinning caused by MIC. Follow-up ultrasonic testing is performed at locations identified by the guided wave inspections to determine if replacement of piping is required. In addition, the periodic running of the fire water pumps has been scheduled during Circulating Water System chlorination to ensure that the water in the Fire Protection System is adequately chlorinated to help prevent MIC. Since the implementation of corrective actions, there has been only one (1) through-wall leak of Fire Protection System piping caused by MIC.

   In addition to the actions described above, an enhancement to allow for chemical addition, accompanied with system flushing to allow for adequate dispersal of the chemicals throughout the system, to prevent or minimize microbiologically induced corrosion has been included in the Fire Water System aging management program for Byron only.

   This example provides objective evidence that when deficient conditions are identified they are entered into the corrective action program and appropriate evaluation and corrective actions are taken to prevent reoccurrence.

2. In March 2008, during the performance of the deluge system flush for the Unit 1 Number 2 system auxiliary transformers (SAT), nine (9) spray nozzles were discovered to be plugged. The degraded condition was entered into the corrective action program. Accumulation of silt and corrosion particles was the most likely cause of the spray nozzle plugging. An extent of condition was performed to determine if similar conditions existed for the deluge systems for the other transformers. It was determined that only the deluge system for the Unit 1 Number 2 SAT had shown an adverse trend in the number of plugged nozzles. An engineering walk down of the Unit 1 Number 2 SAT deluge system verified that there is adequate sloping to allow for sufficient drainage of the system to prevent the accumulation of silt and corrosion particles that could lead to plugging of the spray nozzles. The results of the surveillance are being trended to determine if the frequency of system flushing should be increased. In addition, the surveillance procedure was revised to require additional flushing when spray nozzles are found to be plugged to ensure all particles are removed.

   This example provides objective evidence that the surveillances performed in accordance with this program are adequate to detect deficient conditions and that appropriate corrective actions are taken when deficiencies are identified.

3. In April 2010, it was identified that the 0A jockey pump was running excessively and the condition was entered into the corrective action program. This is an indication of system leakage since the system is unable to maintain system pressure without the jockey pump running. Since the jockey pumps were able to maintain pressure in the system the operability of the system was not affected. In July 2010, the annual fire protection system leakage test was performed. Performance of this test confirmed that system leakage was occurring and it was determined that the system pressure was decaying at a rate of approximately 7.6 psig per minute. This far exceeded the acceptable pressure decay rate. Due to the indication of excessive system leakage, a leakage trace investigation was performed. The investigation concluded that the excessive system pressure decay was due to the 0B jockey pump discharge check valve leaking by. The 0B jockey pump discharge check valve was replaced and the leakage testing of the system was re-performed. The follow-up testing confirmed that system leakage was within acceptable limits.

   This example provides objective evidence that the program is adequate to identify and correct deficient conditions prior to loss of component intended function.

Braidwood Station

1. A review of operating experience related to microbiologically induced corrosion (MIC) of fire protection piping was performed. There have been no identified occurrences of MIC related failures of fire protection piping. Sampling of fire water is performed to detect evidence of biological growth. A review of the sampling data over the past ten years does not indicate any evidence of the occurrence of MIC in the Fire Protection System.

   This example provides objective evidence demonstrating the absence of MIC of fire protection piping and components. Therefore, there is reasonable assurance that existing activities have been adequate to prevent failures of fire protection equipment due to MIC and will continue to be sufficient to prevent failures during the period of extended operation.

2. In November 2008, while performing a routine revision of the triennial fire protection buried ring header flow test procedure, a previously unidentified buried ring header bypass flowpath was discovered in the specified test configuration that invalidated test data previously obtained under this test. It was identified that the procedure did not account for the buried ring header bypass flowpath that was introduced to the system when the fire water supply piping was installed to the new training building built in the early 1990s. Upon discovery of this discrepancy the deficiency was entered into the corrective action program and the flow test was re-performed with the ring header bypass flowpath isolated. The re-performed flow test failed to meet acceptance criteria for differential pressure and flow. These results indicated that degradation of the buried ring header had occurred sometime since the last valid test had been performed in 1989 prior to the installation of the ring header bypass flowpath.

   A pipe flow analysis was performed to confirm the availability of adequate fire water supply to the largest demand sprinkler or deluge system (Unit 1 main power transformer deluge system) with the shortest leg of the fire water supply system out of service, in accordance with Branch Technical Position CMEB 9.5-1. The results of the analysis concluded that, even in the degraded condition, the fire water supply system was capable of meeting expected worst case loads and, therefore, remained operable. The original acceptance criteria for the buried ring header flow test were based on the expected flow characteristics for newly installed piping and not on the flow requirements of the system. The acceptance criteria have been revised based on the results of the new pipe flow analysis to account for actual system flow requirements. In addition, the frequency of the flow testing was increased from triennially to annually. The results of the next two flow tests (performed in November 2009 and November 2010) indicated that the flow test results obtained in November 2008 were invalid and the condition of the buried fire protection ring header is acceptable. Therefore, the frequency of the flow testing was reverted back to triennially.

   This example provides objective evidence that the program is adequate to identify and correct deficient conditions prior to loss of intended function and that when deficient conditions are identified; appropriate corrective actions are taken.

3. In June 2011, during the performance of a run of the 0B fire pump, a sprinkler deluge valve alarm spuriously actuated. The spurious actuation was caused by plugging of a retard chamber drain line for a sprinkler system in the Unit 2 Turbine Building. The deficient condition was entered into the corrective action program. The purpose of the retard chamber is to prevent spurious alarms by allowing for the detection of flow to the sprinkler system without causing alarms from normal system pressure perturbations. If flow into the retard chamber is greater than the flow out of the retard chamber drain line then the pressure in the retard chamber increases causing the actuation of the alarm. Since the drain line was plugged the retard chamber could not be de-pressurized and the spurious alarm could not be immediately cleared. The retard chamber assembly was disassembled and cleaned to provide for proper drainage and allow for de-pressurization per design.

   This example provides objective evidence that the program is capable of detecting minor deficiencies in fire protection system and that appropriate corrective actions are taken to ensure component intended functions are maintained.

The operating experience of the Fire Water System program did not show any significant age-related deficiencies. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Periodic self-assessments of the Fire Water System program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is confidence that continued implementation of the Fire Water System program will effectively identify degradation prior to failure.

Conclusion

The enhanced Fire Water System program will provide reasonable assurance that the loss of material aging effect will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.17 Aboveground Metallic Tanks

Program Description

The Aboveground Metallic Tanks program is a new condition monitoring program which manages loss of material on the external surfaces of aboveground metallic tanks that are supported on concrete and a four inch sand cushion above compacted backfill in soil and outdoor air environments by performing visual inspections on those tanks within the scope of license renewal. The program only applies to the aluminum condensate storage tanks. At Byron and Braidwood Stations the aluminum condensate storage tanks are protected by lagging, roof flashing, and insulation, and are not coated with a protective paint or coating on the external surface. At Byron there is sealant at the base of the lagging and Braidwood has sealant at the base of the tank. The original plant design specifications do not require the aluminum condensate storage tanks to be coated or painted on the external surface as a preventive measure to mitigate corrosion. This is due to the corrosion resistance properties of aluminum. This program includes preventive measures to mitigate corrosion by protecting the external surfaces of metallic components, per standard industry practice, with sealant at the concrete-component interface. Lagging with overlapping seams jacket the insulation to mitigate moisture intrusion and serve as a corrosion preventive measure.

Once per eighteen (18) month operating cycle, the program requires periodic visual inspections for degradation of the external surface of the lagging, flashing, insulation, roofing, and accessible sealant. The program also requires periodic visual inspections of the tank external surfaces and includes, on a sampling basis, removal of selected tank lagging and insulation to permit inspections of the external tank surfaces and exposed sealants. At Braidwood only, inspection of the sealant at the base of the tanks requires the removal of selected tank lagging and insulation. At Byron, the sealant is at the concrete-lagging interface. These sealant visual inspections will be augmented by physical manipulation to detect hardening and loss of strength.

Program effectiveness is determined by measuring the thickness of the tank bottoms to ensure that significant age-related degradation is not occurring and that the component’s intended function is maintained during the period of extended operation. Tank bottom UT inspections will be performed within five (5) years prior to entering the period of extended operation, between years five (5) and 10 of the period of extended operation, and whenever a tank is drained to ascertain whether there is significant loss of material at the tank bottom during normal operation. If no tank bottom plate loss of material is identified after the first two inspections, subsequent inspections will be performed whenever the tank is drained during the period of extended operation. If any age-related degradation of the tank bottom plate is found, further evaluations will be performed as part of the corrective action program.

The monitoring methods required by this aging management program will be effective in detecting the loss of material aging effect and the frequency of monitoring will be adequate to prevent significant age-related degradation. The Aboveground Metallic Tanks program is a new program that will be implemented prior to the period of extended operation.

NUREG-1801 Consistency

The Aboveground Metallic Tanks aging management program will be consistent with the ten elements of aging management program XI.M29, “Aboveground Metallic Tanks” specified in NUREG 1801 with the following exception:

Exceptions to NUREG-1801

1. NUREG-1801 states that inspections will include the entire external surface of the tank. At Byron and Braidwood, visual inspections will be performed at selected locations of the aluminum tank external surface. The lagging and insulation will be removed on a sample basis to demonstrate that the, lagging, roof flashing, insulation, and the sealant are effective in preventing moisture intrusion and in preventing significant loss of material to the aluminum tank external surface. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Detection of Aging Effects (Element 4)**

   #### Justification for Exception

   At Byron and Braidwood Stations the aluminum condensate storage tanks are protected by lagging, roof flashing, and insulation, and are not coated with a protective paint or coating on the external surface. At Byron there is sealant at the base of the lagging and Braidwood has sealant at the base of the tank.

   At Byron and Braidwood Stations the original plant design specifications do not require the aluminum condensate storage tanks to be coated or painted on the external surface as a preventive measure to mitigate corrosion. When aluminum is exposed to oxygen, aluminum oxide immediately forms on the surface which seals the core aluminum from further oxidation. This oxide layer is chemically bound to the surface allowing aluminum to resist corrosion.

   However, on a once per 18 month operating cycle frequency, visual inspections of the external surface of the aluminum tanks will be performed at selected locations where the lagging and insulation will be removed. Visual inspections will include the lagging, roof flashing, insulation, and sealant, including sealant at the base of the tank (Byron only) and lagging (Braidwood only) to verify that they are effective in preventing moisture intrusion to the aluminum tank external surface that may cause significant loss of material.

   Based on the lack of loss of material observed to date, BBS operating experience has shown aluminum condensate storage tanks in an external outdoor air environment to be an appropriate design when properly protected by lagging, roof flashing, insulation, and sealant, including sealant at the base of the tank/lagging.

There is reasonable assurance that the condensate storage tanks without being coated or painted, but protected by lagging, roof flashing, insulation, and sealant will continue to provide their intended function.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Aboveground Metallic Tanks program will be effective in ensuring that intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. In March 2011, degraded sealant was discovered at the lagging on several locations of the Unit 2 condensate storage tank. This included the sealant located on the bottom joint where the lagging meets the concrete foundation as well as sealant located at tank penetrations, including heaters and junction boxes. The degradation at the Unit 2 condensate storage tank was determined to be due to the age of the sealant, however, the sealant was still performing its intended function.

   As an extent of condition, a Unit 1 condensate storage tank sealant inspection was performed and there was no significant degraded sealant found as was identified on the Unit 2 tank. Based on the Unit 1 condensate storage tank inspection results, it was determined that the degraded sealant issue was limited to the Unit 2 condensate storage tank. This issue was entered into the corrective action program and work order activities to correct the condition have been planned in accordance with station procedures.

   This example provides objective evidence that condensate storage tank degraded conditions are identified and entered into the corrective action program.

2. In August 2012, a visual inspection of the Unit 2 condensate storage tank revealed that the flashing, lagging, and insulation on the underside of the roof overhang at the top of the tank wall had dropped approximately 1-1/2 inches from the roof of the tank. This resulted in a gap at the top of the tank, which could allow rainwater to wet the insulation under the lagging. Loosening of the lagging system is the suspected cause. By design, the flashing is shaped and sealed such that it provides a weather barrier between the underside of the roof overhang and the lagging on the walls of

the tank. The seal between the flashing and the underside of the roof overhang broke when the flashing, lagging, and insulation dropped approximately 1-1/2 inches from the roof of the tank. This issue was entered into the corrective action program..

The flashing and insulation on the Unit 1 condensate storage tank was inspected as part of the extent of condition. The visual inspection of the Unit 1 condensate storage tank revealed that the flashing at the top of the tank wall was also degraded but not as significant as Unit 2. Loosening of the lagging system is the suspected cause. This issue was entered into the corrective action program recommending that the flashing be resealed to prevent the potential for ingress of water to the fiberglass insulation. The flashing, lagging, and insulation had not dropped in a manner similar to the Unit 2 condensate storage tank. Work order activities to correct the condition have been planned in accordance with station procedures.

This example provides objective evidence that degraded conditions are entered into the corrective action program to ensure that adequate corrective actions are taken.

3. In March 2009, an ethylene glycol leak was identified on one of the four Unit 1 condensate storage tank heater sight glasses. The electric heaters, which are not in scope, are installed in individual heater wells that protrude into the tank. The ethylene glycol is used to transfer the heat from the electric heater to the heater well, which heats the water in the condensate storage tank. The heater transfer media used at Byron (glycol/water) is not maintained from a chemistry standpoint and is replenished based on sight glass observations and is completely exchanged when heaters are inspected. The leak was limited to one heater sight glass. The issue was entered into the corrective action program. The cause of the leakage was determined to be degraded sight glass o-rings. The o-rings were replaced and post-maintenance observations confirmed that the sight glass was leak tight.

   This example provides objective evidence that deficiencies are entered into the corrective action program and appropriate corrective actions are taken to evaluate and correct deficiencies.

Braidwood Station

1. In July 2007, water seepage was identified on the concrete foundation of the Unit 1 condensate storage tank. The concrete foundation was wet in several areas around the base of the tank. Although initially suspected to be a leak from the condensate storage tank, the Chemistry Department analysis indicated that the water seepage was rainwater, and not water from the condensate storage tank. Further investigation revealed that the lagging at the top of the condensate storage tank had dropped approximately one inch breaking the seal between the flashing and the lagging. By design, the flashing is shaped and sealed such that it provides a weather barrier between the underside of the roof overhang and the

lagging on the walls of the tank. This one (1) inch gap between the flashing and the lagging allowed rain water to reach the fiberglass insulation and the condensate storage tank wall where it trickled down to the bottom of the condensate storage tank and onto the concrete foundation. Loosening of the lagging system is the suspected cause. This issue was entered into the corrective action program.

The extent of condition was initially limited to the Unit 1 condensate storage tank. An inspection of the Unit 2 condensate storage tank did not identify similar water seepage at the tank base, however, two months later water seepage was identified at the base of the Unit 2 condensate storage tank. The Chemistry Department analysis indicated that the water seepage on the Unit 2 condensate storage tank was rainwater. Further investigation revealed that the lagging at the top of the Unit 2 condensate storage tank had also dropped approximately one (1) inch breaking the seal between the flashing and the lagging. Loosening of the lagging system is the suspected cause. The lagging and flashing seals were repaired on both the Unit 1 and Unit 2 condensate storage tanks to manage the aging effect of corrosion on the external surface of the condensate storage tanks.

This example provides objective evidence that deficiencies are entered into the corrective action program and appropriate corrective actions are taken to evaluate and correct deficiencies.

2. In May 2012, the System Manager performed a walkdown of the Unit 1 and Unit 2 condensate storage tanks. The external surface of the insulation lagging and roof flashing covering the tank was inspected and as well as any exposed sealant. No new age-related issues associated with the tank were identified at that time. The insulation lagging, flashing, and sealant were in good condition. No follow-up actions were required.

   This example provides objective evidence that periodic inspections of the condensate storage tanks are performed to monitor the condition of the lagging, flashing, and sealant installed on the condensate storage tanks. These inspections provide the opportunity for degraded conditions to be identified and entered into the corrective action program prior to the loss of the tanks intended function.

3. In March 2006, a security guard identified damage to the drain nozzle on the Unit 2 condensate storage tank. Further investigation revealed that it was the lagging on the drain line that was damaged, and not the drain nozzle. This issue was entered into the corrective action program. The extent of condition was limited to the Unit 2 condensate storage tank. No damage was identified on the Unit 1 tank. The investigation did not identify the cause of the damage to the lagging. However, examination of the damaged lagging led to the conclusion that it was inadvertently damaged by site personnel. The lagging was repaired by maintenance department personnel.

> This example provides objective evidence that deficiencies are entered into the corrective action program and appropriate corrective actions are taken to evaluate and correct deficiencies.

The above examples provide objective evidence that the new Aboveground Metallic Tanks aging management program will effectively monitor and detect the aging effect of loss of material. A review of the operating examples showed that visual inspections have identified issues associated with the condensate storage tanks. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for evaluation, repair, or replacement is provided for locations where age-related degradation is found. Assessments of the Aboveground Metallic Tanks aging management program will be performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the new Aboveground Metallic Tanks aging management program will effectively identify age-related degradation prior to failure.

Conclusion

The new Aboveground Metallic Tanks program will provide reasonable assurance that the loss of material aging effect will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.18 Fuel Oil Chemistry

Program Description

The Fuel Oil Chemistry program is an existing mitigative and condition monitoring program that manages loss of material and reduction in heat transfer in piping, piping elements, piping components, tanks, and heat exchangers in a fuel oil environment. The Fuel Oil Chemistry aging management program relies on a combination of surveillance procedures and maintenance activities being implemented to provide assurance that contaminants are monitored and controlled in fuel oil for systems and components within the scope of license renewal. The program requires fuel oil parameters to be maintained at acceptable levels in accordance with Technical Specifications, Technical Requirement Manual, and ASTM Standards (ASTM D 0975-98/-06b, D 2709-96e, D 4057-95, and D 5452-98). Fuel oil sampling and analysis is performed in accordance with approved procedures for new and stored fuel oil. Monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant age-related degradation. Fuel oil tanks are periodically drained of accumulated water, cleaned, and internally inspected to minimize exposure to fuel oil contaminants. Protective coatings are not credited for mitigating the loss of material due to general, pitting, and crevice corrosion, microbiologically influenced corrosion (MIC), and biological fouling in fuel tanks. These activities effectively manage the effects of aging by maintaining contaminants at acceptably low concentrations.

NUREG-1801 Consistency

The Fuel Oil Chemistry aging management program will be consistent with the ten elements of aging management program XI.M30, “Fuel Oil Chemistry,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Provide for periodic cleaning of the Fire Protection Fuel Oil Storage Tank (Byron only). **Program Element Affected: Preventive Actions (Element 2)**

2. Provide for periodic draining of water from the Auxiliary Feedwater Day Tanks, Diesel Generator Day Tanks, Essential Service Water Make/Up Pump Fuel Oil Storage Tanks (Byron only), and Fire Protection Fuel Oil Storage Tanks. **Program Element Affected: Preventive Actions (Element 2)**

3. Include analysis for the levels of microbiological organisms in the Auxiliary Feedwater Day Tanks and Essential Service Water Make-up Pumps Diesel Oil Storage Tanks (Byron only). **Program Element Affected: Parameters Monitored/Inspected (Element 3)**

4. Include analysis for water and sediment content, particulate concentration, and the levels of microbiological organisms for the Diesel Generator Day Tanks. **Program Element Affected: Parameters Monitored/Inspected (Element 3)**

5. Include analysis for water and sediment content and the levels of microbiological organisms for the Diesel Generator Fuel Oil Storage Tanks. **Program Element Affected: Parameters Monitored/Inspected (Element 3)**

6. Include analysis for particulate concentration and the levels of microbiological organisms for the Fire Protection Fuel Oil Storage Tanks. **Program Element Affected: Parameters Monitored/Inspected (Element 3)**

7. Include internal inspections of the Fire Protection Fuel Oil Storage Tanks at least once during the 10 year period prior to the period of extended operation, and at least once every 10 years during the period of extended operation. Each diesel fuel tank will be drained and cleaned, the internal surfaces visually inspected (if physically possible), and, if evidence of degradation is observed during inspections, or if visual inspection is not possible, these diesel fuel tanks will be volumetrically inspected. **Program Element Affected: Detection of Aging Effects (Element 4)**

8. Include monitoring and trending for the levels of microbiological organisms for the Auxiliary Feedwater Day Tanks and Essential Service Water Make-up Pumps Diesel Oil Storage Tanks (Byron only). **Program Element Affected: Monitoring and Trending (Element 5)**

9. Include monitoring and trending for water and sediment content, particulate concentration, and the levels of microbiological organisms for the Diesel Generator Day Tanks. **Program Element Affected: Monitoring and Trending (Element 5)**

10. Include monitoring and trending for water and sediment content and the levels of microbiological organisms for the Diesel Generator Fuel Oil Storage Tanks. **Program Element Affected: Monitoring and Trending (Element 5)**

11. Include monitoring and trending for total particulate concentration and the levels of microbiological organisms for the Fire Protection Fuel Oil Storage Tanks. **Program Element Affected: Monitoring and Trending (Element 5)**

Operating Experience

The following examples of operating experience provide objective evidence that the Fuel Oil Chemistry aging management program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. In February 2009, the A Essential Service Water Make-up Pump Fuel Oil Storage Tank was identified as having an unsatisfactory fuel oil condition due to elevated particulate concentrations. This resulted in the flushing of the tank, instrument connections, and fuel line to the engine. The issue was entered into the corrective action program with an apparent cause investigation performed. Contamination of the oil by the site transport tank truck was one of the apparent causes, which led to changes in preventative maintenance program for this equipment. Periodic sampling of other fuel oil storage tanks resulted in no extent of condition concerns.

   This example provides objective evidence that fuel oil monitoring activities identify fuel oil contaminants that can lead to aging effects, deficiencies found during fuel oil monitoring activities are documented in the corrective action program, and fuel oil monitoring activity deficiencies are evaluated and corrective actions implemented to maintain system intended functions.

2. In October 2005, the 2B Auxiliary Feedwater Day Tank was drained, cleaned, and inspected. The inspection revealed a thin layer of dark brown material coating the interior of the tank. This finding was entered into the corrective action program. Planned contingency actions were implemented and the material was removed. The inspection revealed no evidence of age-related degradation. The corresponding Unit 1 tank had been inspected earlier that year with no deficiencies noted.

   This example provides objective evidence that fuel oil chemistry control and tank inspection activities are effectively implemented and that adverse conditions associated with fuel oil environments do not impact fuel oil storage tank intended functions.

3. In November 2001, the 2B Diesel Generator Fuel Oil Storage Tank was drained, cleaned, and inspected. Activities included a visual inspection of the tank interior surfaces. The coating inspection revealed a small section of coating missing on the tank wall (3 inch by 48 inch long) as well as a crack in the coating along the circumference of the floor where it joins the tank wall (approximately 3 feet long). This condition was entered into the corrective action program, evaluated by engineering, and found to be acceptable without repair. A volumetric inspection (UT) was performed with nominal wall thickness found. There was no pitting observed within the tank. There was no impact to the component’s intended functions. Extent of condition was reviewed and found applicable to other fuel oil storage tanks, which were scheduled for tank cleanings and inspections as part of

the 10-year inspection plan. Diesel fuel oil storage tank inspections took place during refuel outages through 2005, with no reported issues concerning tank coating degradation.

This example provides objective evidence that deficiencies found during fuel oil tank inspection activities are documented in the corrective action program, and corrective actions are implemented to maintain component intended functions.

Braidwood Station

1. In June 2008, the 2A Diesel Fuel Oil Storage Tank was drained, cleaned, and inspected. Activities included an inspection of the tank's interior surfaces. The coating inspection revealed a small section of coating missing on the wall (2 inch by 1 inch long) as well as various areas on the floor of the tank where the coating was also missing. The coating appeared to be scraped off and the base metal left uncoated. This was attributed to activities taking place during initial construction. This condition was entered into the corrective action program, evaluated by engineering, and found to be acceptable without immediate repair to the coating. The visual inspection revealed no evidence of corrosion. The 2B Diesel Fuel Oil Storage Tank was inspected in August of 2008 with similar findings. Both tanks were recommended to have coatings repair during the subsequent tank cleanings. Unit 1 fuel oil storage tanks had been inspected in 2005 (1DO01TB/D) and 2007 (1DO01TA/C) with no issues identified.

   This example provides objective evidence that deficiencies found during fuel oil tank inspection activities are documented in the corrective action program, and issue are evaluated to assure component intended functions are maintained.

2. In February 2007, an increasing trend in particulate concentration in the Diesel Generator Fuel Oil Storage Tanks was identified and documented in the corrective action program. The data identified the 1B and 1D Diesel Generator Fuel Oil Storage Tanks associated with the 1B Diesel Generator as having the highest adverse trends. To proactively address this condition, filtering of stored oil was recommended using existing station procedural guidance. The cause was investigated and attributed to the reduction of stored inventory in the main fuel oil storage tank due to upcoming conversion to ultra-low sulfur fuel. The smaller volume of stored fuel with the fixed level of particulate contamination caused particulate concentrations to increase as tank levels were reduced.

   This example provides objective evidence that a) fuel oil monitoring and trending activities identify fuel oil contaminants that can lead to aging effects, b) deficiencies found during fuel oil monitoring activities are documented in the corrective action program, and c) fuel oil monitoring activity deficiencies are evaluated and corrective actions implemented to maintain component intended functions.

3. In June 2002, the common Fire Protection Fuel Oil Storage Tank was identified as having an unsatisfactory fuel oil condition due to elevated particulate concentrations. The issue was entered into the corrective action program. Immediate corrective action consisted of flushing the tank and filtering the stored oil. The cause of high particulate was the tank of the station delivery vehicle, which was found to be degraded causing contaminates to be transferred to the Fire Protection Fuel Oil Storage Tank during fueling activities. As a corrective measure, a new tank for the delivery vehicle was procured to prevent recurrence.

   This example provides objective evidence that a) fuel oil monitoring activities identify fuel oil contaminants that can lead to aging effects, b) deficiencies found during fuel oil monitoring activities are documented in the corrective action program, and c) fuel oil monitoring activity deficiencies are evaluated and corrective actions implemented to maintain system intended functions.

The operating experience review relative to the Fuel Oil Chemistry program did not identify an adverse trend in performance or any instances of significant age-related degradation. The above examples provide objective evidence that the existing Fuel Oil Chemistry program will effectively monitor and detect the aging effects of loss of material and reduction of heat transfer. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions are taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where age-related degradation is found. Assessments of the Fuel Oil Chemistry aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the Fuel Oil Chemistry aging management program will effectively identify age-related degradation prior to failure.

Conclusion

The enhanced Fuel Oil Chemistry program will provide reasonable assurance that the loss of material and reduction of heat transfer aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.19 Reactor Vessel Surveillance

Program Description

The Reactor Vessel Surveillance aging management program is an existing condition monitoring program that manages the loss of fracture toughness due to neutron irradiation embrittlement of the ferritic reactor pressure vessel (RPV) beltline materials in a reactor coolant and neutron flux environment. The program meets the requirements of 10 CFR Part 50, Appendix H. The program evaluates neutron irradiation embrittlement by projecting Upper Shelf Energy (USE) for reactor materials and impact on Adjusted Reference Temperature for the development of pressure-temperature limit curves. Neutron irradiation embrittlement evaluations are performed in accordance with Regulatory Guide 1.99, Revision 2, “Radiation Embrittlement of Reactor Vessel Materials.” The Reactor Vessel Surveillance program provides sufficient material and dosimetry data to monitor irradiation embrittlement at the end of the period of extended operation, and determine the need for operating restrictions on the irradiation temperature (i.e., cold leg operating temperature), neutron spectrum, and neutron fluence.

There were six (6) specimen capsules installed in each Byron and Braidwood Stations (BBS) RPV prior to plant start-up. The capsules contain representative RPV material specimens, neutron dosimeters, and thermal monitors (eutectic alloy). All six (6) specimen capsules have been withdrawn from each of the BBS RPVs. Three (3) specimen capsules from each RPV were tested and the remaining three (3) untested specimen capsules from each RPV are currently stored in the spent fuel pool. Of the three (3) untested specimen capsules from each RPV at least one (1) untested specimen capsule has been irradiated in excess of the projected peak neutron fluence of the associated RPV at the end of the period of extended operation. Capsules that have been withdrawn will be tested as necessary to fulfill the surveillance capsule recommendations contained in ASTM 185-82 as required by 10 CFR Part 50, Appendix H.

Byron Station, Unit 1 has two (2) untested specimen capsules irradiated in excess of the end of period of extended operation projected peak neutron fluence of 3.21E+19 n/cm2 (E >1.0 MeV). Specimen capsule Z was pulled during the Byron Station, Unit 1 Fall 2003 Refueling Outage and was irradiated to 3.34E+19 n/cm2 (E >1.0 MeV). Specimen capsule Y was pulled during the Byron Station, Unit 1 Spring 2008 Refueling Outage and was irradiated to 3.97E+19 n/cm2 (E >1.0 MeV).

Byron Station, Unit 2 has two (2) untested specimen capsules irradiated in excess of the end of period of extended operation projected peak neutron fluence of 3.19E+19 n/cm2 (E >1.0 MeV). Specimen capsule Z was pulled during the Byron Station, Unit 2 Spring 2004 Refueling Outage and was irradiated to 3.25E+19 n/cm2 (E >1.0 MeV). Specimen capsule Y was pulled during the Byron Station, Unit 2 Spring 2010 Refueling Outage and was irradiated to 4.19E+19 n/cm2 (E >1.0 MeV).

Braidwood Station, Unit 1 has one (1) untested specimen capsule irradiated in excess of the end of period of extended operation projected peak neutron fluence of 3.19E+19 n/cm2 (E >1.0 MeV). Specimen capsule V was pulled during the Braidwood Station, Unit 1 Spring 2009 Refueling Outage and was irradiated to 3.71E+19 n/cm2 (E >1.0 MeV).

Braidwood Station, Unit 2 has one (1) untested specimen capsule irradiated in excess of the end of period of extended operation projected peak neutron fluence of 3.19E+19 n/cm2 (E >1.0 MeV). Specimen capsule V was pulled during the Braidwood Station, Unit 2 Fall 2009 Refueling Outage and was irradiated to 3.73E+19 n/cm2 (E >1.0 MeV).

The remaining untested specimen capsules are stored in the respective spent fuel pool to allow for re-insertion and further irradiation if required for the period of extended operation. Testing of remaining untested specimen capsules will be performed in accordance with ASTM E 185-82, “Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels.”

Ex-core dosimetry has been installed at Byron and Braidwood Stations, Units 1 and 2. The ex-core dosimetry provides a method to verify the fast neutron exposure distribution. Using the ex-core dosimetry data in conjunction with historical in-vessel specimen analysis results and neutron transport calculations reduces the uncertainty in the projection of neutron irradiation embrittlement gradients through the RPV wall in accordance with Regulatory Guide 1.190, “Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence.” The ex-core dosimetry will be used during the period of extended operation to monitor RPV peak neutron fluence.

These measures and frequencies are effective in monitoring the extent of loss of fracture toughness of the RPV beltline material due to neutron irradiation embrittlement to prevent significant age-related degradation of the RPV during the period of extended operation.

NUREG-1801 Consistency

The Reactor Vessel Surveillance aging management program will be consistent with the ten elements of aging management program XI.M31, "Reactor Vessel Surveillance," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancement will be implemented in the following program elements:

1. Establish operating restrictions to ensure that the plant is operated under the conditions to which the surveillance capsules were exposed. The operating restrictions are as follows:

   Byron Station, Unit 1:

   - Cold leg operating temperature limitation: 525 degrees Fahrenheit (minimum) to 590 degrees Fahrenheit (maximum)
   - RPV beltline material fluence: 3.21E+19 n/cm2 (E >1.0 MeV) (maximum)

   Byron Station, Unit 2; Braidwood Station, Units 1 and 2:

   - Cold leg operating temperature limitation: 525 degrees Fahrenheit (minimum) to 590 degrees Fahrenheit (maximum)
   - RPV beltline material fluence: 3.19E+19 n/cm2 (E >1.0 MeV) (maximum)

   If the reactor pressure vessel exposure conditions (neutron fluence, neutron spectrum) or irradiation temperature (cold leg inlet temperature) are altered, then the basis for the projection to the end of the period of extended operation needs to be reviewed and, if deemed appropriate, updates are made to the Reactor Vessel Surveillance program. Any changes to the Reactor Vessel Surveillance program must be submitted for NRC review and approval in accordance with 10 CFR Part 50, Appendix H. **Program Elements Affected: Parameters Monitored/Inspected (Element 3), Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5), Acceptance Criteria (Element 6)**

Operating Experience

The following examples of operating experience provide objective evidence that the Reactor Vessel Surveillance program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron Station</u>

1. In September 2010, Westinghouse issued WCAP-17250-NP, Ex-Core Neutron Dosimetry Program for Byron Unit 1 Cycle 16, Revision 0. This was an analysis of the ex-core dosimetry that was withdrawn during the Byron Station, Unit 1 Fall 2009 Refueling Outage. The ex-core dosimetry was irradiated for one (1) cycle prior to withdrawal. The analysis performed a neutron fluence assessment for the Byron Unit 1 reactor pressure vessel beltline region based on the guidance specified in Regulatory Guide 1.190, Revision 0, “Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence.” In the analysis, fast neutron exposures expressed in terms of fast neutron fluence (E >1.0MeV) and iron atom

displacements (dpa) were established for each of the materials comprising the beltline region of the reactor pressure vessel. In addition, the neutron dosimetry sensor sets from the three (3) internal surveillance capsules previously withdrawn from Byron Unit 1 were re-analyzed using current dosimetry evaluation methodology. The dosimetry re-evaluations, along with the Cycle 16 ex-core neutron dosimetry, were then used to validate the calculational models that were applied in the plant-specific neutron transport analyses. The comparisons of calculations with the Byron Unit 1 measurement database provided a validation demonstrating that the plant-specific calculations meet the uncertainty requirements specified in Regulatory Guide 1.190.

This operating experience provides objective evidence that the existing Reactor Vessel Surveillance program adequately monitors the loss of fracture toughness of reactor pressure vessel beltline materials due to neutron irradiation embrittlement.

2. In January 2011, Westinghouse issued WCAP-17333-NP, Ex-Core Neutron Dosimetry Program for Byron Unit 2 Cycle 15, Revision 0. This was an analysis of the ex-core dosimetry that was withdrawn during the Byron Station, Unit 2 Spring 2010 Refueling Outage. The ex-core dosimetry was irradiated for one (1) cycle. The analysis performed a neutron fluence assessment for the Byron Unit 2 reactor pressure vessel beltline region based on the guidance specified in Regulatory Guide 1.190, Revision 0, “Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence.” In the analysis, fast neutron exposures expressed in terms of fast neutron fluence (E >1.0MeV) and iron atom displacements (dpa) were established for each of the materials comprising the beltline region of the pressure vessel. In addition, the neutron dosimetry sensor sets from the three (3) internal surveillance capsules previously withdrawn from Byron Unit 2 were re-analyzed using current dosimetry evaluation methodology. The dosimetry re-evaluations, along with the Cycle 15 ex-core neutron dosimetry, were then used to validate the calculational models that were applied in the plant-specific neutron transport analyses. The comparisons of calculations with the Byron Unit 2 measurement database provided a validation demonstrating that the plant-specific calculations meet the uncertainty requirements specified in Regulatory Guide 1.190.

   This operating experience provides objective evidence that the existing Reactor Vessel Surveillance program adequately monitors the loss of fracture toughness of reactor pressure vessel beltline materials due to neutron irradiation embrittlement.

<u>Braidwood Station</u>

1. In October 2007, Braidwood engineering evaluated delaying the withdrawal of the last remaining reactor surveillance capsule (capsule V) from the Unit 1 reactor pressure vessel lower core barrel, during the Braidwood Station, Unit 1 Fall 2007 Refueling Outage, by one refueling outage due to scheduling conflicts. Due to the specimen capsule proximity to the core, the

lead factor for this specimen was calculated to be 3.92. The lead factor is a measure of the amount of radiation exposure experienced by the specimen in excess to that experienced at the actual reactor vessel wall due to the specimen's proximity to the core, as compared to the vessel wall. Braidwood engineers consulted with the reactor vessel manufacturer, Westinghouse. It was calculated that capsule V had experienced approximately 64 effective full power years (EFPY) worth of radiation exposure to date. Westinghouse materials engineers specified the limit of 80 EFPY worth of exposure to any in-vessel reactor surveillance specimen in order to remain useful for future analysis. Westinghouse and Braidwood engineering personnel agreed that the withdrawal of capsule V could be delayed by one refueling outage without exceeding the exposure limit of 80 EFPY. In addition, it was determined that there would be no impact to the current licensing basis pressure-temperature limits. Capsule V was subsequently withdrawn during the next refueling outage and stored in the spent fuel pool for possible future analysis. A similar analysis was also performed in February 2008, for capsule V for the Braidwood Unit 2 reactor pressure vessel.

This operational experience demonstrates Braidwood Station's engagement with the reactor vessel manufacturer with regards to the Reactor Vessel Surveillance program and how information from the program is used to assess impacts to plant operational limits.

2. In March 2010, Westinghouse issued WCAP-17194-NP, Ex-Core Neutron Dosimetry Program for Braidwood Unit 1 Cycle 14, Revision 0. This was an analysis of the ex-core dosimetry that was withdrawn during the Braidwood Station, Unit 1 Spring 2009 Refueling Outage. The ex-core dosimetry was irradiated for one (1) cycle prior to withdrawal. The analysis performed a neutron fluence assessment for the Braidwood unit 1 reactor pressure vessel beltline region based on the guidance specified in Regulatory Guide 1.190, Revision 0, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence." In the analysis, fast neutron exposures expressed in terms of fast neutron fluence (E >1.0MeV) and iron atom displacements (dpa) were established for each of the materials comprising the beltline region of the pressure vessel. In addition, the neutron dosimetry sensor sets from the three (3) internal surveillance capsules previously withdrawn from Braidwood Unit 1 reactor vessel were re-analyzed using current dosimetry evaluation methodology. The dosimetry re-evaluations, along with the Cycle 14 ex-core neutron dosimetry, were then used to validate the calculational models that were applied in the plant-specific neutron transport analyses. The comparisons of calculations with the Braidwood Unit 1 measurement database provided a validation demonstrating that the plant-specific calculations meet the uncertainty requirements specified in Regulatory Guide 1.190.

   This operating experience provides objective evidence that the existing Reactor Vessel Surveillance program adequately monitors the loss of fracture toughness of reactor pressure vessel beltline materials due to neutron irradiation embrittlement.

3. In May 2010, Westinghouse issued WCAP-17204-NP, Ex-Core Neutron Dosimetry Program for Braidwood Unit 2 Cycle 14, Revision 0. This was an analysis of the ex-core dosimetry that was withdrawn during the Braidwood Station, Unit 2 Fall 2009 Refueling Outage. The ex-core dosimetry was irradiated for one (1) cycle prior to withdrawal. The analysis performed a neutron fluence assessment for the Braidwood Unit 2 reactor pressure vessel beltline region based on the guidance specified in Regulatory Guide 1.190, Revision 0, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence." In the analysis, fast neutron exposures expressed in terms of fast neutron fluence (E >1.0MeV) and iron atom displacements (dpa) were established for each of the materials comprising the beltline region of the reactor pressure vessel. In addition, the neutron dosimetry sensor sets from the three (3) internal surveillance capsules previously withdrawn from Braidwood Unit 2 reactor vessel were re-analyzed using current dosimetry evaluation methodology. The dosimetry re-evaluations, along with the Cycle 14 ex-core neutron dosimetry, were then used to validate the calculational models that were applied in the plant-specific neutron transport analyses. The comparisons of calculations with the Braidwood Unit 2 measurement database provided a validation demonstrating that the plant-specific calculations meet the uncertainty requirements specified in Regulatory Guide 1.190.

The operating experience relative to the Reactor Vessel Surveillance program did not identify an adverse trend in performance. The inspection methods being implemented by the program have been proven effective in detecting aging effects including loss of fracture toughness. Appropriate guidance for evaluation, repair, or replacement is provided for locations where degradation is found. Periodic self-assessments of the Reactor Vessel Surveillance program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the Reactor Vessel Surveillance program will effectively identify degradation prior to failure or loss of intended function during the period of extended operation.

Conclusion

The enhanced Reactor Vessel Surveillance program will provide reasonable assurance that the loss of fracture toughness aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.20 One-Time Inspection

Program Description

The One-Time Inspection aging management program is a new condition monitoring program that will be used to verify the system-wide effectiveness of the Water Chemistry (B.2.1.2), Fuel Oil Chemistry (B.2.1.18), and Lubricating Oil Analysis (B.2.1.26) aging management programs which are designed to prevent or minimize age-related degradation so that there will not be a loss of intended function during the period of extended operation. The program manages loss of material, cracking, and reduction of heat transfer in piping, piping components, piping elements, tanks, pump casings, heat exchangers, and other components within the scope of license renewal for fuel oil, lubricating oil, reactor coolant, steam, treated water, and treated borated water environments. The program identifies inspections focused on locations that are isolated from the flow stream, that are stagnant, or have low flow for extended periods and are susceptible to the gradual accumulation or concentration of agents that promote certain aging effects. A representative sample size of 20 percent of the population (up to a maximum of 25 component inspections) will be established for each of the sample groups and will focus on the bounding or lead components most susceptible to aging due to time in service, and severity of operating conditions. The program verifies either no unacceptable age-related degradation is occurring or triggers additional actions that will assure the intended function of affected components will be maintained during the period of extended operation. Technical justification of the methodology and sample size used for selecting components for one-time inspection is documented in the One-Time Inspection Sample Basis Document.

The elements of the program include (a) determination of the sample size of components to be inspected based on an assessment of materials of fabrication, environment, plausible aging effects, and plant-specific and industry operating experience, (b) identification of the inspection locations in the system or component based on the potential for the aging effect to occur, (c) determination of the examination technique, including acceptance criteria that would be effective in managing the aging effect for which the component is examined, and (d) an evaluation of the need for follow-up examinations to monitor the progression of aging if age-related degradation is found that could adversely impact an intended function before the end of the period of extended operation. The monitoring methods will be effective in detecting the applicable aging effects and the frequency of monitoring will be adequate to prevent significant age-related degradation.

This program is not used for systems or components with known age-related degradation or when the environment in the period of extended operation is not expected to be equivalent to that in the prior 40 years. Periodic inspections will be used in these cases.

The One-Time Inspection program will be implemented prior to the period of extended operation. The one-time inspections will be performed within the 10 year period prior to the period of extended operation.

NUREG-1801 Consistency

The One-Time Inspection aging management program will be consistent with the ten elements of aging management program XI.M32, "One-Time Inspection," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the One-Time Inspection program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron Station</u>

1. In October 2005, the Unit 2 fuel oil day tank associated with the 2B Auxiliary Feedwater Day Tank pump diesel was drained, cleaned, and visually inspected during its scheduled periodic inspection. The inspection revealed a thin layer of dark brown material coating the interior of the tank. This finding was entered into the corrective action program. Planned contingency actions were implemented and the material was removed with a rag. The source or cause of the coating was never determined. The inspection revealed no evidence of age-related degradation. The corresponding Unit 1 fuel oil day tank had been inspected earlier that year with no deficiencies noted. The One-Time Inspection program will be used to validate that there are no significant aging effects on the tank internal surfaces during the next internal tank inspection (every ten years) prior to entering the period of extended operation.

   This example provides objective evidence that fuel oil chemistry control and tank inspection activities are effectively implemented and that any adverse conditions associated with inspection activities are entered into the corrective action program for evaluation and disposition.

2. In October 2003, a through-wall leak in the Unit 2 refueling water storage tank (RWST) heater outlet piping was discovered by operations personnel. An ultrasonic inspection was performed on the pipe in the area of the leak. This nonsafety-related type of heater assembly is installed on both RWSTs at Byron. The Unit 2 heater assembly was replaced a year earlier with an

in-kind carbon steel heater. Given the heater assembly had only been in service for a short period, the probable cause was determined to be a manufacturing defect. The piping was replaced in kind. The inlet pipe and heater were also inspected and no degradation was noted. The Unit 2 RWST heater was replaced with a stainless steel heater in 2011. The Unit 1 heater has no history of failures. A work request was initially written to inspect the Unit 1 RWST heater in 2004 to determine the extent of condition, but the Unit 1 heater was subsequently replaced with a stainless steel RWST heater in June 2006.

Although this non-conformance was attributed to a manufacturing defect associated with the component, this event demonstrates that the use of the non-destructive examination (NDE) is effective in identifying age-related degradation and that the corrective action program is utilized to evaluate degraded conditions and implement corrective actions to maintain component intended function.

Braidwood Station

1. In April 2011, an indication was observed during ultrasonic examination of a pipe weld in the Unit 2 Residual Heat Removal System ASME Class 2 piping. This examination was being performed to the requirements of MRP-192 (Assessment of RHR Mixing Tee Thermal Fatigue in PWR Plants). The indication was found on an eight-inch pipe and was 0.7 inches in length with a remaining wall thickness of 0.185 inches with a nominal wall thickness of 0.322 inches (43% through-wall). The actual cause of the defect was attributed to a manufacturing defect. The flaw analysis showed that the indication in the mixing tee weld met the requirements of ASME Section XI, IWB-3500, in its as-found condition. Engineering evaluated the condition and justified continued operation until repairs are completed in Spring 2014.

   In accordance with the requirements of the ASME Code Section XI, IWC-2420, the weld of interest will be re-inspected in the next inspection period. The ASME Code allows re-inspection of the weld to be performed in any one of the next three refueling outages.

   Although this degradation was caused during the construction of the system, this event demonstrates that the use of non-destructive examination is performed and effective in identifying degradation and that the corrective action program is utilized to evaluate degraded conditions and implement corrective actions to maintain component intended function.

2. In June 2008, the 2A Diesel Fuel Oil Storage Tank was drained, cleaned, and inspected as part of the ten-year examination. Activities included an inspection of the tank's interior surfaces. The coating inspection revealed a small section of coating missing on the wall (2-inches by 1-inch in length) as well as various areas on the floor of the tank where the coating was also missing. The coating appeared to be scraped off and the base metal left uncoated following the initial construction activities. This condition was entered into the corrective action program, evaluated by engineering, and

found to be acceptable without immediate repair to the coating. The visual inspection revealed no evidence of corrosion on the bare metal. The 2B Diesel Fuel Oil Storage Tank was inspected in August 2008 with similar findings. Both tanks were recommended to have coating repairs during the subsequent ten-year tank cleanings. There are only two tanks on Unit 2. The four Unit 1 fuel oil storage tanks were inspected in 2005 and 2007 with no issues identified.

This example provides objective evidence that deficiencies found during fuel oil tank inspection activities are documented in the corrective action program, and issues are evaluated to assure component intended functions are maintained during plant operations.

3. On February 25, 2011, dried boric acid was identified on a 1A safety injection (SI) pump discharge line. A dye penetrant test was performed on the area where the dried residue was identified. The dye penetrant test revealed a through-wall crack, numerous pits, and curvilinear indications in the area that contained the dried boric acid. Chemical analysis performed on the dried residue retrieved from the surface of the pipe was consistent with boric acid concentrations in the refueling water storage tank (RWST), which is the water source for the SI system. The apparent cause of the through-wall crack is outside diameter (transgranular) stress corrosion cracking that initiated from the external surface of the pipe caused by chloride exposure. The likely source of chlorides was tape residue. Corrective actions included replacing the portion of the safety injection line containing the flaw with new stainless steel pipe, and performing extent of condition walkdowns of portions of the SI discharge piping. An extent of condition walkdown was performed and no additional deficiencies were identified on the 1B SI train or the Unit 2 corresponding components.

   A contributor to the event was installed pipe support clamps, which created stresses that generated crevice conditions, which locally retained moisture for long periods in combination with concentrated detrimental chlorides causing a crevice corrosion mechanism. The chemical analysis proved that the corrosion was not from the inside of the piping, which has a treated borated water environment, verifying that the Water Chemistry program is effective in managing the aging effects on the inside of the stainless steel piping.

   The section of the 1A SI pump discharge line containing the flaw was removed from the system and replaced with a new like-for-like pipe. Following pipe replacement and radiography of the new welds, an ASME Section XI Inspection (VT-2) was performed with the system pressurized to nominal operating pressure as part of the post maintenance test. No leakage was observed from the new pipe and new pipe welds.

   This example provides objective evidence that non-destructive examination techniques are effective in identifying age-related degradation, and deficiencies found during non-destructive examinations are documented and evaluated for impact on system intended functions.

The operating experience examples described above are applicable to the One-Time Inspection program. The inspection techniques and methods used are the same as those to be used by the new One-Time Inspection program and have been proven effective in detecting aging effects including cracking, loss of material, and reduction of heat transfer. Degraded conditions are reported in the corrective action program and evaluated for corrective actions. Problems identified would not cause significant impact to the safe operation of the plant, and adequate actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the One-Time Inspection program will be performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the One-Time Inspection program will effectively identify age-related degradation prior to failure or loss of intended function during the period of extended operation.

Conclusion

The new One-Time Inspection program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.21 Selective Leaching

Program Description

The Selective Leaching aging management program is a new condition monitoring program which ensures the integrity of the components that may be susceptible to loss of material due to selective leaching by demonstrating the absence of selective leaching. Components include piping and fittings, valve bodies, pump casings, heat exchanger components, and structural members. Susceptible materials are gray cast iron and copper alloy with greater than 15 percent zinc. Service environments of susceptible components within the scope of license renewal include raw water, closed-cycle cooling water, air-outdoor (Byron only), and waste water. There are no aluminum bronze in-scope components with greater than eight (8) percent aluminum in any environment. The aging management program includes visual examination, supplemented by hardness measurement or other appropriate examination methods, of a representative sample of components to determine whether loss of material by the preferential removal of one of the alloying elements from a material in an aqueous environment is occurring.

The process for selection of the material and environment combinations is covered in the Selective Leaching Inspection Sample Basis Document. A sample size of 20 percent of susceptible components will be subjected to a one-time inspection with a maximum of 25 inspections for each of the susceptible material and environment combination groups. If selective leaching is found, the program will require an evaluation of the aging effect on the ability of the affected components to perform their intended function(s) during the period of extended operation. The sample size for each material and environment combination group may be expanded based on the results of the evaluation and laboratory testing. This confirmatory condition monitoring program will provide adequate inspection methods that are effective in demonstrating the absence of selective leaching.

The selective leaching process involves the preferential removal of one of the alloying elements from the material, which leads to the increased concentration of the remaining alloying elements. Dezincification (loss of zinc from brass) and graphitization (removal of iron from cast iron) are examples of such a process. Susceptible materials, high temperatures, stagnant-flow conditions, and a corrosive environment, such as acidic solutions for brasses with high zinc content and dissolved oxygen, are conducive to selective leaching. These environmental and material conditions are considered when choosing samples for inspection. In treated water and closed cycle cooling water environments, chemistry is monitored in accordance with the Water Chemistry (B.2.1.2) and Closed Treated Water Systems (B.2.1.12) aging management programs to control corrosive contaminants and pH minimizing dissolved oxygen. In some cases corrosion-inhibiting additives are used. These activities are considered effective in reducing the occurrence of selective leaching. The Selective Leaching aging management program will be implemented prior to the period of extended operation. One-time inspections will be performed within the five (5) year period prior to entering the period of extended operation.

NUREG-1801 Consistency

The Selective Leaching aging management program is consistent with the ten elements of aging management program XI.M33, "Selective Leaching," specified in NUREG-1801, as modified by LR-ISG-2011-03.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Selective Leaching program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. The Selective Leaching program is a new program for Byron Station. Industry operating experience supports the basis for this program. Plant-specific operating experience was reviewed to ensure that the operating experience discussed in the NUREG-1801, Chapter XI, XI.M33 aging management program is bounding (i.e., that there is no relevant plant-specific operating experience in addition to that described in NUREG-1801). The BBS Corrective Action Program and component history databases were searched to determine if selective leaching has been identified to date for components in the applicable material and environment combinations. In addition, the failure analysis database of the Exelon Power Labs (the research facility, which performs detailed failure and metallurgical analyses) was searched to determine if selective leaching has been identified for components at Byron Station. No occurrences of selective leaching were identified in an exhaustive search of Byron Station historical information.

Braidwood Station

1. The Selective Leaching program is a new program for Braidwood Station. Industry operating experience supports the basis for this program. Plant-specific operating experience was reviewed to ensure that the operating experience discussed in the NUREG-1801, Chapter XI, XI.M33 aging management program is bounding (i.e., that there is no relevant plant-specific operating experience in addition to that described in NUREG-1801). The BBS Corrective Action Program and component history databases were searched to determine if selective leaching has been identified to date

for components in the applicable material and environment combinations. In addition, the failure analysis database of the Exelon Power Labs (the research facility, which performs detailed failure and metallurgical analyses) was searched to determine if selective leaching has been identified for components at Braidwood Station. One occurrence of selective leaching was found in an exhaustive search of Braidwood Station historical information and is discussed in detail below. This occurrence is bounded by the operating experience discussed in the NUREG-1801, Chapter XI, XI.M33 aging management program description and was on equipment that is not within the scope of license renewal, but provides objective evidence that the station personnel are able to recognize the aging mechanism and take the appropriate corrective actions.

2. In June 2005 during the performance of routine maintenance in the New Training Building washroom, a potable water brass fitting on the supply line for one of the toilets sheared off the wall. The New Training Building is not within the scope of license renewal, since it is located outside the protected area and does not impact any license renewal systems. The water line was not isolated for about thirty minutes resulting in flooding of the second floor training area. The event resulted in a significant financial loss, so the station management decided to conduct a detailed review of the failure. The failed fitting was sent out to Exelon Power Labs for failure analysis. The metallurgical analysis determined the fitting had undergone dezincification, which had weakened the fitting, so that when the toilet was moved during the renovation, the fitting failed. In addition, a contributing factor of the failure was that the fitting threads had been re-machined, which reduced the metal thickness of the fitting.

   Copper alloy components exposed to raw water within the scope of this program include welded or bolted fittings and valve bodies that are substantially thicker than the failed fitting. Therefore, there is significantly lower probability that a similar failure from selective leaching would occur on these in-scope components. In addition, the service environment for the failed fitting is potable water rather than the raw water service environment of the in-scope components. Currently, no indications of selective leaching have been found in any in-scope license renewal systems. Due to the design and environmental differences between the failed fitting and the in-scope components, and the absence of operating experience indicating the presence of selective leaching on in-scope systems, this example is not representative of susceptible components within the scope of license renewal. Therefore, the Selective Leaching aging management program will be implemented as described to perform one-time inspections within the five years prior to the period of extended operation to demonstrate the absence of selective leaching of components within the scope of license renewal at Braidwood Station.

A review of operating experience did not identify any relevant occurrences of selective leaching. Therefore, a one-time inspection to confirm that selective leaching is not occurring in susceptible components is appropriate. The review of plant-specific operating experience has confirmed that the operating experience described in the NUREG-1801, Chapter XI, XI.M33 Selective Leaching aging management program is bounding and, therefore, the inspection techniques recommended are adequate to ensure that selective leaching is not occurring on susceptible components within the scope of license renewal. Appropriate guidance for evaluation, repair, or replacement is provided for locations where selective leaching is found. Therefore, there is sufficient confidence that implementation of the Selective Leaching program is adequate to demonstrate the absence of selective leaching or, if selective leaching is identified, take appropriate corrective actions to ensure that intended functions are maintained consistent with the current licensing basis through the period of extended operation.

Conclusion

The new Selective Leaching program will provide reasonable assurance that either selective leaching is not occurring or, if selective leaching is identified, appropriate corrective actions are taken to ensure that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.22 One-Time Inspection of ASME Code Class 1 Small-Bore Piping

Program Description

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program is a new conditioning monitoring program that will manage cracking of piping in a reactor coolant environment. The program will perform one-time inspections of a sample of ASME Code Class 1 piping less than nominal pipe size four (4) inches (NPS 4) and greater than or equal to one (1) inch (NPS 1). The program includes piping, fittings, branch connections, and full penetration (butt) welds and partial penetration (socket) welds. Cracking of ASME Code Class 1 small-bore piping due to intergranular stress corrosion or fatigue due to cyclical loading (including thermal, mechanical, and vibratory fatigue; thermal stratification; and thermal turbulence) has not been experienced at Byron and Braidwood Units 1 and 2. These monitoring methods are effective in detecting cracking due to intergranular stress corrosion or fatigue due to cyclical loading to prevent significant age-related degradation. Therefore, this one-time inspection program is applicable and adequate to manage this aging effect during the period of extended operation. Program inspections will augment ASME Code, Section XI requirements.

The current Inservice Inspection (ISI) program for the third ten-year interval, applies Risk Informed Inservice Inspection (RI-ISI) based on EPRI Topical Report, EPRI TR-112657, and certain provisions of ASME Code Case N-578-1 as an approved substitute for the 2001 Edition through the 2003 Addenda of the ASME Section XI Code Edition for small-bore Code Class 1 Examination Category B-J welds. Included within the current ISI program is ASME Code Class 1 small-bore piping less than NPS 4 and greater than NPS 1. For the Byron and Braidwood Stations, piping components that are less than or equal to NPS 1 are exempt from the volumetric and external surface examination requirements of IWB-2500 per IWB-1220. Welds within the scope of the program that are greater than NPS 1 have been ranked relative to “consequence risk” as high, medium, or low risk per the Byron and Braidwood Risk Informed Inservice Inspection Evaluation Reports. These reports provide the basis for the current RI-ISI program implementation at each site. The current ISI program performs periodic volumetric ultrasonic test (UT) examination of high and medium risk ASME Code Class 1 small-bore piping butt welds, and visual external surface (VT) examination of high or medium risk ASME Code Class 1 small-bore piping socket welds.

Although the Byron and Braidwood ISI programs exempt volumetric and surface examination of piping components equal to NPS 1, the scope of the new One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program will include piping components equal to NPS 1.

One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program inspection of socket welds will be performed by volumetric examination techniques demonstrated to be capable of detecting cracking. If such volumetric techniques are not available by the time of the inspections, the examination method will be by destructive testing. If destructive testing is performed, each examination will be credited as equivalent to two volumetrically examined welds.

Byron Unit 1 and 2 have been operating for approximately 29 years and 27 years, respectively, at the time of license renewal application submittal (less than 30 years) and Braidwood Unit 1 and 2 have each been operating for approximately 27 years and 26 years, respectively, at the time of license renewal application submittal (less than 30 years), and have not experienced cracking of ASME Code Class 1 small-bore piping due to intergranular stress corrosion or fatigue due to cyclical loading. Since each of the Byron and Braidwood units has a population of more than 250 ASME Code Class 1 socket welds less than NPS 4 and greater than or equal to NPS 1, the inspection sample size will be 25 socket welds for each unit. Also, since each of the Byron and Braidwood units has a population of at least 160 ASME Code Class 1 butt welds less than NPS 4 and greater than NPS 1, and an assumed population of minimum of approximately 90 butt welds equal to NPS 1, the inspection sample size will be 25 butt welds for each unit. This ensures an adequate sample size to provide confidence that the aging effect of cracking is not an issue at Byron and Braidwood. Sample locations will be selected based on susceptibility for cracking due to intergranular stress corrosion cracking and fatigue due to cyclical loading, consequence of failure, inspectability, dose considerations, operating experience, and limiting locations of the total population of ASME Code Class 1 small-bore piping locations. RI-ISI program high or medium risk ASME Code Class 1 small-bore piping butt and socket welds will be utilized as input for the selection of new One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program inspection locations. Technical justification of the methodology and sample size used for selecting components will be documented in procedural controls.

The program will include procedural controls to implement an alternate plant specific periodic inspection aging management program should evidence of ASME Code Class 1 small-bore piping cracking caused by intergranular stress corrosion cracking (IGSCC) or fatigue due to cyclical loading be revealed by new Byron and Braidwood operating experience prior to the period of extended operation or by the examinations performed as part of this program, and design changes have not been implemented to correct the cause.

The program also will include procedural controls to ensure that if ASME Code Class 1 small-bore piping in a particular plant system experiences cracking, small-bore piping in all ASME Code Class 1 plant systems shall be evaluated to determine whether the cause for the cracking affects those other systems.

The new One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program will be implemented prior to the period of extended operation. One-time inspections will be performed and evaluated within the six (6) year period prior to the period of extended operation.

NUREG-1801 Consistency

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program will be consistent with the ten elements of aging management program XI.M35, “One-Time Inspection of ASME Code Class 1 Small-Bore Piping,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis during the period of extended operation:

<u>Byron Station</u>

1. In 1998, Byron Unit 1 experienced a failure of a one and one half (1 ½) inch ASME Code Class 1 socket weld that attached an elbow to a pipe on a safety injection system line. The condition was entered into the corrective action program. The elbow and pipe assembly was removed from service, replaced with new piping, tested and returned to service. The removed section of piping was shipped to the Argonne National Laboratory for metallurgical analysis. Macro-etching of the sample revealed that the crack was located entirely in the weld. The weld root exhibited a lack of fusion area measuring 0.003 by 0.1 inches. The analysis concluded that the cracking initiated from a large lack of fusion defect at the weld root. The lack of fusion resulted in localized stress concentrations, which resulted in crack initiation due to service induced vibration from system surveillance testing. An extent of condition evaluation identified the failed connection as an original installation shop weld. Dye penetrant examinations were performed on 13 similar Unit 1 socket welds that had also been subject to the same operational conditions. No defects were detected.

   Even though the failure occurred due to a fabrication error, this example provides objective evidence that demonstrates that ASME Code Class 1 small-bore piping deficiencies are entered into the corrective action program and appropriate actions are taken to evaluate deficiencies, determine the root cause, determine extent of condition, and implement corrective actions.

2. An extensive review of the operating experience was performed to determine if Byron Units 1 or 2 have experienced cracking of ASME Code Class 1 small-bore piping caused by intergranular stress corrosion or

fatigue due to cyclical loading during their operating history. The review included key word searches of the corrective action program, a review of correspondence to the NRC, and solicitation of Byron subject matter experts for their input as to whether such ASME Code Class 1 small-bore piping cracking had occurred. The review did not identify any issues during the operating history, where cracking of ASME Code Class 1 small-bore piping caused by intergranular stress corrosion or fatigue due to cyclical loading.

The only cracking issues identified in ASME Code Class 1 small-bore piping are in the first discussion above. However, the issue discussed above was not caused by intergranular stress corrosion or fatigue due to cyclical loading. The results of the operating experience review provides objective evidence that the measures in place to prevent cracking of ASME Code Class 1 small-bore piping caused by intergranular stress corrosion and fatigue due to cyclical loading have been effective. The measures include effective water chemistry controls to prevent IGSCC and the appropriate design of the plant piping systems to prevent cracking caused by fatigue due to cyclical loading.

3. Byron Unit 1 and 2 have been operating for more than 29 years and 27 years, respectively, at the time of license renewal application submittal. Periodic volumetric examinations of ASME Code Class 1 small-bore piping butt welds and visual external surface examinations of ASME Code Class 1 small-bore piping socket welds (greater than NPS 1) have been performed in accordance with the Risk Informed ISI program since 2006 on Byron Unit 1 and 2, with no unacceptable examination results. Prior to the Risk Informed inspections, ASME Code Class 1 small-bore piping butt welds and socket welds received periodic examination per ASME Code, Section XI, Table IWB-2500-1 Examination Category B-J with no unacceptable examination results.

   The only cracking issue identified in ASME Code Class 1 small-bore piping less than NPS 4 and greater than or equal to NPS 1, is in the first discussion above. However, that issue was not caused by intergranular stress corrosion or fatigue due to cyclical loading.

   The ISI program ASME Code Class 1 small-bore piping inspection results provide objective evidence that the measures in place to prevent cracking of ASME Code Class 1 small-bore piping caused by intergranular stress corrosion and fatigue due to cyclical loading have been effective. The measures include effective water chemistry controls to prevent IGSCC and the appropriate design of the plant piping systems to prevent cracking caused by fatigue due to cyclical loading.

Braidwood Station

1. In January 2011, Braidwood Unit 2 personnel identified an accumulation of boric acid on a socket weld that attaches an ASME Class 2 safety-related two (2) inch pipe to a two (2) inch valve on the chemical and volume control system. Inspection of the leakage showed a through wall indication at the

toe of the weld. The condition was entered into the corrective action program. The valve and pipe assembly were removed from service, replaced with new components, tested and returned to service. The removed assembly was shipped to the Exelon Laboratory for metallurgical analysis.

Laboratory inspection of the affected area led to the conclusion that the leak was attributed to the re-use of a pipe section that was damaged and inadequately repaired during a previous removal. The pipe sample identified the remnants of a transverse mechanical cut in the pipe wall from the previous removal process. The sample contained large lack of fusion defects between a local weld repair at the mechanical cut and the re-installed pipe to valve socket weld. The combined length of the mechanical cut defect and lack of fusion defect extended through approximately 90% of the local pipe cross-section for the re-installed pipe. The final through wall leakage occurred when the defects propagated by fatigue.

Although the failure occurred due to a fabrication error and was on an ASME Code Class 2 socket weld, this example demonstrates that ASME Code small-bore piping deficiencies are entered into the corrective action program and appropriate actions are taken to evaluate deficiencies and determine the root cause.

2. An extensive review of the operating experience was performed to determine if Braidwood Units 1 or 2 have experienced cracking of ASME Code Class 1 small-bore piping caused by intergranular stress corrosion or fatigue due to cyclical loading during their operating history. The review included key word searches of the corrective action program, a review of correspondence to the NRC, and solicitation of Braidwood subject matter experts for their input as to whether such Code Class 1 small-bore pipe cracking had occurred. The review did not identify any issues during the operating history, where cracking of ASME Code Class 1 small-bore piping caused by intergranular stress corrosion or fatigue due to cyclical loading.

   The results of the operating experience review provides objective evidence that the measures in place to prevent cracking of ASME Code Class 1 small-bore piping caused by intergranular stress corrosion and fatigue due to cyclical loading have been effective. The measures include effective water chemistry controls to prevent IGSCC and the appropriate design of the plant piping systems to prevent cracking caused by fatigue due to cyclical loading.

3. Braidwood Unit 1 and 2 have each been operating for more than 27 years and 26 years, respectively, at the time of license renewal application submittal. Periodic volumetric examinations of ASME Code Class 1 small-bore piping butt welds and visual external surface examinations of ASME Code Class 1 small-bore piping socket welds (greater than NPS 1) have been performed in accordance with the Risk Informed ISI program, since 2008 on Braidwood Unit 1 and 2, with no unacceptable examination results. Prior to the Risk Informed inspections ASME Code Class 1 small-bore

piping butt welds and socket welds received periodic examination per ASME Code, Section XI, Table IWB-2500-1 Examination Category B-J with no unacceptable examination results.

The ISI program ASME Code Class 1 small-bore piping inspection results provide objective evidence that the measures in place to prevent cracking of ASME Code Class 1 small-bore piping caused by intergranular stress corrosion and fatigue due to cyclical loading have been effective. The measures include effective water chemistry controls to prevent IGSCC and the appropriate design of the plant piping systems to prevent cracking caused by fatigue due to cyclical loading.

The operating experience relative to the new One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program did not identify an adverse trend in performance. A review of BBS specific operating experience and ISI inspections performed per ASME Section XI and the current ISI program indicates that cracking of ASME Code Class 1 small-bore piping caused by IGSCC or fatigue due to cyclical loading has not occurred. The inspection methods being implemented by the existing ISI program have been effective in detecting the intended aging effect of cracking for greater than NPS 1 and less than NPS 4. The expanded scope of inspection and improved inspection methods implemented by the new One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program will further improve the effectiveness of the ISI program to manage the aging effect of cracking. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the new One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program will be performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that the implementation of the One-Time Inspection of ASME Code Class 1 Small-Bore Piping aging management program will effectively identify cracking prior to failure.

Conclusion

The new One-Time Inspection of ASME Code Class 1 Small-Bore Piping program will provide reasonable assurance that the aging effect of cracking will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.23 External Surfaces Monitoring of Mechanical Components

Program Description

The External Surfaces Monitoring of Mechanical Components aging management program is a new condition monitoring program that directs visual inspections of external surfaces of components be performed during system inspections and walkdowns. The program consists of periodic visual inspection of metallic and elastomeric components such as piping, piping components, ducting, elastomeric components, and other components within the scope of license renewal. The program manages aging effects of metallic and elastomeric components through visual inspection of external surfaces for evidence of loss of material in air-indoor, air-outdoor, and air with borated water leakage environments. Visual inspections are augmented by physical manipulation as necessary for evidence of hardening and loss of strength.

Materials of construction inspected under this program include aluminum alloy, carbon steel, copper alloy, ductile cast iron, galvanized steel, gray cast iron, low alloy steel, and stainless steel. Examples of components this program inspects are piping and piping components, ducting, heat exchangers, tanks, pumps, expansion joints, and hoses. The inspection parameters for metallic components include material condition, which consists of evidence of rust, general, pitting and crevice corrosion, discoloration and coating degradation; evidence of insulation damage or wetting; leakage from piping, ducting, or component bolted joints. Coating degradation is used as an indicator of possible underlying degradation of the component. Inspection parameters for elastomeric components include hardening, discoloration, surface cracking, crazing, scuffing, exposure of internal reinforcement for reinforced elastomers, and dimensional changes.

The External Surfaces Monitoring of Mechanical Components program is a visual condition monitoring program that does not include preventive or mitigative actions. The monitoring methods are effective in detecting the loss of material, and hardening and loss of strength aging effects and the once per refueling cycle frequency of monitoring is adequate to prevent significant age-related degradation.

Inspections are performed at a frequency not to exceed once per refueling cycle. This frequency accommodates inspections of components that may be in locations that are normally only accessible during refueling outages. Surfaces that are not readily visible during plant operations and refueling outages are inspected when they are made accessible and at such intervals that would ensure the components intended functions are maintained.

Any visible evidence of degradation will be evaluated for acceptability of continued service. Acceptance criteria will be based upon component, material, and environment combinations. Deficiencies will be documented and evaluated under the corrective action program.

The external surfaces of components that are buried are inspected via the Buried and Underground Piping (B.2.1.28) program. The external surfaces of above ground tanks are inspected via the Aboveground Metallic Tanks (B.2.1.17) program. This program does not provide for managing aging of internal surfaces. The External Surfaces Monitoring of Mechanical Components program is a new program that will be implemented prior to the period of extended operation.

NUREG-1801 Consistency

The External Surfaces Monitoring of Mechanical Components aging management program will be consistent with the ten elements of aging management program XI.M36, "External Surfaces Monitoring of Mechanical Components," specified in NUREG-1801, as modified by LR-ISG-2011-03.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the External Surfaces Monitoring of Mechanical Components program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. In 2005, at Byron Unit 2, coating degradation and general corrosion was identified on the bottom of the ten-inch common extraction steam header for the first and second reheat continuous vents. This issue was entered into the corrective action program. The pipe was cleaned, an ultrasonic test was performed on 100% of the bottom area of the pipe to ensure that the pipe wall had not degraded to less than minimum wall thickness, and the pipe was recoated. The ultrasonic test results indicated that the pipe wall thickness was greater than the minimum wall thickness required. Pipe repair or replacement was not required and no followup inspection was determined necessary. As an extent of condition, the Unit 1 piping was inspected. Coating degradation and general corrosion were not identified on the Unit 1 piping.

   This example provides objective evidence that deficiencies found during inspection activities are documented in the corrective action program, and that inspection activity deficiencies are evaluated and corrective actions implemented to maintain component intended functions.

2. In 2008, at Byron Unit 2, surface corrosion was identified on a nitrogen accumulator supply and test connection isolation valve and associated piping. This issue was entered into the corrective action program. The corrosion was caused by water leaking onto the valve and piping. The water was coming from a pipe cap on a Unit 2 RHR heat exchanger test connection isolation valve, which is located directly above the nitrogen accumulator valve and associated piping. The corrosion was limited to the valve and piping located directly beneath this RHR heat exchanger test connection valve. The nitrogen accumulator supply and test connection isolation valve and associated piping were cleaned and repainted. The RHR heat exchanger test connection isolation valve and cap were replaced. No leaks were identified following replacement of the RHR heat exchanger test connection isolation valve and cap. No additional corrosion was identified on Unit 1 or Unit 2 nitrogen accumulator supply and test connections and associated piping.

   This example provides objective evidence that degradation found during inspection activities are effectively addressed by using the corrective action program, and that the cause of the issue is corrected in order to maintain component intended functions.

3. On October 19, 2007, the station was in the process of determining the extent of pipe wall thinning of the 24” Essential Service Water (SX) System pump discharge riser piping at the common SX cooling tower. While preparing to perform NDE of this piping, the station experienced a through wall leak in the “C” SX riser line. Appropriate LCO’s were entered and a shutdown was commenced for Byron Units 1 and 2. A dual unit forced outage was required to facilitate the necessary repairs. The condition was entered into the corrective action program and a root cause was performed to identify the cause and appropriate corrective actions. The corrosion-related failure was due to a failure to preserve and protect the carbon steel piping external surface from the corrosive environment of the Essential Service Water System. Based on the corrosion product compositions, the primary cause of the through wall holes was the long-term external exposure of the non-protected carbon steel pipe to the misting air/water cooling tower environment. The pipe was repaired, recoated, and the units returned to service. As a result of this failure, system walkdowns were performed on critical systems to identify components that required coating to protect the external surfaces. While many of the components are stainless steel and, therefore, do not require a coating, several hundred corrective action reports were written to document coating deficiencies. These walkdowns were performed for both units, including the auxiliary building, containment areas, and all Essential Service Water System vaults with piping in potentially moist environments. In addition, to prevent reoccurrence, the system walkdown template was revised to include identification of degraded coatings and corrosion on external surfaces of piping, bolting or equipment / components, with the requirement for corrective action reports to be written to document any identified equipment deficiencies on steel pipe. Additionally, enhancements to procedural guidance related to trending, tracking, identification threshold, and follow-up

action determination for safety related external pipe corrosion were implemented. In addition, organizational enhancements to improve management's decision-making ability affecting issue prioritization and driving timely completion of corrective actions were implemented.

This example provides objective evidence that degradation found during inspection activities are effectively addressed by using the corrective action program, and that additional inspection activities are performed for components of a similar material and environment in order to evaluate the extent of condition.

Braidwood Station

1. In 2006, surface corrosion was identified on the fire system deluge supply piping and supports leading to the Unit 1E and 1W main power transformers. This issue was entered into the corrective action program. The piping and supports leading to the Unit 1E and 1W main power transformers were cleaned and repainted. The corrosion was limited to the piping and supports from the turbine building outside wall to the transformer area. The piping at the transformers had recently been painted and, therefore, the piping and supports were not corroded. The cause of the corrosion was due to the outside air environment and the fact that the supply piping from the turbine building wall to the transformer area had not been painted at the same time as the piping at the transformers. These conditions were identified during the performance of the automatic deluge systems inspection surveillance, which is performed on a semi-annual frequency. Corrosion was not identified on the Unit 2E and 2W main power transformers deluge supply piping and supports that were inspected as part of the extent of condition review.

   This example provides objective evidence that deficiencies found during inspection activities are documented in the corrective action program, and that inspection activity deficiencies are evaluated and corrective actions implemented to maintain component intended functions.

2. In 2007, at Braidwood Unit 1, pitting was discovered on one of the four auxiliary feedwater pipe lines that supplies water to the steam generators. The affected piping is located in the auxiliary feedwater pipe tunnel. The pitting was observed next to the tunnel penetration to the main steam isolation valve room. As part of the corrective action program the pipe was cleaned, an ultrasonic test was performed on the pipe to ensure that the pipe wall had not degraded to less than minimum wall thickness, and the pipe was repainted. The ultrasonic test results indicated that the pipe wall thickness was greater than the minimum wall thickness required. Pipe repair or replacement was not required. As part of the extent of condition, the three remaining auxiliary feedwater lines in the auxiliary feedwater pipe tunnel were inspected in the same area. Three feet of insulation was removed from the pipes next to the penetration to the main steam isolation valve room. Visual inspection revealed light general corrosion on two of the lines, and light to medium corrosion on one of the lines within two feet of the

tunnel ceiling. There was no indication of any significant material wastage on any of the lines inspected. The three pipes were cleaned and repainted prior to the insulation being replaced. No leaks were identified on the piping. The corrosion was caused by condensation on the pipe surface. The auxiliary feedwater pipes are relatively cool as compared to the ambient temperature next to the main steam isolation valve room penetration, resulting in condensation forming on the outside of the pipe under the insulation. Application of the coating and re-insulating the affected sections of piping should prevent recurrence of the condition.

This example provides objective evidence that degradation found during inspection activities are effectively addressed by using the corrective action program, and that additional inspection activities are performed for components of a similar material and environment in order to evaluate the extent of condition.

3. In January of 2008, surface corrosion, as indicated by pitting and surface irregularities was identified on the outside surfaces on the common Essential Service Water (SX) piping and valves located in the Lake Screen House valve pits. The condition was entered into the corrective action program. These components are on the suction side of the SX pumps. The cause of the corrosion was due to the moist indoor air environment. The water in the pipes is relatively cool in comparison to the warmer humid conditions in the valve pit resulting in condensation forming on the surface of the pipe. NDE inspections to measure wall thickness were performed to verify that the measured minimum wall thickness was greater than the required minimum wall thickness. The results of the NDE inspections were satisfactory. The piping and valves were cleaned and recoated to prevent corrosion and protect the components from any future age-related degradation. All six of the valve pits, three on each unit, were inspected. Any surface corrosion identified was addressed on the piping and valves in each valve pit.

   This example provides objective evidence that degradation found during inspection activities are effectively addressed by using the corrective action program, and that additional inspection activities are performed for components of a similar material and environment in order to evaluate the extent of condition.

The above examples provide objective evidence that the new External Surfaces Monitoring of Mechanical Components is capable of both monitoring and detecting the aging effects of loss of material, and hardening and loss of strength. A review of the operating examples showed that deficiencies found during inspection activities are documented in the corrective action program. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where age-related degradation is found. Assessments of the External Surfaces Monitoring of Mechanical Components aging management program will be performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the External Surfaces Monitoring of Mechanical Components aging management program will effectively identify age-related degradation prior to failure.

Conclusion

The new External Surfaces Monitoring of Mechanical Components program will provide reasonable assurance that the loss of material, and hardening and loss of strength aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.24 Flux Thimble Tube Inspection

Program Description

The Flux Thimble Tube Inspection aging management program is an existing condition monitoring program that manages the loss of material in flux thimble tubes due to wear (i.e., wall thinning) in a reactor coolant environment. Flux thimble tubes, which provide a path for the in-core neutron flux monitoring system detectors, establish part of the reactor coolant pressure boundary and are subject to flow-induced fretting which causes wear. The program uses the non-destructive examination methodology of eddy current testing to periodically inspect the full length of all flux thimble tubes, which encompasses the path from the reactor vessel instrument nozzle to the fuel assembly instrument guide. The results of the periodic eddy current testing are evaluated and trended to determine if corrective actions are required or if the inspection frequency needs to be changed to ensure reactor coolant pressure boundary integrity is maintained. Acceptance criteria include allowances for factors such as instrument uncertainties and uncertainties in scar wear geometry. The Flux Thimble Tube Inspection aging management program establishes a maximum allowable wall loss of 60 percent before corrective actions are required. If the wall loss is greater than 60 percent but less than 80 percent corrective actions include repositioning, isolation, or flux thimble tube replacement. Flux thimble tubes that exhibit wall loss of greater than 80 percent are isolated or replaced. If inspection to inspection degradation wear rate data indicates that a flux thimble tube will exceed 80 percent wall loss prior to the next scheduled inspection, corrective actions include repositioning, isolation, or flux thimble tube replacement.

The Flux Thimble Tube Inspection program implements the recommendations of NRC IE Bulletin 88-09, “Thimble Tube Thinning in Westinghouse Reactors.”

NUREG-1801 Consistency

The Flux Thimble Tube Inspection aging management program is consistent with the ten elements of aging management program XI.M37, “Flux Thimble Tube Inspection,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Flux Thimble Tube Inspection program will be effective in ensuring that intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. The most recent eddy current testing of the Byron Station, Unit 1 flux thimble tubes was performed during the Byron Station, Unit 1 Fall 2009 Refueling Outage. Byron Station, Unit 1 flux thimble tube inspections are performed on a three (3) refueling outage frequency. No flux thimble tubes exceeded the specified acceptance criteria and the highest recorded wall loss was 24 percent. Two (2) flux thimble tubes have been removed from service due to an issue other than wear (displaced anti-vibration sleeves). One (1) flux thimble tube was removed from service in 2002 and the other in 1991.

   This example provides objective evidence that the Flux Thimble Tube Inspection program implements examinations using the methods and examination frequency recommended in the appropriate PWR guidelines.

2. The most recent eddy current testing of the Byron Station, Unit 2 flux thimble tubes was performed during the Byron Station, Unit 2 Fall 2008 Refueling Outage. Byron Station, Unit 2 flux thimble tube inspections are performed on a three (3) refueling outage frequency. Eddy current data for 31 flux tubes was obtained and no flux thimble tubes exceeded the specified acceptance criteria as the highest recorded wall loss was 26 percent.

   This example provides objective evidence that the Flux Thimble Tube Inspection program implements examinations using the methods and examination frequency recommended in the appropriate PWR guidelines.

Braidwood Station

1. Eddy current testing of the Braidwood Station, Unit 1 flux thimble tubes was performed during the Braidwood Station, Unit 1 Spring 2012 Refueling Outage. Braidwood Station, Unit 1 flux thimble tube inspections were performed on a one (1) refueling outage frequency. No flux thimble tube exceeded the specified acceptance criteria and the highest recorded wall loss was 49 percent. This test was an abbreviated examination in which 16 of the 58 flux thimble tubes were examined due to other under vessel work. The abbreviated scope was justified based on the inspection of all flux thimble tubes with greater than 20 percent wall loss as indicated by previous inspections, the maximum wear rate observed was 11 percent per cycle, and the highest wall loss detected was 49 percent. The performance of the abbreviated examination was entered into the corrective action program and the examination frequency for all flux thimble tubes remained as one (1) refueling outage frequency.

   This example provides objective evidence that the Flux Thimble Tube Inspection program implements examinations using the methods and examination frequency recommended in the appropriate PWR guidelines. Issues identified per this program did not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence.

2. Eddy current testing of the Braidwood Station, Unit 2 flux thimble tubes was performed during the Braidwood Station, Unit 2 Fall 2011 Refueling Outage. Braidwood Station, Unit 2 flux thimble tube inspections were performed on a two (2) refueling outage frequency. No flux thimble tubes exceeded the specified acceptance criteria and the highest recorded wall loss was 57 percent. During a review of the results it was noted that two (2) flux thimble tubes that had been in service for only one (1) cycle of operation exhibited excessive wear of 32 percent and 35 percent wall loss and one (1) flux thimble tube indicated higher than anticipated wear of 21 percent since the last inspection. These unexpected results were entered in to the corrective program and the examination frequency for all tubes was changed to every refueling outage. The full length of one (1) flux thimble tube could not be tested due to an obstruction. This flux thimble tube was entered in to the corrective action program and removed from service.

   This example provides objective evidence that the Flux Thimble Tube Inspection program implements examinations using the methods and examination frequency recommended in the appropriate PWR guidelines. For results obtained, appropriate guidance for evaluation, repair, or replacement is provided for locations where age-related degradation is found.

The above examples provide objective evidence that the Flux Thimble Tube Inspection aging management program is capable of both monitoring and detecting the aging effect of loss of material. A review of the operating examples showed that periodic eddy current testing of the flux thimble tubes has been successful in detecting flux thimble tube wear prior to loss of reactor coolant pressure boundary integrity. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where age-related degradation is found. Assessments of the Flux Thimble Tube Inspection aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that continued implementation of the Flux Thimble Tube Inspection aging management program will effectively identify degradation prior to failure.

Conclusion

The existing Flux Thimble Tube Inspection program provides reasonable assurance that the loss of material aging effect is adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.25 Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components

Program Description

The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components aging management program is a new condition monitoring program that manages the aging of the internal surfaces of piping, piping elements and piping components, ducting components, tanks, heat exchangers, and other components. This program will manage the aging effects of loss of material, reduction of heat transfer, and cracking for metallic components that are exposed to air - indoor uncontrolled, diesel exhaust, condensation, raw water, treated water, and waste water environments. This program will also manage the aging effects of loss of material and hardening and loss of strength for elastomeric components that are exposed to condensation, fuel oil, lubricating oil, and treated water environments. The program includes provisions for visual inspections of the internal surfaces of components not managed under other aging management programs, augmented by physical manipulation or pressurization to detect hardening or loss of strength of elastomers where appropriate. Inspections will be performed when the internal surfaces are made accessible during the performance of periodic surveillances, maintenance activities, and scheduled outages.

Identified deficiencies due to age-related degradation are documented and evaluated under the corrective action program. Acceptance criteria are established in the maintenance and surveillance procedures or are established during engineering evaluation of the degraded condition. If the inspection results are not acceptable, the condition is evaluated to determine whether the component intended function is affected, and a corrective action is implemented.

The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program will be implemented prior to the period of extended operation.

NUREG-1801 Consistency

The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components aging management program will be consistent with the ten elements of aging management program XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program will be effective in ensuring that intended functions will be maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron Station</u>

1. In 2003 and 2005, during scheduled periodic maintenance, the Unit 1 and Unit 2 auxiliary feedwater shaft-driven essential service water booster pump 6-inch discharge check valves (two total) were disassembled by maintenance and inspected by the valve engineer. The inspections revealed corrosion and degradation of the valve body and internals due to the raw water environment's aging effects. The check valves were replaced with in-kind check valves.

   Recognizing the repeated degraded conditions of these check valves, engineering developed a plan to replace the existing carbon steel check valves with stainless steel check valves. Under the corrective action program, the plan was presented to and approved by site management. The engineering and maintenance organizations planned to implement the check valve replacements during the next scheduled periodic disassembly and inspection PMs.

   In 2008, during the scheduled periodic disassembly and inspection work, the pre-approved design change to replace the carbon steel check valves with stainless steel check valves was implemented.

   Evaluating the extent of condition, engineering successfully sponsored a similar replacement of the Unit 1 and Unit 2 auxiliary feedwater check valves (two total) for the 3-inch return flow to the essential water system with stainless steel check valves.

   Since 2008, there have been no failed as-found inspections during the disassembly and inspection of these new stainless steel check valves. The identification and evaluation of this adverse trend provide objective evidence that site organizations will develop and implement appropriate corrective actions prior to the loss of component intended functions.

2. In July 2002, the System Manager noted periodic spiking of the Unit 2 containment sump input flow rates and corresponding level changes. Based on industry experience that obstructed containment floor drains could trigger this issue, a plan was developed to investigate the cause during the 2002 refuel outage. Initial troubleshooting performed in September 2002 identified foreign material in the reactor containment fan cooler (RCFC) drip

trays of the 2D RCFC. Recognizing the potential extent of condition, work orders were initiated to clean the drip trays on all four (4) Unit 2 RCFCs. All foreign material was removed from the forty (40) drip trays, and the drip trays were verified clean by engineering.

These findings on Unit 2 were entered into the corrective action program. As follow-up, the site initiated preventive maintenance work orders to periodically inspect and clean all of the Unit 1 and Unit 2 RCFC bank drip trays. These work orders are performed on a 36-month frequency and are designed to assure that the RCFC bank drip trays remain unobstructed.

This operating experience provides objective evidence that performance monitoring activities of containment sump parameters identified a degraded condition and resolved the issue. Additionally long-term corrective actions that included periodic inspections were established to avoid recurrence of the condition to assure no loss of component intended functions.

3. In May 2012, a maintenance history search going back to 1998 was performed for the Byron Station Engineered Safeguard Feature (ESF) pump cubicle coolers. The search was conducted to identify plant operating experience citing loss of material or reduction of heat transfer of safety-related pump cubicle cooler heat exchanger components in a condensation environment. The twenty-two (22) ESF pump cubicle coolers are draw-through type, and each of the twenty-two (22) ESF pump cubicle coolers is comprised of cooling coils and fans enclosed in steel-plate housing. ESF pump cubicle coolers are provided for the Chemical and Volume Control (centrifugal charging pumps) (CV), Safety Injection (SI), Residual Heat Removal (RH), Containment Spray (CS), Auxiliary Feedwater (AF), and Essential Service Water (SX) pump areas, and are designed to function during abnormal conditions to maintain a room temperature not exceeding the maximum design temperature.

   Plant operating experience has shown that, with proper maintenance, the aging effects of condensation are not aggressive on the carbon steel, aluminum, and copper materials in the safety-related pump cubicle coolers. The above maintenance history search for the period of 1998 to 2012 identified no age-related degradation issues of loss of material or reduction of heat transfer associated with components of the safety-related pump cubicle coolers in a condensation environment.

   There are instances where the accumulation of dirt or mechanical damage (bent fins) on safety-related pump cubicle components was identified and addressed in the corrective action program.

   Interviews with the Byron GL 89-13 program engineer confirmed that the safety-related pump cubicle coolers have not experienced a loss of material, reduction of heat transfer, or any other degradation on the carbon steel, aluminum, and copper components in the scope of this program.

   This operating experience provides objective evidence that existing maintenance activities for safety-related pump cubicle coolers monitor for degradation prior to loss of component intended function, and that potentially adverse component conditions are identified and addressed in the corrective action program.

Braidwood Station

1. In May 2012, a maintenance history search going back to 1998 was performed at Braidwood for the control room ventilation system to identify plant operating experience with loss of material or other age-related degradation on the internal surfaces of galvanized and carbon steel components. The control room ventilation system contains and processes air drawn directly from outdoors or air drawn from various plant areas. In the plenums where condensation is expected on the control room chilled water coils, the condensation is contained by collection and drain systems. Plant operating experience for components of the control room ventilation system indicates that the aging effects of a condensation environment on galvanized and carbon steel materials are not aggressive. The above maintenance history search for the period of 1998 to 2012 identified no age-related degradation issues associated with the control room ventilation system internal surfaces. The results of periodic internal inspections of the control room ventilation system plenums performed since 1998 indicate component conditions are satisfactory, and do not indicate internal surface corrosion or degradation. Interviews with the Braidwood control room ventilation system manager confirmed that the control room ventilation system has not experienced a loss of material or other age-related degradation on the internal surfaces for the galvanized and carbon steel components in the scope of this program.

   This operating experience example provides objective evidence that existing maintenance activities have monitored for internal degradation prior to loss of the control room ventilation system components intended functions.

2. In March 2012, the control room ventilation system manager identified an industry OPEX issue (OE35389), which applied to Braidwood Station. According to the industry operating experience, control room operators detected an acrid odor after a control room air handler was returned to service subsequent to its annual preventive maintenance. The control room air handler was removed from service and re-isolated, extending the duration of the Technical Specification LCO. Inspections revealed that a piece of insulation internal to the air handler enclosure had become dislodged and was rubbing on the air handler fan cage causing the odor detected by the control room operators. The insulation was retrieved, the air handler was inspected, and the control room ventilation train was returned to service.

   Based on the operating experience review, the system manager assessed the extent of condition by evaluating the control room ventilation system, the auxiliary building ventilation system, and the primary containment ventilation system. The system manager determined that only the control room ventilation system had insulation inside its plenums. The system manager recognized that the insulation internal to the enclosure of the Control Room Cooling Coil plenums could cause an issue similar to the industry operating experience issue. Knowing that the control room ventilation train plenums are inspected periodically, the system manager identified the issue in the corrective action program, and recommended revising the current preventive maintenance work orders to include inspection of the internal insulation.

By including the inspection of insulation inside both of the control room ventilation plenums, events similar to the industry operating experience event have not occurred. This identification, evaluation, and implementation of lessons learned based on industry operating experience provide objective evidence that engineering reviews of industry operating experience will identify and implement appropriate actions prior to the occurrence of a similar event at the site and the loss of component intended functions.

3. In May 2012, a maintenance history search going back to 1998 was performed for the Braidwood Station Engineered Safeguard Feature (ESF) pump cubicle coolers. The search was conducted to identify plant operating experience citing loss of material or reduction of heat transfer of safety-related pump cubicle cooler heat exchanger components in a condensation environment. The twenty-two (22) ESF pump cubicle coolers are draw-through type, and each is comprised of cooling coils and fans enclosed in a steel-plate frame/housing. ESF pump cubicle coolers are provided for the Chemical and Volume Control (centrifugal charging pumps) (CV), Safety Injection (SI), Residual Heat Removal (RH), Containment Spray (CS), Auxiliary Feedwater (AF), and Essential Service Water (SX) Pump areas, and are designed to function during abnormal conditions to maintain a room air temperature not exceeding the maximum design temperature.

   Plant operating experience has shown that, with proper maintenance, the aging effects of condensation are not aggressive on the carbon steel, aluminum, and copper materials in the safety-related pump cubicle coolers. The above maintenance history search for the period of 1998 to 2012 identified no age-related degradation issues of loss of material or reduction of heat transfer due to their service in a condensing environment.

   There are instances where the accumulation of boric acid residue, caustic or dirt on safety-related pump cubicle cooler components was identified and addressed in the corrective action program.

   Interviews with the Braidwood GL 89-13 Program Manager confirmed that the safety-related pump cubicle coolers have not experienced a loss of material, reduction of heat transfer, or any other degradation of the carbon steel, aluminum, and copper components in a condensation environment.

   This operating experience example provides objective evidence that the current maintenance program for safety-related pump cubicle coolers adequately monitors for degradation prior to loss of component intended function, and that potentially adverse component conditions are identified and addressed in the corrective action program.

The above examples provide objective evidence that the operating experience of the components in the new Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components aging management program did not show any adverse trends in performance. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that the implementation of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program will effectively identify degradation prior to failure.

Conclusion

The new Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.26 Lubricating Oil Analysis

Program Description

The Lubricating Oil Analysis aging management program is an existing preventive and mitigative program that ensures the oil environment in mechanical systems subject to aging management review is maintained to the required quality to prevent or mitigate age-related degradation of components within the scope of this program. The Lubricating Oil Analysis program maintains oil systems contaminants within acceptable limits through periodic sampling and analysis, and comparing the analytical results to pre-determined limits that are associated with corrective actions such as filtering or oil replacement in order to manage the aging effects of loss of material due to corrosion or reduction of heat transfer due to fouling. The program directs scheduled activities that include routine sampling, analyses, and trending, thereby, preserving an oil environment in piping, piping components, piping elements, valve bodies, pump casings, gear boxes, tanks, and heat exchangers that is not conducive to loss of material or reduction of heat transfer. The lubricating oil testing (sampling and analysis) and condition monitoring activities identify detrimental contaminants such as water, sediments, specific wear elements, and elements from an outside source. The oil contaminant levels (e.g., water and particulates) are trended. Any result that is outside of the acceptance criteria is entered into the corrective action program to evaluate the condition, which could include in-leakage or corrosion product buildup, and implement corrective actions such as component repairs, filtering, or oil replacement to maintain the lubricating oil contaminants within acceptable limits.

To verify the effectiveness of the Lubricating Oil Analysis program, selected components will be inspected as described in the One-Time Inspection (B.2.1.20) program, to ensure that age-related degradation is not occurring and component intended functions are maintained during the period of extended operation.

NUREG-1801 Consistency

The Lubricating Oil Analysis aging management program is consistent with the ten elements of aging management program XI.M39, “Lubricating Oil Analysis,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Lubricating Oil Analysis program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. In March 2012, a routine oil sample was taken from the 0A essential service water make-up pump diesel crankcase. The oil sample analysis results showed an elevated silicon level at 21 ppm. The "alert" level is 20 to 30 ppm. An alert level indicates that there is an adverse trend or deviation from normal operating conditions, but there is a low probability of damage or failure of the equipment. Silicon levels are an indication of the amount of dirt, grit, anti-foam agents, seals, grease, gasket sealants, or other coolant additives present in the oil. This condition was entered into the corrective action program. All the other oil parameters were at normal and acceptable levels. The lab retested the oil sample and confirmed the test results. An analysis of the historical oil sample results and trends of both 0A and 0B essential service water make-up pump diesels showed that the silicon levels in the crankcase oil increases linearly about 2 to 5 ppm per quarter with normal diesel engine service. The condition of the crankcase oil was evaluated to be acceptable for continued use until the scheduled oil change in June 2012. The 0A essential service water make-up pump diesel crankcase oil was changed with new oil that met all required specifications in June 2012. The old oil was analyzed and the results were similar to the March 2012 oil analysis results with elevated silicon levels and all other parameters at normal acceptable levels.

   This example provides objective evidence that the Lubricating Oil Analysis program is capable of monitoring critical lubricating oil parameters, recognizing a potential condition adverse to quality, and implementing appropriate actions to maintain the quality of the component lubricating oil.

2. In April 2011, a routine oil sample was taken from the 1A containment chiller oil sump. The oil sample analysis results showed a decrease in oil viscosity to 47.9 Centistokes @ 40C. The normal range for this oil type is 61.2 to 74.8 Centistokes @ 40C. This condition was entered into the corrective action program for evaluation and trending. An analysis of the historical oil sample results and trends of the other three (1B, 2A, and 2B) containment chiller oil sample results showed that a decrease in viscosity is expected during the service life of the oil. The oil viscosity decreases because freon gets entrained in the lubricating oil during normal chiller operation. All the other oil parameters were at normal acceptable levels. The condition of the chiller oil was evaluated to be acceptable for continued use until the scheduled oil change in January 2012. The 1A containment chiller oil was changed out with new oil that met all required specifications in January 2012. The old oil was sampled and analyzed and the results showed that the old oil quality was still acceptable for continued use in the chiller.

This example provides objective evidence that the Lubricating Oil Analysis program is capable of monitoring critical lubricating oil parameters, recognizing a potential condition adverse to quality, and implementing appropriate actions to maintain the quality of the component lubricating oil.

3. In July 2010, a review of routine monthly oil samples for the 1B diesel generator crank case oil per the lubricating oil analysis program revealed an unexpected increase in copper content in the diesel crankcase oil. The copper content in the diesel crankcase oil had trended up from 4 ppm to 13 ppm since the last oil change in December 2008. The “alert” level for copper is 10 to 20 ppm. All the other oil parameters were within the normal acceptance limits. This issue was entered into the corrective action program. The diesel was still operable since the oil parameters were all within their acceptance limits. The copper content in the other diesel generators (1A, 2A, and 2B) were steady, therefore, the extent of condition was limited to the 1B diesel generator. The initial investigation to determine the possible source of the copper in the 1B diesel crankcase oil was conducted using industry operating experience and collaboration with other industry subject matter experts, including the diesel vendor. For example, the oil analysis guidelines published by the Cooper Bessemer Owners Group explains that elevated copper levels in the lubricating oil is indicative of wear in various copper containing parts such as wrist pin, piston pin bushings, cam and main and rod bearings. The Exelon Oil Analysis Interpretation Guideline explained that a possible source could be copper from the oil cooler tubes. Finally, an Exelon subject matter expert suggested that the copper temperature elements for the oil cooler temperature control valves could be a source. All of this information was used to augment the upcoming 1B diesel generator work window to specifically examine those diesel components that contain copper. The 1B diesel generator was inspected in November 2010. The maintenance technicians implemented the augmented inspection plan, which directed a detailed search for worn or broken bronze pieces. The source of copper was identified as coming from a broken piston wrist pin bushing. The piston, wrist pin, and bushing were replaced. All the other piston wrist pin bushings were inspected and found to be in good condition. The cause of the piston wrist pin bushing to break was most likely due to excessive long term wear of the piston wrist pin bushing. The diesel maintenance work was completed with no other discrepancies. The 1B diesel generator was tested satisfactorily and has performed well since the repair. The subsequent 1B diesel generator crankcase oil samples from December 2010 to August 2012 have shown the copper levels to be acceptable.

   This example provides objective evidence that the Lubricating Oil Analysis program, the operating experience program, and the corrective action program is able to recognize a potential condition adverse to quality so that degraded conditions are identified and corrected prior to equipment failure.

Braidwood Station

1. A Focused Area Self-Assessment (FASA) was performed for the Braidwood

lubrication sampling program in 2005. The FASA identified deficiencies in the administration of the trending software program in accordance with corporate procedures and standards. Specifically, there were inconsistencies between the oil sample parameter alarm limits in the lubricating oil trending software and the Exelon Oil Analysis Interpretation Guideline. This inconsistency was causing many components to be in a “red” status when no adverse condition existed. A “red” status means that action is required to resolve the abnormal oil parameter condition. This issue was entered into the corrective action program. The Braidwood lubrication oil program coordinator resolved the discrepancies by aligning the oil sample parameter data set alarm limits in the trending software program to those that were explicitly defined in the oil analysis interpretation guideline. As a result, many components that were incorrectly marked as being in a “red” status were adjusted to a “green” status. A “green” status means that the oil parameter is in the normal acceptance band. This improvement to the trending software program eliminated many “false” alarms regarding the monitoring of component lubricating oil trends at Braidwood.

This example demonstrates that the results of self assessments and the corrective action program are used to enhance the Braidwood Lubricating Oil Analysis program.

2. In May 2005, a routine oil sample analysis of the 2B centrifugal charging pump gearbox oil showed a copper level of 35 ppm, which was greater than the acceptance criteria of 30 ppm. A review of previous oil sample results revealed that the copper content in the 2B centrifugal charging pump gearbox oil had jumped up from 3 ppm to 35 ppm over the prior six months. All the other oil parameters were within the normal acceptance limits. This issue was entered into the corrective action program. The centrifugal charging pump was still operable because the other oil parameters were all within their acceptance limits, the pump vibration analysis was normal, and the pump thermography analysis was normal. The copper content in the other centrifugal charging pumps (1A, 1B, and 2A) were within specifications, therefore the extent of condition was limited to the 2B centrifugal charging pump. An adverse condition monitoring plan was implemented to more closely monitor the performance of the 2B centrifugal charging pump until the maintenance work could be performed on the gearbox. The gearbox oil temperature and oil pressure was monitored frequently while the pump was operating. Vibration signatures and thermography images were taken more frequently. The initial determination of the possible source of the copper in the 2B centrifugal pump gearbox oil used industry operating experience, lubricating oil analysis guidelines, and collaboration with other subject matter experts. For example, the oil analysis interpretation guideline explained that possible sources of the copper include wear from journals, rolling element bearing retainers, oil cooling coils, oil additive, bushings, thrust bearings and washers, or slinger rings. It was determined that the most likely source of the copper is from wear of the bronze components in the gearbox. The 2B centrifugal charging pump gearbox was inspected in July 2006. The source of copper was

identified as coming from a high speed bearing that was found with its babbit worn away. The high speed bearing was replaced. All the other bearings were inspected and found to be in good condition. The cause of the missing babbit on the high speed bearing was most likely due to excessive long term wear of the shaft on the bearing. The remaining 2B centrifugal charging pump work was completed with no other discrepancies. The subsequent 2B centrifugal charging pump gearbox oil samples have shown the copper levels to be normal levels at less than 30 ppm.

This example provides objective evidence that the Lubricating Oil Analysis program and the corrective action program is able to recognize a potential condition adverse to quality so that degraded conditions are identified and corrected prior to equipment failure.

3. In June 2005, a sample of the 1B diesel generator governor oil was taken and analyzed as part of newly implemented portion of the 1B diesel generator predictive maintenance plan. The oil analysis results showed that the oil viscosity at 115.7 Centistokes which is below the minimum acceptance criteria of 120 Centistokes for the oil brand analyzed. This issue was entered into the corrective action program. All of the other diesel generator (1A, 2A, and 2B) governor oil sample results were normal, so the issue was limited to the 1B diesel generator governor. The subsequent engineering evaluation, which included discussions with the diesel generator governor vendor, determined that the “as found” oil viscosity was within the diesel governor vendor requirements (10 to 600 Centistokes) but was out of specification for the oil brand used in the governor. As a result, there was no adverse impact to the operation of the 1B diesel generator governor. The oil in the 1B diesel generator governor was flushed out and replaced with new oil. The 1B diesel generator governor operated satisfactory before this event and continued to operate satisfactorily after the governor oil replaced with new oil. The 1B diesel generator governor oil sampling frequency was increased to more closely monitor the governor oil quality. A sample of the 1B diesel generator governor oil was taken again in August 2005. The governor oil change was effective because the oil sample analysis showed the oil viscosity to be within the acceptance limits. Given that the diesel generator governors are replaced every ten years with factory refurbished governors as part of the diesel generator preventive maintenance program, the most likely cause of the reduced oil viscosity was due to residual solvent inside the governor used at the factory. A follow up 1B diesel generator governor oil sample was taken and analyzed in February 2006. All of the lube oil parameters were within the acceptance criteria. The 1B diesel generator governor oil sampling frequency was restored to its normal frequency.

   This example provides objective evidence that the Lubricating Oil Analysis program and the corrective action program ensures that appropriate acceptance criteria and sampling frequencies are established for monitoring lube oil quality so that degraded conditions are identified and corrected prior to equipment failure.

The above examples provide objective evidence that the existing Lubricating Oil Analysis program is capable of ensuring that the oil environment in mechanical systems is maintained to the required quality. The sampling activities and corrective actions being implemented by the program have been proven effective in mitigating aging effects including loss of material and reduction of heat transfer. Appropriate guidance for evaluation is provided for locations where deviations from the lubricating oil parameter limits are found. Assessments of the Lubricating Oil Analysis program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that continued implementation of the Lubricating Oil Analysis program will effectively identify age-related degradation prior to failure.

Conclusion

The existing Lubricating Oil Analysis program provides reasonable assurance that the loss of material and reduction of heat transfer aging effects are adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.27 Monitoring of Neutron-Absorbing Materials Other than Boraflex

Program Description

The Monitoring of Neutron-Absorbing Materials Other than Boraflex aging management program is an existing condition monitoring program that periodically inspects and analyzes test coupons of the Boral material in the spent fuel storage racks to determine if the neutron-absorbing capability of the material has degraded over time. This program ensures that a five (5) percent sub-criticality margin in the spent fuel pool is maintained during the period of extended operation by monitoring for loss of material, changes in dimension, and loss of neutron-absorption capacity of the Boral material.

The Monitoring of Neutron-Absorbing Materials Other than Boraflex aging management program monitors changes in condition of the Boral material in the spent fuel storage racks through visual inspections, dimensional measurements, neutron-attenuation testing, and weight and specific gravity measurements of representative test coupons. The test coupons are mounted in a vented stainless steel jacket, simulating as nearly as possible, the actual in-service geometry, physical mounting, and flow conditions of the Boral in the storage racks. The primary measurements used to characterize performance of the Boral coupons are thickness measurements (to detect bulging or swelling) and neutron-attenuation testing (to confirm the boron-10 areal density). Results of each coupon surveillance are documented and retrievable for purposes of trending. Acceptance criteria thresholds are established as indicators of potential adverse trends in the condition of the Boral material so as to ensure corrective actions are taken prior to compromising the five (5) percent sub-criticality margin as contained within the spent fuel pool criticality analysis.

The acceptance criteria for coupon surveillances are for neutron-attenuation results to show that no more than a five (5) percent decrease in boron-10 areal density has occurred, and that dimensional measurements show that an increase in thickness at any point does not exceed 10 percent of the initial thickness at that point. These criteria are established with the intent of being indicators of potential degradation that could lead to challenges to the five (5) percent sub-criticality margin. Failure to meet the established criteria, results in the condition being entered in the corrective action program.

The existing coupon inspection frequency ensures at least one (1) coupon is examined during each 10 year period, beginning 10 years prior to the period of extended operation, for both Byron and Braidwood Stations.

NUREG-1801 Consistency

The Monitoring of Neutron-Absorbing Materials Other than Boraflex aging management program is consistent with the ten elements of aging management program XI.M40, "Monitoring of Neutron-Absorbing Materials Other than Boraflex," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Monitoring of Neutron-Absorbing Materials Other than Boraflex program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

Byron and Braidwood Stations

1. In 2009, the NRC published Information Notice (IN) 2009-26, “Degradation of Neutron-Absorbing Materials in the Spent Fuel Pool,” to alert licensees of a trend in adverse findings relative to a variety of neutron-absorbing materials. Included in those materials experiencing degradations was Boral. One of the common degradations, and aging effects that require management, was a change in dimension of the Boral as seen through blistering of the Boral material and bulging of the racks.

   Blistering of the material is a result of the aluminum cladding separating from the inner boron-aluminum matrix due to hydrogen gas generation from the material’s submersion in the spent fuel pool water. Blistering of the Boral material does not affect the material’s ability to absorb neutrons. Bulging of the racks occurs when the generated hydrogen gas is trapped within the stainless steel sheathing of the Boral, resulting in dimensional changes of the rack and cells. The concern in each case is that if the racks are unvented, the hydrogen gas generated can become trapped and displace water, reduce dimensions of flux traps, if included in the design, and ultimately challenge the dimensional assumptions used in the spent fuel pool criticality analysis. The spent fuel pool racks at Byron and Braidwood Stations are vented. Therefore, any hydrogen generation from the Boral material’s submersion in the spent fuel pool water will not result in dimensional changes to the racks, gas displacement of water, and changes in the dimensional assumptions used in the spent fuel pool criticality analysis. Furthermore, test coupons are installed in the spent fuel pool mimicking the actual in-service mounting and environmental conditions of the racks. These test coupons are periodically inspected, including visual examinations for evidence of blistering and swelling. Of the five coupons tested at Byron Station and four coupons tested at Braidwood Station since installation of the racks, no evidence of blistering has been observed.

   Another potential degradation concern, based on industry operating experience, relating to Boral is the potential loss of material. As documented in NUREG-1801 Revision 2, XI.M40, Element 10, example 1, increases in the aluminum concentration in the spent fuel pool water chemistry of another applicant were observed following installation of their Boral spent fuel racks. Increases in the aluminum concentration in the spent fuel pool water can be an indicator of loss of material of the Boral material. Byron and Braidwood Stations perform water chemistry sampling and testing for aluminum concentrations in the spent fuel pool once a month. A review of the last six years of sampling data did not identify any instances of aluminum concentrations exceeding acceptance criteria or otherwise indicating loss of material of the Boral material is a concern.

This example provides objective evidence that the degradation phenomena documented in known industry operating experience events, as discussed above, are not occurring at Byron and Braidwood Stations. Swelling and bulging of spent fuel pool storage racks is not a concern due to the vented design of the racks. Spent fuel pool water chemistry monitoring has not indicated a loss of material of the aluminum and aluminum-carbide constituents of the Boral material. Therefore, there is sufficient confidence that the Boral neutron-absorber material in the spent fuel storage racks will continue to perform its intended function.

Byron Station

1. In 2007, a Boral coupon was pulled from the spent fuel pool for testing and inspection. Inspections of coupons include visual examination for evidence of blistering and pitting, length, width, and thickness measurements, neutron-attenuation testing for boron-10 content, and weight and specific gravity measurements. Acceptance criteria include an increase in thickness of no more than 10%, and no more than a 5% decrease in boron-10 concentration. The other measurements provide supplementary information for comparison and trending. The results of the 2007 coupon inspection indicated a 1-4% increase in thickness at the multiple points measured on the coupon, therefore meeting acceptance criteria. The results of the neutron-attenuation testing indicated a 5.28% decrease in boron-10 concentration, therefore exceeding the acceptance criteria by 0.28%. This condition was entered into the corrective action program for evaluation.

   As part of the corrective actions taken, the results of the coupon surveillance, as well as other previous coupon inspection data from both Byron and Braidwood Stations, were sent to the spent fuel rack manufacturer for evaluation. Based upon the manufacturers' review of data, it was concluded that the non-conforming coupon results was likely attributed to measurement uncertainty and differences in measurement equipment and techniques between the pre-irradiated and post-irradiated coupon data. Although the boron-10 content did not meet acceptance criteria based on the nominal pre-irradiated data, it still exceeded the minimum required boron-10 content assumed in the spent fuel pool criticality analysis. In order to eliminate uncertainties between pre-irradiated data and post-irradiated data, and to establish a more accurate trend in the boron-10 content of the failed coupon, it was recommended by the manufacturer to return the Boral test coupon to the spent fuel pool for subsequent testing. The Boral coupon was returned to the spent fuel pool and subsequent testing is planned. Furthermore, another coupon was tested in 2010 and all acceptance criteria were met satisfactorily. As a result, Boral coupons will continue to be inspected in accordance with the manufacturers' recommended frequency. Based upon the results of the three coupons inspected prior to 2007, as well as the fifth coupon inspected in 2010, the recommended frequency is sufficient to detect degradations of the Boral neutron-absorber material prior to a loss of intended function. The next coupon inspection is scheduled for the Fall of 2014.

This example provides objective evidence that Byron Station has implemented a Boral monitoring program capable of detecting degradations of the neutron-absorber material used in the spent fuel pool racks. The existing program contains acceptance criteria that will identify adverse trends in the ability of the Boral material to absorb neutrons prior to a loss of intended function so as to ensure the assumptions in the spent fuel pool criticality analysis remain valid. When acceptance criteria are not met, the condition is entered in the corrective action program for evaluation. Corrective actions are developed to ensure the assumptions of spent fuel pool criticality remain valid.

2. In Spring of 2010, a Boral test coupon was removed from the common Byron spent fuel pool for testing. This was the fifth coupon test since installation of the high density Boral spent fuel pool racks in 2000. Testing of the Boral coupon included visual inspections for evidence of blistering and pitting, weight and specific gravity measurements, neutron-attenuation testing for boron-10 content, and dimensional measurements for height, length, and thickness. The test coupons are mounted in a vented stainless steel jacket, simulating as nearly as possible, the actual in-service geometry, physical mounting, and flow conditions of the Boral in the storage racks. Visual examination of the test coupon identified no evidence of blistering or pitting on the coupon. The measurements for coupon thickness and boron-10 content were compared to values taken prior to submersion in the spent fuel pool and irradiation. The acceptance criteria consists of no more than a 10% increase in thickness and no more than a 5% reduction in boron-10 content. Both of these criteria were found satisfactory. The change in thickness of the coupon was reported as a decrease of 3%, attributed to removal of the oxide film during decontamination, and the average boron-10 areal density taken at five locations on the coupon exhibited no change from the pre-irradiated value. As a result, Byron Station will continue coupon testing in accordance with the manufacturers recommended frequency. The next scheduled coupon inspection is planned for 2014.

   This example provides objective evidence that Byron Station has implemented a Boral monitoring program that periodically inspects representative test coupons for parameters that will ensure the Boral poison panels in the spent fuel pool racks continue to perform their intended function. This example also demonstrates that the Boral spent fuel racks continue to maintain the sub-criticality margin of the spent fuel pool.

Braidwood Station

1. In April 2003, it was identified that Braidwood Station was not performing accelerated irradiation of the Boral coupon tree in accordance with the manufacturers' recommendations. The manufacturers' recommendations included surrounding the coupon tree with freshly discharged fuel assemblies on all eight sides following the first five refueling cycles, of a single unit, after installation of the racks. The new high density Boral spent fuel pool racks were installed in the common Braidwood spent fuel pool in the Spring of 2001. Following the Unit 1 Fall 2001 refueling outage, freshly discharged fuel assemblies were placed on all eight sides of the coupon tree. Approximately three months later in January 2002, three fuel assemblies surrounding the coupon tree were removed and not replaced.

   In April 2003, this condition was discovered and entered into the corrective action program. As a result, the coupon tree was relocated to a location where it was surrounded on all eight sides by fuel recently discharged from Unit 2 following its last refueling outage in early 2002. Approximately one month later, at the conclusion of the Unit 1 refueling outage in May 2003, the coupon tree was again relocated and surrounded on all eight sides by recently discharged Unit 1 fuel assemblies to resume the accelerated irradiation plan as originally directed by the manufacturer. In addition, work orders were created for the next three Unit 1 refueling outages to ensure the coupon tree was surrounded on all eight sides by recently discharged fuel assemblies. These work orders ensured compliance with the manufacturers' recommendations to maintain the coupon tree surrounded by recently discharged fuel assemblies through at least the fifth refueling cycle following installation of the spent fuel racks.

   This example provides objective evidence that when adverse findings or deficiencies are identified, they are entered into the corrective action program for resolution and corrective actions are initiated within a timely manner. In addition, this example provides evidence that Braidwood Station has performed accelerated irradiation of its Boral coupons to ensure they remain representative of the radiation exposure of the individual Boral spent fuel rack walls.

2. In Spring of 2009, a Boral test coupon was removed from the common Braidwood spent fuel pool for testing. This was the fourth coupon test since installation of the high density Boral spent fuel pool racks in 2001. Testing of the Boral coupon included visual inspections for evidence of blistering and pitting, weight and specific gravity measurements, neutron-attenuation testing for boron-10 content, and dimensional measurements for height, length, and thickness. The test coupons are mounted in a vented stainless steel jacket, simulating as nearly as possible, the actual in-service geometry, physical mounting, and flow conditions of the Boral in the storage racks. Visual examination of the test coupon identified no evidence of

blistering or pitting on the coupon. The measurements for coupon thickness and boron-10 content were compared to values taken prior to submersion in the spent fuel pool and irradiation. The acceptance criteria consists of no more than a 10% increase in thickness and no more than a 5% reduction in boron-10 content. Both of these criteria were found satisfactory. The change in thickness of the coupon was reported as a decrease of 2.3%, attributed to removal of the oxide film during decontamination, and the average boron-10 areal density taken at five locations on the coupon exhibited no change from the pre-irradiated value. As a result, Braidwood Station will continue coupon testing in accordance with the manufacturers' recommended frequency. The next scheduled coupon inspection is planned for 2013.

This example provides objective evidence that Braidwood Station has implemented a Boral monitoring program that periodically inspects representative test coupons for parameters that will ensure the Boral poison panels in the spent fuel pool racks continue to perform their intended function. This example also demonstrates that the Boral spent fuel racks continue to maintain the sub-criticality margin of the spent fuel pool.

The operating experience relative to the existing Monitoring of Neutron-Absorbing Materials Other than Boraflex program did not identify an adverse trend in performance. The above examples provide objective evidence that the inspection methods being implemented by the program have been proven effective in detecting the aging effects of reduction of neutron absorbing capacity, change in dimensions, and loss of material. Appropriate guidance for evaluation, repair, or replacement is provided for locations where degradation is found. Therefore, there is sufficient confidence that continued implementation of the Monitoring of Neutron-Absorbing Materials Other than Boraflex program will effectively identify degradation prior to failure or loss of intended function during the period of extended operation.

Conclusion

The existing Monitoring of Neutron-Absorbing Materials Other than Boraflex program provides reasonable assurance that the reduction of neutron absorbing capacity; change in dimensions and loss of material aging effects are adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.28 Buried and Underground Piping

Program Description

The Buried and Underground Piping aging management program is an existing preventive, mitigative, and condition monitoring program that manages the external surface aging effects for buried and underground piping. The program manages aging through preventive, mitigative, and inspection activities for piping and components within the scope of license renewal. It manages the aging effects of loss of material at Byron and Braidwood Stations, as well as cracking and change in material properties (e.g., cracking, blistering, and change in color) at Braidwood Station only.

The Buried and Underground Piping aging management program includes preventive and mitigative techniques, such as external coatings for external corrosion control, the application of cathodic protection, and the quality of backfill utilized. The program also relies on periodic inspection activities, including visual examination of buried and underground piping, manual examination of polymeric materials, and electrochemical verification of the effectiveness of the cathodic protection system. Directed inspections of buried and underground piping are planned based on categorization criteria contained in LR-ISG-2011-03, “Changes to the Generic Aging Lessons Learned (GALL) Report Revision 2 Aging Management Program XI.M41, ‘Buried and Underground Piping and Tanks.’” Buried and underground piping are opportunistically inspected by visual means whenever they become accessible.

The Fire Protection System was installed in accordance with National Fire Protection Association (NFPA) Standard 24. Aging management of the buried Fire Protection System piping will be accomplished through performance of annual system leakage surveillances. Any abnormal system leakage beyond baseline acceptance criteria will be investigated, and the location, source, and cause of the abnormal leakage identified in the system. Therefore, directed inspections of fire protection piping are not required.

Byron and Braidwood Stations do not have any buried or underground tanks within the scope of license renewal.

The program will be enhanced as described below to provide reasonable assurance that buried and underground piping and components, constructed of steel, stainless steel, and polymeric materials at Byron and Braidwood Stations will perform their intended function during the period of extended operation.

NUREG-1801 Consistency

The Buried and Underground Piping aging management program will be consistent with the ten elements of aging management program XI.M41, “Buried and Underground Piping and Tanks,” specified in NUREG-1801 and as modified by LR-ISG-2011-03, with the following exceptions:

Exceptions to NUREG-1801

1. NUREG-1801, Chapter XI.M41, as modified by LR-ISG-2011-03, states buried carbon steel pipe should be coated in accordance with Table 1 of NACE SP0169-2007. Buried piping and components embedded in reinforced concrete are not coated (Byron only).
   Program Elements Affected: Preventive Actions (Element 2)

   Justification for Exception

   Original plant specifications do not require coatings to be installed for carbon steel piping embedded in reinforced concrete. The reinforced concrete provides superior corrosion protection for the embedded piping such that coatings are not necessary. Given the inaccessibility of piping embedded in concrete, installation of new coatings is not practical. However, upon opportunistic excavation, the condition of the concrete which encases the piping shall be examined for indications of degradations that could adversely impact the embedded piping. Recent opportunistic inspections of below grade reinforced concrete surfaces at Byron and Braidwood Stations have shown the reinforced concrete to be in good condition. Additionally, direct inspections of buried piping fully backfilled in controlled low strength material has shown the cementitious material to be in good condition and providing superior protection for the piping. Therefore, there is reasonable assurance that the components embedded in reinforced concrete will continue to perform their intended function.

2. NUREG-1801, Chapter XI.M41, as modified by LR-ISG-2011-03, states underground carbon steel pipe should be coated in accordance with Table 1 of NACE SP0169-2007. Underground carbon steel Service Water System piping at Braidwood Station is coated with a Kevlar fiber reinforced epoxy coating system. Epoxy coatings are not included in Table 1 of NACE SP0169-2007 (Braidwood only).
   Program Elements Affected: Preventive Actions (Element 2)

   Justification for Exception

   Each of the two Service Water discharge pipes pass through an approximately eight (8) foot long valve vault prior to discharging back into the essential service water cooling pond. Each of these segments of pipe is coated with BIO-GARD 258, manufactured by Thin Film Technology, Inc. BIO-GARD 258 is a liquid epoxy polymer based coating that is reinforced with Kevlar fibers. It is an anticorrosive coating used in marine and “heavy-duty” industrial chemical applications, which are considered more aggressive environments than the Service Water valve vaults. Therefore, this coating system will provide adequate corrosion protection to the underground carbon steel Service Water System piping. Additionally, the program has been enhanced, consistent with LR-ISG-2011-03, to ensure that each underground segment will be inspected at least once every 10 years, beginning 10 years prior to the period of extended operation. These inspections will verify the adequacy of corrosion protection provided by the BIO-GARD 258 Kevlar fiber reinforced epoxy coating system.

3. NUREG-1801, Chapter XI.41, as modified by LR-ISG-2011-03, states in Table 4a that piping constructed of stainless steel or polymeric materials, when backfilled in accordance with Table 2a, should be inspected once during each 10 year period, beginning 10 years prior to entering the period of extended operation. Braidwood Station will perform one (1) direct inspection within the first 10 years during the period of extended operation on HDPE polymeric piping, with stainless steel piping elements, which are within the scope of license renewal (Braidwood only). **Program Elements Affected: Detection of Aging Effects (Element 4)**

   Justification for Exception

   In 2008, Braidwood Station excavated and cut a buried carbon steel Main Condensate and Feedwater system pipe at both ends of a nonsafety-related building under which it ran. An HDPE polymeric pipe sleeve was inserted through the portion of the carbon steel pipe that is under the building. On each side of the building, the HDPE pipe was connected to a stainless steel piping component reducer and welded to the remaining upstream and downstream portions of the original carbon steel pressure boundary portion of piping. In each location, the HDPE piping is directly exposed to soil for less than 10 linear feet where it exits the cut ends of the former carbon steel pressure boundary piping.

   Prior to backfilling, the stainless steel piping reducers were coated with a silicon-ceramic coating and polymeric tape wrap. The HDPE polymeric and stainless steel piping and components were backfilled using compacted sand placed within six (6) inches of the pipe. HDPE polymeric materials are highly corrosion resistant materials in a variety of environments, including buried and underground, where aging effects are not expected to occur. Stainless steel has also shown superior corrosion resistance in buried applications when effective preventive measures, including coatings and backfill, are utilized.

   Therefore, given the recent installation of these components in 2008, their inherent superior corrosion resistant characteristics, and the preventive measures applied during installation; one confirmatory direct visual inspection will be performed within the first 10 years of the period of extended operation on the buried HDPE polymeric and stainless steel piping and piping components within the scope of license renewal. The confirmatory direct inspection will verify the absence of any age-related degradation and ensure the components are capable of maintaining their intended functions through the end of the period of extended operation.

4. NUREG-1801, Chapter XI.M41, as modified by LR-ISG-2011-03, allows for alternatives to direct inspections of buried fire protection piping. These alternatives include annual system flow testing and monthly monitoring of fire protection jockey pumps. Aging management of the buried Fire Protection System piping at Byron and Braidwood Stations will be accomplished through annual Fire Protection System leakage testing. **Program Elements Affected: Preventive Actions (Element 2), Detection of Aging Effects (Element 4)**

   Justification for Exception

   Fire Protection System leakage testing at Byron and Braidwood Stations is performed on an annual basis. Testing is accomplished by initially running the jockey pump to achieve an elevated and constant system pressure. This pressure is documented, the jockey pump operation is terminated, and the pressure decrease over the duration of the test, typically one hour, is monitored for any abnormal pressure decrease. At the conclusion of the test, the final pressure and surveillance time is recorded. The pressure decay rate is calculated and compared to baseline decay rate acceptance criteria. When the pressure decay rate exceeds the baseline acceptance criteria, investigation is required by procedure. Investigation includes isolation of sections of the Fire Protection System and repetition of the test until the location, source, and cause of the abnormal pressure decay is identified in the system. This method and frequency is consistent with the intent of crediting flow tests performed in accordance with Section 7.3 of NFPA 25, as allowed for in NUREG-1801, Chapter XI.M41 and LR-ISG-2011-03. Annual system leakage testing is capable of detecting significant leakage prior to a loss of system intended function, thus ensuring delivery of sufficient flow at sufficient pressure for fire suppression requirements.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Perform manual examinations, in addition to visual inspections, to detect hardening, softening, or other changes in material properties for buried polymeric piping (Braidwood only). **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4)**

2. Cracking will be managed for stainless steel components, utilizing a method that has been demonstrated to be capable of detecting cracking, whenever coatings are removed and expose the base

material (Braidwood only). **Program Elements Affected: Parameters Monitored or Inspected (Element 3)**

3. Ensure all underground carbon steel essential service water system piping within the scope of license renewal is coated in accordance with NACE SP0169-2007 prior to the period of extended operation (Byron only). **Program Elements Affected: Preventive Actions (Element 2)**

4. Direct visual inspections of coated piping and components will be performed by an individual possessing a NACE Coating Inspector Program Level 2 or 3 operator qualification, or by an individual who has attended the EPRI Comprehensive Coatings Course and completed the EPRI Buried Pipe Condition Assessment and Repair Training Computer Based Training Course. **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Acceptance Criteria (Element 6)**

5. Inspection quantities of buried piping within the scope of license renewal will be performed in accordance with LR-ISG-2011-03, Element 4, Table 4a, and based upon the as-found results of cathodic protection system availability and effectiveness during each 10 year period, beginning 10 years prior to the period of extended operation. **Program Elements Affected: Detection of Aging Effects (Element 4)**

6. The buried carbon steel condensate system piping within the scope of license renewal will be addressed, through means of a long term mitigation strategy, prior to entering the period of extended operation. Mitigation may include activities such as fully recoating, complete replacement with like or upgraded material, installation of internal polymeric sleeves, and routing of pipe above ground or in an engineered trench for leak detection. Inspections of the condensate system piping will be performed in accordance with LR-ISG-2011-03, Element 4, Table 4a, and based on the mitigation strategy implemented (Braidwood only). **Program Elements Affected: Preventive Actions (Element 2), Detection of Aging Effects (Element 4)**

7. Inspection quantities of underground piping within the scope of license renewal will be performed in accordance with LR-ISG-2011-03, Element 4, Table 4b, during each 10 year period, beginning 10 years prior to the period of extended operation. **Program Elements Affected: Detection of Aging Effects (Element 4)**

8. If adverse indications are detected during inspection, inspection sample sizes within the affected piping categories will be doubled. If adverse indications are found in the expanded sample, an analysis will be conducted to determine the extent of condition and extent of cause. The size of the follow-on inspections will be determined based on the analysis. Timing of the additional inspections will be based on

the severity of the identified degradation and the consequences of leakage. In all cases, the additional inspections will be performed within the same 10 year inspection interval in which the original adverse indication was identified. Expansion of sample size may be limited by the extent of piping subject to the observed degradation mechanism. **Program Elements Affected: Detection of Aging Effects (Element 4)**

9. In performing cathodic protection surveys, only the -850mV polarized potential criterion specified in NACE SP0169-2007 for steel piping will be used for acceptance criteria and determination of cathodic protection system effectiveness, unless the -100mV polarization criteria can be demonstrated effective through use of buried coupons, electrical resistance probes, or placement of reference cells in the immediate vicinity of the piping being measured. An upper limit of -1200mV for pipe-to-soil potential measurements of coated pipes will also be established, so as to preclude potential damage to coatings. **Program Elements Affected: Acceptance Criteria (Element 6)**

10. An extent of condition evaluation will be conducted if observed coating damage caused by non-conforming backfill has been evaluated as significant. The extent of condition evaluation will be conducted to ensure that the as-left condition of backfill in the vicinity of the observed damage will not lead to further degradation. **Program Elements Affected: Acceptance Criteria (Element 6)**

Operating Experience

The following examples of operating experience provide objective evidence that the Buried and Underground Piping program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron Station</u>

1. In August 2009, during a planned inspection of underground safety-related Service Water piping and components, maintenance personnel discovered approximately eight to ten feet of standing water in the 0SX138A essential service water valve pit, containing the isolation valve for the suction to the Units 1 and 2 A-train essential service water pumps, located on the west side of the Essential Service Water Cooling Towers. The issue was entered into the corrective action program. The cause of the standing water was attributed to groundwater intrusion and inadequate weather sealing of the access plug. The standing water in the valve pit was subsequently pumped out and the valve and piping cleaned. Ultrasonic inspections were performed on the piping for thickness measurements with satisfactory results. The pipe was also coated with a protective coal tar coating system and polymeric tape wrap. A weather sealant was also installed on the access plug.

As part of evaluating the extent of condition for this issue, the following additional actions were performed:

- In August 2009, the 0SX138B essential service water valve pit, containing the isolation valve for the suction to the Units 1 and 2 B-train essential service water pumps, located just south of the 0SX138A valve pit, was inspected and found with approximately six inches of standing water. The water was pumped out and the valve and piping were cleaned and ultrasonically tested with satisfactory results. A weather sealant was also installed on the access plug. Coating of the pipe was completed in 2012.
- In 2009, the frequency of existing Preventive Maintenance (PM) inspections of the 0SX138A & 0SX138B valve pits was changed from every two years to every three months.
- In 2012, Byron Station inspected, cleaned, and coated the Circulating Water, Demineralized Water, and Service Water piping located inside the essential service water instrumentation pit, located on the west side of the Essential Service Water Cooling Towers.

This example provides objective evidence that Byron Station is implementing an effective aging management program that is capable of successfully detecting, and mitigating, potential degradation to inaccessible piping and components prior to loss of intended function.

2. In May 2011, nine high risk Service Water system pipe segments, ranging from six to forty-eight inches in diameter, were excavated and inspected. The pipes were found either completely backfilled in a controlled compacted fill, or, for larger diameter pipes, partially encased in a cementitious material with compacted fill around the remaining pipe surface. Coatings were generally found in good condition and well adhered. Where coating damage was observed and resulted in the pipe surface being exposed, coating damage was generally attributed to the excavation process due to the light surface corrosion and lack of pitting observed. In one instance, the coatings inspector noted that the observed coating damage was not attributed to excavation damage, but was likely from inadequate initial application during installation. This condition was entered into the corrective action program and ultrasonic testing was performed with satisfactory results. A cathodic protection test point was installed for future monitoring of pipe-to-soil potentials during the annual cathodic protection survey. Following inspection, all pipes were recoated as necessary and backfilled in controlled compacted fill.

This example provides objective evidence that Byron Station has proactively begun implementation of a comprehensive buried piping inspection program that performs direct inspections of high risk buried piping and, that upon discovery of adverse indications, ensures appropriate corrective actions are implemented. It also demonstrates that the inspection techniques implemented in this program are capable of detecting age-related degradation prior to a loss of the component intended function.

3. In January 2009, a review of cathodic protection system trends and vendor recommendations from recent annual surveys identified a downward trend in system performance. As result, the condition was entered into the corrective action program. Between the Fall of 2009 and Spring of 2010, three of the four original deep anode beds were replaced with new anode beds. The fourth original deep anode bed is planned for replacement with new anodes in 2013. In 2010 and 2012, two of the four original rectifiers were also replaced with new rectifiers to improve performance of the system. The remaining two original rectifiers are planned to be replaced with new rectifiers in 2013. To provide additional information relative to the degree of cathodic protection coverage at Byron Station, supplementary test points were installed on buried pipes excavated in 2012. This example provides object evidence that Byron Station is implementing measures to maintain and enhance the cathodic protection system to ensure adequate preventive measures are in place to protect buried piping.

Braidwood Station

1. In Spring and Fall of 2010, three excavations of carbon steel Main Condensate and Feedwater System piping exposed 19 individual high risk segments. Instances of coating damage were identified, primarily at locations of field applied tape coatings. Shop applied coatings, consistent with design specifications, were generally found in good condition and providing adequate protection to the piping. Upon removal of the coatings at the locations of isolated damage, the exposed steel pipe surface exhibited minimal surface corrosion and several small areas of localized corrosion. Ultrasonic thickness measurements were taken to confirm pipe wall thickness. Although some locations were found less than the 87.5% nominal wall thickness acceptance criteria, all locations exceeded minimum wall thickness requirements. The absence of significant corrosion activity was primarily attributed to effective cathodic protection. Based on the maximum depths of the localized corrosion areas, conservatively estimated remaining lives were calculated for each pipe.

   Permanent guided wave collars were installed on each segment in each of the three excavations to provide addition information on the condition of the pipes outside the excavated areas. The permanent guided wave collars also allow for periodic monitoring and detection of potential changes in corrosion rates. Based on trending of the guided wave results, direct inspection schedules can be altered accordingly to ensure pipe integrity and preclude the possibility of leakage. Cathodic protection test points were also installed on every excavated segment to allow for more direct monitoring of cathodic protection levels. Sacrificial anodes were also added to seven segments in the third excavation to supplement the existing impressed current cathodic protection system. Following inspection, all pipes were recoated in areas of coating damage, or where coatings were removed, and then backfilled in controlled low strength cementitious material.

Between 2010 and 2012, Braidwood Station has inspected approximately 300 feet of buried Main Condensate and Feedwater piping. Based on the as-found conditions to date, Braidwood Station also plans to address, through means of a long term mitigation strategy, the buried Main Condensate and Feedwater piping within the scope of license renewal in accordance with NEI 09-14 Revision 1, “Underground Piping and Tanks Integrity Initiative,” prior to 2025. Mitigation may include, but is not limited to, activities such as fully recoating, complete replacement with like or upgraded material, installation of internal polymeric sleeves, and routing of pipe above ground or in an engineered trench for leak detection. These actions have been included as an enhancement to Braidwood Station’s License Renewal Buried and Underground Piping aging management program.

This example provides objective evidence that Braidwood Station has proactively begun implementation of a comprehensive buried piping inspection program that performs direct inspections of high risk buried piping and, that upon discovery of adverse indications, ensures appropriate corrective actions are implemented. It also demonstrates that the inspection techniques implemented in this program are capable of detecting age-related degradation prior to a loss of the component intended function.

2. In August 2009, two underground valve vaults containing safety-related Service Water piping and components were inspected. Upon inspection, the vaults were found to contain approximately four to eighteen inches of standing water. The standing water was attributed to groundwater intrusion through the concrete vault wall. Visual inspection of the Service Water components identified moderate to heavy general corrosion on the lower half of the 48” discharge lines running through each vault, particularly where the pipes penetrated the vault walls. A six inch local drain line is attached to the bottom of each discharge line, which also exhibited moderate to heavy general corrosion. The top half of the discharge lines exhibited only minor to light surface corrosion. The areas of more significant corrosion were attributed to the moist conditions resulting from their proximity to standing groundwater at the bottom of the vault. The conditions were entered into the corrective action program. As a result, the Service Water piping in each vault was cleaned and ultrasonically tested to determine pipe wall thickness. The results of the ultrasonic thickness measurements were satisfactory and met acceptance criteria. The pipe was then recoated with a protective Kevlar reinforced epoxy coating system designed for marine and chemical industry applications. The two Service Water underground vaults are inspected once a year to pump out any standing groundwater intrusion and visually inspect the piping and components contained within.

This example provides objective evidence that Braidwood Station is periodically inspecting underground piping in inaccessible areas. It also demonstrates that the inspection techniques used to implement the program are capable of detecting age-related degradation prior to a loss of the component intended function. When adverse conditions are found, issues are entered into the corrective action program. Based on the conditions identified, corrective actions are taken to adequately assess the condition and implement measures to prevent reoccurrence.

3. In 1999, an observation was made on the adverse trend in the number of corrective maintenance issues related to the cathodic protection system. It was also concluded that the deep anode beds required replacement. As a result, corrective actions were taken in 2000 to replace the deep anode beds and rectifiers. Since the replacement, periodic cathodic surveys have been performed at Braidwood Station every two years in accordance with NACE SP0169-2007. The surveys have resulted in several cathodic protection repairs and upgrades as follows:

    - In 2008, 17 ground access ports (Buffalo boxes) were also installed in order monitor the cathodic protection around the site more effectively.
    - In 2009, 2010 and 2011, reference cells and additional test points were installed on Chemical and Volume Control, Circulating Water, Demineralized Water, Main Condensate and Feedwater, Non-Radioactive Drain, Radwaste, and Service Water buried piping.
    - In 2010, sacrificial anodes were installed on Circulating Water, Non-Radioactive Drain, and Main Condensate and Feedwater piping to supplement the impressed current cathodic protection.
    - In addition, in 2013 the frequency of cathodic protection surveys was changed from every two years to every year.

    With the installation of additional anodes in several locations, Braidwood Station has increased the corrosion resistance of its buried piping. With the addition of reference cells and test stations, Braidwood has been able to obtain more accurate test results during cathodic protection surveys. This example provides object evidence that Braidwood Station is monitoring its cathodic protection system and implementing measures to maintain and enhance their system to ensure adequate preventive measures are in place to protect buried piping such that the intended functions will be maintained through the period of extended operation.

The preventive measures and inspection methods being implemented by the existing Buried and Underground Piping program have proven effective in mitigating and detecting aging effects, including cracking, blistering, change in color and loss of material. Appropriate guidance for evaluation, repair, or replacement is provided for locations where degradation is found. Periodic self-assessments of the Buried and Underground Piping program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the Buried and Underground Piping program will effectively identify degradation prior to failure or loss of intended function during the period of extended operation.

Conclusion

The enhanced Buried and Underground Piping program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.29 ASME Section XI, Subsection IWE

Program Description

The ASME Section XI, Subsection IWE aging management program is an existing condition monitoring program that provides for periodic examination of the Containment Structure surfaces and components, including bolting for containment closure, containment liner, containment penetrations (electrical, instrumentation, and control assemblies), mechanical penetrations, penetration bellows at the containment boundary, penetration sleeves at the containment boundary, personnel airlock and equipment hatch, and the moisture barrier between the bottom of the containment liner and the base mat for cracking, loss of leak-tightness, loss of material, loss of preload, and loss of sealing. Environments include air-indoor (uncontrolled), air-outdoor, air with borated water leakage, and treated borated water. The scope of the ASME Section XI, Subsection IWE aging management program is consistent with the scope identified in Subsection IWE-1000 and includes the Class MC pressure retaining components and their integral attachments, containment pressure-retaining bolting, and metal containment surface areas, including welds and base metal. Containment seals and gaskets are included in the scope of the 10 CFR Part 50, Appendix J (B.2.1.32) program. Service Level 1 coatings are included in the scope of the Protective Coating Monitoring and Maintenance Program (B.2.1.36).

The program utilizes inspections that detect degradation before loss of intended function. The ASME Code Section XI, Subsection IWE, is a condition monitoring program, which also relies on design change procedures that will be revised to include guidance to ensure proper specification of bolting material, lubricant and sealants, and installation torque or tension to prevent or mitigate degradation and failure of structural bolting. The program implements the requirements of IWE by providing visual examinations (General Visual and VT-3) and augmented inspections (VT-1) for evidence of aging effects that could affect structural integrity or leak tightness of the Containment Structure. Areas subject to augmented inspection are subject to visual inspection (VT-1) and volumetric (ultrasonic) examination techniques as required by engineering. The program addresses the E-A and E-C examination categories described in Table IWE-2500-1 and as approved per 10 CFR 50.55a. The program specifies examinations of accessible surfaces to detect aging effects as addressed in IWE-3500. The frequency and scope of examinations specified is in accordance with 10 CFR 50.55a, and ASME Section XI, Subsection IWE-2400.

The ASME Section XI, Subsection IWE program complies with Subsection IWE of ASME Section XI, 2001 Edition through the 2003 Addenda, for inspection of Class MC and metallic shell and penetration liners of Class CC pressure retaining components and their integral attachments, in accordance with the provisions of 10 CFR 50.55a. The monitoring methods have been demonstrated effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant aging. The concrete portions of the Containment Structures are inspected in accordance with ASME Section XI, Subsection IWL (B.2.1.30) program.

The ASME Section XI, Subsection IWE program provides for periodic inspections for the presence of age related degradation on all accessible surfaces of the containment on a scheduled basis. When examination results require an evaluation and are found to be acceptable for continued service, the areas containing such flaws, degradation, or repair are reexamined during the next inspection period, in accordance with Examination Category E-C.

The acceptance criteria for the ASME Section XI, Subsection IWE program are in accordance with the requirements of the 2001 Edition through the 2003 Addenda of the ASME Code, Subsections IWE-3000 and IWE-3500.

The ASME Section XI, Subsection IWE program documents contain the acceptance criteria for containment surface examinations. Category E-A examinations are conducted by a Certified VT-3 examiner or engineer; and Category E-C examinations are conducted by a Certified VT-1 examiner or engineer. Indications are evaluated and compared to acceptance standards. The IWE Responsible Individual is responsible for evaluation of examination results. Unacceptable conditions are recorded and documented in accordance with the corrective action program and supplemental examinations are performed in accordance with IWE-3200. Conditions which do not meet the acceptance criteria are accepted by an engineering evaluation or corrected by repair or replacement in accordance with IWE-3122.

Repairs and reexaminations, when required, are performed in accordance with IWA-4000 as required by IWE-3124 and the components are repaired or replaced to the extent necessary to meet the acceptance standards of IWE-3500. Component reexaminations are conducted in accordance with the requirements of IWA-2200 and the results are recorded to demonstrate that the repair meets the owner defined acceptance standards per IWE-3500.

The program will be enhanced, as noted below, to provide reasonable assurance that the ASME Section XI, Subsection IWE program aging effects will be adequately managed during the period of extended operation.

NUREG-1801 Consistency

The ASME Section XI, Subsection IWE aging management program will be consistent with the ten elements of aging management program XI.S1, “ASME Section XI, Subsection IWE,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancement will be implemented in the following program elements:

1. Provide guidance for specification of bolting material, lubricant and sealants, and installation torque or tension to prevent or mitigate degradation and failure of structural bolting. **Program Element Affected: Preventive Actions (Element 2)**

Operating Experience

The following examples of operating experience provide objective evidence that the ASME Section XI, Subsection IWE program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron and Braidwood Stations</u>

1. NRC Information Notice 92-20, Inadequate Local Leak Rate Testing, described an instance of containment bellows cracking, resulting in loss of leak tightness. As described in NRC IN 92-20, the local leak rate testing was limited to testing for leakage between the plies of the containment bellows and was unsuccessful due to the close contact between the plies of the containment bellows. As a result, there was a loss of leak tightness that was not found through the local leak rate testing. Performing a local leak rate test on the overall containment penetration assembly would have revealed the leakage. At BBS, surface examinations of the bellows at the fuel transfer tube are not possible due to accessibility limitations. Appropriate local leak rate tests are conducted for these inaccessible pressure boundary components. The local leak rate test of the fuel transfer tube at BBS, performed under the 10 CFR Part 50, Appendix J aging management program, tests the entire space between the 20” fuel transfer tube and the 24” sleeve, which includes the surface of the bellows, and is not limited to only testing between the plies of the bellows.

   This example provides objective evidence that Byron and Braidwood Stations are utilizing industry OE and implementing the industry specified actions.

2. NRC Information Notices IN 97-10, Liner Plate Corrosion in Concrete Containments, IN 2004-09, Corrosion of Steel Containment and Containment Liner, IN 2010-12, Containment Liner Corrosion, and IN 2011-15, Steel Containment Degradation and Associated License Renewal Aging Management Issues, identified specific locations where concrete containments are susceptible to liner plate corrosion. The operating experience identified in these Information Notices is considered applicable to BBS Containment Structures. Although localized corrosion has been identified in various locations, it has been evaluated and found acceptable, and the ASME Section XI, Subsection IWE aging management program will

provide reasonable assurance that the intended function of the containment liner will be maintained during the period of extended operation.

Industry operating experience at other domestic nuclear power plants that identified through wall holes due to embedded organic foreign material is not applicable to BBS. Considering the 1/4 inch liner thickness as well as the years of service involved, if any organic foreign material was inadvertently embedded in the BBS Containment Structure concrete and lodged directly against the surface of the liner, a through wall corrosion cell would have manifested itself by this time. The accessible BBS Containment Structure liner surfaces receive a 100 percent visual inspection for defects including coating defects that could indicate the presence of liner degradation. BBS plant specific operating experience has not found blistered paint covering a through wall liner corrosion cell. Essentially, all of the liner surfaces of the containment cylinder and dome are accessible for visual inspection with only limited inaccessible areas, such as at the fuel transfer tube.

This example provides objective evidence that Byron and Braidwood Stations are utilizing industry OE and implementing the industry specified actions.

Byron Station

1. At Byron Units 1 and 2, the ASME Section XI, Subsection IWE program has been effective in providing assurance that the containment liner has and will continue to remain capable of performing its design function through the period of extended operation. No areas of significant containment liner degradation were identified in the 2000 and 2001 outages. The moisture barriers were removed completely on Unit 2 and partially on Unit 1, all exposed liner areas were inspected, and no degradation that caused the shell to be less than the nominal 1/4” thickness was identified. Some surface rust was found at Byron Unit 2. UT examinations were performed at these areas, which confirmed the liner to still have nominal thickness. After examinations, all the exposed areas were re-coated with an epoxy, Service Level 1 coating. As a result of subsequent Braidwood operating experience, during the 2009 and 2010 refueling outages at Byron limited areas of the moisture barrier were removed at locations similar to where localized areas of corrosion in liner were found at Braidwood. No liner plate degradation was found on either Byron Unit 1 or Unit 2.

   This example demonstrates that the IWE Program has been, and will continue to be expected to effectively manage the condition of the containment liner, such that the intended function will be maintained consistent with the current licensing basis during the period of extended operation.

2. During the 2009, the ASME Section XI, Subsection IWE Containment Inspection Program examinations at Byron Unit 1 identified degraded areas of the moisture barrier. The degraded areas varied from 4 inches to 4 feet

in length, with a total length of the degraded areas less than 30 feet, over the 440 foot total circumference of the containment liner. The degraded areas were attributed to damage from traffic on the moisture barrier during outages. The degraded areas of the moisture barrier were removed to allow for examination of the Containment liner plate below the moisture barrier. The exposed areas of the Containment liner plate met the acceptance criteria. The moisture barrier was then replaced with new material. The moisture barrier is scheduled to be examined during the current inspection period. During the 2012, the ASME Section XI, Subsection IWE Containment Inspection Program examinations at Byron Unit 1 identified areas where the moisture barrier was degraded. The degraded moisture barrier was removed to allow for examination of the Containment liner plate below the moisture barrier. All exposed liner areas were examined. It was determined that no coating had ever been applied to those portions of the liner below the moisture barrier. Some material loss due to corrosion was found at the exposed areas. UT examinations were performed at these areas, which confirmed the minimum containment liner thickness in the exposed areas was 0.2220” thick, which was evaluated and determined to be acceptable. After examinations, all the exposed areas were coated with an epoxy, Service Level 1 coating. Further examinations of the containment liner plate below the moisture barrier at Byron Unit 1 are planned to ensure all areas below the moisture barrier are coated with an epoxy, Service level 1 coating.

This example demonstrates that degradation of the moisture barrier is detected, an examination for potential corrosion losses of the liner plate performed, and the moisture barrier replaced before there is an impact on the integrity of the Containment liner plate.

3. During the 2007, the ASME Section XI, Subsection IWE Containment Inspection Program examinations at Byron Unit 2 identified two degraded bolts used at the cover for a spare Containment penetration. Plant procedures control how spare penetrations into the Containment are opened during outages to allow for Containment access to route temporary electrical cables, air hoses, and water hoses used during refueling activities. An as-found LLRT, required by plant procedures to be performed prior to start of work on the spare penetration, was acceptable. The degraded bolting material was identified after disassembly of the spare penetration, during examinations required by plant procedure. The degraded bolting material was replaced with new material and the spare penetration restored to the permanent configuration. A follow-up inspection in 2010 did not identify any deficiencies when the spare penetration was used.

   This example demonstrates that degradation of the Containment bolting material is detected and corrected before there is an impact on the integrity of the Containment

Braidwood Station

1. At Braidwood Unit 1, the ASME Section XI, Subsection IWE program has been effective in detecting areas of localized containment liner corrosion, correcting the underlying cause of the corrosion, initiating repairs to the liner coating, and establishing plans for weld repairs to the liner at localized areas that will restore the liner to its nominal thickness. Operating experience demonstrates that the IWE Program has been effective in providing assurance that the containment liner has and will continue to remain capable of performing its design function through the period of extended operation.

   Localized areas of corrosion were identified in 2000, during the first IWE visual inspections of the liner, in the area directly below the moisture barrier. All of the moisture barrier and underlying ceramic fiber blanket material was removed to facilitate the liner inspection. The inspections revealed that the ceramic fiber blanket and adjacent liner area was wet and the original liner coating was degraded. Localized areas of corrosion were recorded, and accepted after engineering evaluation. The liner directly below the moisture barrier was recoated with a zinc rich, Service Level I coating, which was the same as the original liner coating. The ceramic fiber blanket material and moisture barrier were also replaced with new material.

   In the subsequent examination period in 2003, augmented liner inspections were performed and areas of localized corrosion not previously identified were found. The inspections found the moisture barrier in good condition with all areas dry under the moisture barrier. Where localized areas of corrosion were found, UT thickness readings confirmed the liner plate thickness at these locations. The areas exposed for inspection in 2003 were recoated with an epoxy, Service Level 1 coating, the existing ceramic fiber blanket material was replaced with new ceramic fiber blanket material, and the moisture barrier was replaced with new material.

   Additional inspections were performed during refueling outages in 2006, 2009, 2010 and 2012. The inspections in 2006, 2009, 2010, and 2012 found all areas dry, with no active corrosion directly under the moisture barrier. Some additional, inactive, localized corrosion was found in 2009, 2010 and 2012 in areas of the liner that were still coated with the zinc rich coating from 2000. These areas were accepted by engineering evaluation for continued service without repair and recoated with the epoxy coating system. As of the end of the outage in the Spring of 2012, the entire liner in the area under the moisture barrier, which had been coated with zinc rich coating in 2000, had been cleaned and recoated with the epoxy coating.

   An engineering evaluation was performed in 2009 to determine the most likely cause of the localized areas of liner corrosion found in 2003 and subsequent years. The most likely cause of containment liner corrosion, below the moisture barrier prior to implementation of the IWE program, is the lack of regular inspection of the moisture barrier before implementation of the IWE program. The most likely cause of containment liner corrosion, below the moisture barrier after implementation of the IWE program, is an event caused by improper surface preparation of the liners when the zinc-rich coating was applied in 1999 and 2000 causing subsequent localized areas of liner corrosion. As indicated above, the zinc rich coating, applied to the Braidwood Unit 1 liner below the moisture barrier in 2000, has now been replaced with the epoxy coating system and the leak-tight moisture barrier has been restored above the inaccessible area.

All areas of localized corrosion have been evaluated and it was determined that the areas were acceptable without repair. Even though the engineering evaluations have demonstrated the adequacy of the liner to perform its intended function, plans have been developed to make weld repairs to the liner in localized areas, where the liner will be restored to its nominal thickness.

This example demonstrates that the IWE Program has been, and will continue to effectively manage the condition of the containment liner, such that the intended function will be maintained consistent with the current licensing basis during the period of extended operation.

2. At Braidwood Unit 2, the ASME Section XI, Subsection IWE program has been effective in detecting areas of localized containment liner corrosion, correcting the underlying cause of the corrosion, initiating repairs to the liner coating, and establishing plans for weld repairs to the liner at localized areas that will restore the liner to its nominal thickness. Operating experience demonstrates that the IWE Program has been effective in providing assurance that the containment liner has and will continue to remain capable of performing its design function through the period of extended operation.

   Localized areas of corrosion were identified in 1999, during the first scheduled IWE visual inspections of the liner, in the area directly below the moisture barrier. In 2000, 100% of the moisture barrier and underlying ceramic fiber blanket material was removed to facilitate the liner inspection. The inspections revealed that the ceramic fiber blanket and adjacent liner area was wet and the original liner coating was degraded. Localized areas of corrosion were recorded and accepted after engineering evaluation. The liner directly below the moisture barrier was recoated with a zinc rich, Service Level I coating, which was the same as the original liner coating. The ceramic fiber blanket material and moisture barrier were also replaced with new material.

   In the subsequent examination period in 2003, augmented liner inspections were performed and areas of localized corrosion not previously identified were found. The inspections found the moisture barrier in good condition with all areas dry under the moisture barrier. Where localized areas of corrosion were found, UT thickness readings confirmed the liner plate thickness at these locations. The areas exposed for inspection in 2003 were recoated with an epoxy, Service Level 1 coating, the existing ceramic fiber blanket material was replaced with new ceramic fiber blanket material, and the moisture barrier was replaced with new material.

Additional inspections were performed during refueling outages in 2006, 2009, 2011, and 2012 that encompass approximately 50% of the liner in the area under the moisture barrier, which had been coated with zinc rich coating in 2000. The inspections in 2006, 2009, and 2011 found all areas dry, with no active corrosion directly under the moisture barrier. Some additional, inactive, localized corrosion was found in 2009 in areas of the liner still coated with the zinc rich coating. These areas were accepted by engineering evaluation for continued service without repair and recoated with the epoxy coating system.

An engineering evaluation was performed in 2009 to determine the most likely cause of the localized areas of liner corrosion found in 2003 and subsequent years. The most likely cause of containment liner corrosion, below the moisture barrier prior to implementation of the IWE program, is the lack of regular inspection of the moisture barrier before implementation of the IWE program. The most likely cause of containment liner corrosion, below the moisture barrier after implementation of the IWE program, is an event caused by improper surface preparation of the liners when the zinc-rich coating was applied in 1999 and 2000 causing subsequent localized areas of liner corrosion. Plans have been developed to complete the examination of the liner in the area under the moisture barrier, which had been coated with zinc rich coating in 2000. These plans include the replacement of the zinc rich coating, applied to the Braidwood Unit 2 liner below the moisture barrier in 2000, with the epoxy coating system and then to restore the moisture barrier.

All areas of localized corrosion, which were identified during examinations, have been evaluated and it was determined that the areas were acceptable without repair. Even though the engineering evaluations have demonstrated the adequacy of the liner to perform its intended function, plans have been developed to make weld repairs to the liner in localized areas, where the liner will be restored to its nominal thickness.

This example demonstrates that the IWE Program has been, and will continue to effectively manage the condition of the containment liner, such that the intended function will be maintained consistent with the current licensing basis during the period of extended operation.

3. During the 1999 ASME Section XI, Subsection IWE Containment Inspection Program examinations at Braidwood Unit 2, localized areas with reductions in the liner thickness were identified above the moisture barrier. These indications were attributed to historical mechanical damage that occurred during maintenance activities. These areas were accepted by engineering evaluation for continued service without repair of the liner and the coatings replaced. Subsequent augmented IWE examinations and UT thickness measurements in 2003 have confirmed the integrity of the liner and coating

that was applied over the mechanically damaged area, showing no sign of ongoing degradation of the containment liner in these areas.

This example demonstrates that loss of material is detected and evaluated before there is an impact on the integrity of the Containment liner plate and that follow-up examinations are performed to verify that there is no on-going degradation.

The above examples provide objective evidence that the existing ASME Section XI, Subsection IWE program is capable of detecting the aging effects associated with this program. The Containment Structure including bolting for containment closure, containment liner, containment penetrations (electrical, instrumentation, and control assemblies), mechanical penetrations, penetration bellows at the containment boundary, penetration sleeves at the containment boundary, personnel airlock and equipment hatch, and the moisture barrier between the bottom of the containment liner and the base mat have been found to be in acceptable condition during inspections performed in accordance with ASME Section XI, Subsection IWE. The corrosion identified would not cause significant impact to the safe operation of the plant. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the ASME Section XI, Subsection IWE program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is confidence that continued implementation of the ASME Section XI, Subsection IWE program will effectively identify degradation prior loss of intended function.

Conclusion

The enhanced ASME Section XI, Subsection IWE program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained, consistent with the current licensing basis during the period of extended operation.

B.2.1.30 ASME Section XI, Subsection IWL

Program Description

The ASME Section XI, Subsection IWL aging management program is an existing condition monitoring program which implements examination requirements of the ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWL for Class CC Concrete Components of Light-Water Cooled Plants, as mandated by 10 CFR 50.55a. The scope of the program includes reinforced concrete and unbonded post-tensioning system.

The current program complies with ASME Section XI, Subsection IWL, 2001 Edition through the 2003 Addenda, supplemented with the applicable requirements of 10 CFR 50.55a(b)(2). This program is consistent with provisions in 10 CFR 50.55a that specify use of the ASME Code edition in effect 12 months prior to the start of the inspection interval. BBS will use the ASME Code edition consistent with the provisions of 10 CFR 50.55a during the period of extended operation. In accordance with 10 CFR 50.55a(g)(4)(ii), the ISI program is updated each successive 120-month inspection interval to comply with the requirements of the latest edition of the ASME Code specified twelve months before the start of the inspection interval.

The primary inspection method is a visual examination, supplemented by testing. Inspection methods, inspected parameters, and acceptance criteria are in accordance with ASME Section XI, Subsection IWL as approved by 10 CFR 50.55a. Accessible concrete surfaces are subject to General Visual examination to detect deterioration and distress such as defined in ACI 201.1R and ACI 349.3R, including loss of material, cracking, increase in porosity and permeability, and loss of bond in the air-outdoor and air-indoor (uncontrolled) environments. Concrete surfaces that exhibit deterioration and distress, based on General Visual examination, are subject to Detailed Visual examination to determine the magnitude and extent of deterioration and distress. In addition, concrete surfaces at the bearing plates for tendon anchorages are subject to Detailed Visual examination. One tendon wire of each type is also examined for loss of material and subject to physical testing to determine yield strength, ultimate tensile strength, and elongation. Tendon corrosion protection medium is analyzed for alkalinity, water content, and soluble ion concentrations. Any free water contained in the anchorage end cap and free water which drains from tendons during the examination is documented. Samples of the free water are also analyzed for pH. At Braidwood only, as a result of operating experience, enhancements related to monitoring and maintenance of the tendons and grease condition have been included in the ASME Section XI, Subsection IWL aging management program to ensure the condition of the tendons and grease is understood and maintained both prior to and during the period of extended operation.

Prestressing forces are measured in selected sample tendons. Evaluation of prestressing forces is addressed in the Concrete Containment Tendon Prestress (B.3.1.2) program. Acceptance criteria, corrective actions, and expansion of the inspection scope when degradation exceeding the acceptance criteria is found, are in accordance with ASME Section XI, Subsection IWL. Prestressing forces of the sample and common tendons are compared to the minimum required values and values predicted for the specific tendon at the specific time of the test, as described in Regulatory Guide 1.35.1. Conditions that do not meet acceptance criteria are entered into the corrective action process.

The augmented examination requirements following post-tensioning system repair and replacement activities will be in accordance with ASME Section XI, Subsection IWL following program enhancement as noted below. Post-tensioning system repair and replacement activities following post-tensioning system repair and replacement activities are in accordance with ASME Section XI, Subsection IWL.

NUREG-1801 Consistency

The ASME Section XI, Subsection IWL aging management program will be consistent with the ten elements of aging management program XI.S2, "ASME Section XI, Subsection IWL," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Include additional augmented examination requirements after post-tensioning system repair/replacement activities in accordance with Table IWL-2521-2. **Program Element Affected: Parameters Monitored / Inspected (Element 3)**

2. A one-time inspection of one (1) vertical and one (1) horizontal tendon on each unit will be performed prior to the period of extended operation. The inspection will consist of visually examining one (1) wire from each of the two (2) types of tendons at a worst-case location based on evidence of free water, grease discoloration, and grease chemistry results. This location will serve as a leading indicator for potential degradation or tendon surface corrosion (Braidwood only). **Program Element Affected: Parameters Monitored / Inspected (Element 3), Program Element Affected: Detection of Aging Effects (Element 4)**

3. In order to monitor for tendon exposure to free water and moisture and manage any potential adverse effects, a periodic tendon water monitoring and grease sampling program will be implemented (Braidwood only). The program will consist of:

a) A baseline inspection of tendon grease caps at the bottom of all vertical and dome tendons, as well as all below-grade horizontal tendons, prior to the period of extended operation. The baseline inspection will check for evidence of free water and grease discoloration, with further actions taken based on the condition of the grease.

b) A follow-up tendon grease cap inspection of all vertical and dome tendons, as well as all below-grade horizontal tendons, will be performed within 10 years of the initial inspection, using the same approach as the baseline inspection.

c) For those tendons where free water, moisture, and grease did not meet acceptance criteria during the two (2) previous inspections, periodic monitoring of grease chemistry and moisture, free water, and grease discoloration will be performed on a frequency not to exceed 10 years.

Corrective actions will be taken as necessary to ensure that the tendon grease meets ASME Section XI, Subsection IWL requirements. **Program Element Affected: Preventive Actions (Element 2), Program Element Affected: Parameters Monitored / Inspected (Element 3), Program Element Affected: Detection of Aging Effects (Element 4), Program Element Affected: Monitoring and Trending (Element 5), Program Element Affected: Corrective Actions (Element 7)**

4. Explicitly require that areas of concrete deterioration and distress be recorded in accordance with the guidance provided in ACI 349.3R. **Program Element Affected: Acceptance Criteria (Element 6)**

5. Include quantitative acceptance criteria, based on the "Evaluation Criteria" provided in Chapter 5 of ACI 349.3R, that will be used to augment the qualitative assessment of the Responsible Engineer. **Program Element Affected: Acceptance Criteria (Element 6)**

Operating Experience

The following examples of operating experience provide objective evidence that the ASME Section XI, Subsection IWL program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron and Braidwood Stations</u>

1. NRC Information Notice IN 99-10, Degradation of Prestressing Tendon Systems in Prestressed Concrete Containments, included observations of containment prestressing system conditions that may precipitate breakage of tendon wires, which were found at the tops of the vertical tendons. Conditions such as uneven shim stack heights on the anchor-heads, spalling and cracking of concrete beneath the anchor-head base plates,

free water in the bottom grease caps, poorly drained top anchorage ledges, and the absence of filler grease in various areas can lead to corrosion of tendons and eventually to wire breakage. The conditions at BBS were evaluated and it was determined that the tops of the vertical tendons are not susceptible to breakage of the tendon wires, when compared to those conditions cited in NRC IN 99-10. At BBS the top anchorage ledges have been drained, there has been no absence of grease at the tops of the vertical tendons, and an improved version of the protective grease was used. The results of the evaluation at BBS did identify some potential weaknesses in the Containment Structure tendon inspection program. This issue was entered into the corrective action program. Corrective actions were implemented to improve the tendon inspection program. For example, the administrative and implementing procedures for conducting the inservice inspection and testing of the prestressed concrete containment post tensioning systems were consolidated into a single comprehensive document. In addition, the tendon inservice inspection procedure explicitly directs the responsible engineer to perform and document the regression analysis for the post tensioning system subjected to physical testing per IN 99-10.

This example provides objective evidence that the corrective action and operating experience programs at Byron and Braidwood Stations are utilizing industry OE and implementing the industry specified actions to ensure that best practices for monitoring the tendon system are implemented so that degraded conditions are identified and corrected prior to equipment failure.

2. Significant Event Notification SEN 287, Delamination of Concrete Discovered During Hydro-Excavation of Reactor Containment Building Wall, was issued to describe the degradation of a prestressed concrete containment. In response to this industry operating experience, SEN 287 was entered into the corrective action program to formally evaluate the lessons learned from this event using the operating experience program. A comparison of the containment concrete reinforcement designs reveals that there is significantly more transverse reinforcement at BBS to prevent the cracking that occurred as described in SEN 287. In addition, the results of the evaluation and the industry lessons learned were incorporated into the Byron and Braidwood station administrative procedures for controlling the containment post tensioning system. This issue was entered into the corrective action program. As a result of this operating experience, the post tensioning system maintenance procedure was revised to specifically direct that a detailed analysis be performed to ensure that the stresses in the containment are acceptable in order to prevent delamination of the concrete wall prior to performing any activities that require de-tensioning of more than one tendon per group.

   This example provides objective evidence that the corrective action and operating experience programs at Byron and Braidwood Stations are utilizing industry OE to determine if the causes of containment degradation at another plant could occur at BBS. This example also provides objective evidence that the corrective action and operating experience programs at Byron and Braidwood Stations are implementing the industry specified actions to improve the stations administrative procedures for controlling the containment post tensioning system and prevent events that have occurred at other plants.

Byron Station

1. As documented in NRC Information Notice 85-10, between November 1979 and January 1980, four post-tensioning tendon anchor-heads failed at Byron Unit 1. The anchor-heads failed between 1 and 64 days after the post tensioning of the Byron Unit 1 containment during the construction of the containment structure. The first failure was reported to the NRC on November 29, 1979. An investigation was conducted by the post-tensioning system vendor and was documented in a report titled "Failure Investigation of Post Tensioning Anchorheads Used in the Byron Unit 1 Nuclear Containment Structure," dated May 30, 1980. The failure investigation included a thorough study of the chemistry, metallurgy, and fracture phenomena of the failed anchor-heads. The investigation found that the basic steel material used in several of the anchor-head lots had been manufactured by a process that utilized vanadium grain refinement. This process caused an incompatibility with the post fabrication heat treatment. Specifically, the different steel chemistry requires a higher temperature for proper heat treatment. As a result, all anchor heads that had received improper heat treatment for the basic steel chemistry were removed from the Byron containment structure and replaced with anchor-heads from accepted heat treatment lots. The failure of the anchor-heads at Byron Unit 1 was caused by a manufacturing process error, not an aged related failure mechanism. There have been no anchor-head failures at Byron since this event.

   The ASME Section XI, Subsection IWL program includes monitoring the material condition of the tendon anchor-heads during the service life of the tendon system. The ASME Section XI, Subsection IWL program complies with the criteria found in IWL-2524 and regulatory Guides 1.35 and 1.35.1. This example provides objective evidence that the corrective action and operating experience programs ensure that when examination results do not meet the acceptance criteria, the cause of the condition is identified, the extent and nature of additional examinations were performed to identify similar conditions, and corrective actions were implemented to prevent additional anchor-head failures.

2. The water infiltration into the tendon sheaths at Byron, at the present time, is limited to four tendons, two horizontal and two dome, in Unit 2 only, where varying quantities of water have been consistently present. However, the Responsible Engineer has always evaluated this condition and determined that the condition was acceptable, as there has been no evidence of damage, degradation, grease leakage, or end cap deformation based on visual inspections and sample analysis results. No tendon failures have been identified at Byron, except for the tendon anchorage

failures that occurred during construction as described previously. As such, no additional examinations are currently required other than inclusion of these tendons in every scheduled tendon surveillance, for trending purposes. In addition, Byron conducts visual examination of grease caps in the tendon tunnels on a 20-month frequency due to evidence of minor grease leakage at several locations. This examination frequency is used to identify leaking caps and allow corrective actions to be implemented in a timely manner to prevent significant loss of grease. Grease caps are examined for evidence of water leakage, grease leakage, and conditions that could indicate degradation of the anchorage components.

This example provides objective evidence that the corrective action and operating experience programs ensure that when examination results do not meet the acceptance criteria, an evaluation is performed to determine if the containment is acceptable without repair, the cause of the condition, and the nature and frequency of additional examinations to maintain component intended functions.

3. In 2009, Byron Units 1 and 2 performed the 25th year interval Subsection IWL examinations of the concrete containment tendons. The tendon corrosion protection medium of the 28 tendons sampled met the testing requirements of IWL-2525.2. Free water was found at three of the tendons, where water had previously been identified. The free water was tested and the pH was greater than 12. No cracking was observed on any of the anchorage components. Only surface rust, with no pitting, was observed on any of the anchorage components. No surface rust was observed on the three tendon anchorage components where free water was observed. Three tendon wires were removed for testing and examination and were found to have no visible corrosion or mechanical damage and met the acceptance criteria for yield tensile strength, ultimate tensile strength, and elongation.

   These examinations included testing to assess the loss of prestressing forces in select containment tendons, consistent with IWL requirements. The regression analyses document the results of all tendon prestress surveillance data through the 25th year interval. The trend lines were developed for each of the three tendon groups (dome, hoop, vertical) in accordance with NRC Information Notice 99-10, Attachment 3. The results of the extended regression analyses demonstrate that the predicted prestress for all three tendon groups at Byron, Units 1 and 2, will remain above the respective minimum required values (MRV) until the next surveillance interval. Therefore, monitoring of the results of containment tendon prestress to date indicate that the prestressing systems will continue to maintain their intended function. The regression analyses for the three tendon groups will continue to be updated with individual measured results following each surveillance interval to ensure the intended function of the prestressing systems is maintained in accordance with design requirements. If, as a result of subsequent updates to the regression analysis, the predicted prestress forces for a tendon group fall below the respective MRV, the condition will be entered into the corrective action program for evaluation and determination of appropriate corrective action.

This example provides objective evidence of the following, regarding parameters monitored/inspected: a) tendon anchorages and wires or strands are visually examined for cracks, corrosion, and mechanical damage; b) tendon wires are also tested for yield strength, ultimate tensile strength, and elongation; c) the tendon corrosion protection medium is tested by analysis for alkalinity, water content, and soluble ion concentrations; d) the pH of free water samples is analyzed. This example also provides objective evidence that the monitoring and trending of the prestressing forces in the tendons is performed and compared with the acceptance standards based upon the predicted force for that type of tendon over its life.

Braidwood Station

1. Free water has been found in 3-8% of the tendon inspections at Braidwood Unit 2, depending upon the type of tendon. In 1999, the grease plugs at the lower grease caps for all of the Unit 2 vertical tendons were removed to allow for identification of free water. Free water was found in 12 of the 162 grease caps. The presence of free water has been consistently detected in specific horizontal, vertical, and dome tendons, and this type of condition has also been detected Braidwood Units 1. The presence of free water in a relatively few, specific horizontal and vertical tendon anchorages located below grade level has existed since Braidwood construction. The majority of the tendon sheaths do not have free water, and the water in the vertical and horizontal sheaths below grade is not concentrated in any specific area.

   As a result of the presence of free water in the tendon sheaths, Braidwood has performed augmented inspections on additional tendons beyond those selected for the ASME Section XI, Subsection IWL program. The Braidwood augmented inspection is performed on a 5 year frequency, in conjunction with the ASME Section XI, Subsection IWL, and includes grease cap removal, inspection for presence of free water, tendon sheathing corrosion protection medium (grease) and free water chemical analysis, visual inspection for corrosion, and re-greasing. At Braidwood, the augmentation of the ASME Section XI, Subsection IWL program has existed since plant start up for horizontal and vertical tendons and was started for dome tendons when free water was detected in the 1990’s.

   The historic presence of free water in dome tendons has been due to degraded roof drainage systems at the containment domes. Repairs to the roof drains have been planned and have already been initiated to prevent the accumulation of water on the dome. It is expected that once these repairs are completed, that water infiltration into the sheaths at the dome will be reduced or eliminated at the top of the Containment Structure.

   The water leakage entering the sheaths at the below grade portion of the containment is due to the high water table, which is about 20 to 25 feet higher than the bottom of the containment. The test results for the pH were all greater than 7 in 2011 for the 21 tendons where water was detected. Active corrosion of the tendons or anchorages has not been identified through the IWL visual inspections, even when water is found in the grease caps and sheaths. In 2000 and 2001, single wires were pulled from one horizontal and one vertical tendon, which exhibited water in the sheaths and some of the highest moisture content in the grease, for testing and examination. No corrosion was found on the wires. A test was performed to verify the continuity of all wires in the same horizontal tendon to verify that the protruding or unseated wires were continuous, verifying that there were no additional broken wires in the tendon.

Monitoring of the grease condition, in accordance with IWL-2525.2, is used as an indication of the potential for corrosion of the tendons in inaccessible areas of the tendons. All of the grease testing to date has met the acceptance criteria in IWL-2525.2 except for instances when the moisture content exceeded 10%, at which time, the grease was replaced. The adequacy of the grease monitoring to indicate conditions in inaccessible areas is confirmed through the removal of a wire at a tendon. Based on past and current inspection results, the high quality grease, which is used as a corrosion protection medium to protect the tendons and is tolerant of excessive quantities of moisture, has been adequate to prevent corrosion of the tendons exposed to water. No tendon failures have been identified at Braidwood. All of the inspection evidence so far reveals that the tendons are being adequately managed, even with the exposure to water.

This example provides objective evidence that the presence of free water in the tendon components is being effectively managed through performance of the ASME Section XI, Subsection IWL examinations and current augmented inspections on additional tendons beyond those selected for the ASME Section XI, Subsection IWL aging management program.

In addition to the actions described above, enhancements related to monitoring and maintenance of the tendons and grease condition have been included in the ASME Section XI, Subsection IWL aging management program to ensure the condition of the tendons and grease is understood and maintained both prior to and during the period of extended operation.

2. Braidwood conducts an annual examination of grease cans in areas susceptible to moisture intrusion because there has been a history of identification of the existence of free water at specific tendon anchorage locations. These locations are primarily located below grade level. Due to this known condition, grease cans are examined for evidence of water leakage, grease leakage, and conditions that could indicate degradation of the anchorage components. To date, only small amounts of grease leakage have been identified, these have been quantified, and are trended so that any potential concerns that the prestressing system components have become uncovered can be resolved prior to the worsening of conditions. These examinations are performed as an annual surveillance in

the summer months when grease leakage would be most likely detected when the grease viscosity is lower due to higher temperatures.

This example provides objective evidence that the corrective action and operating experience programs ensure that when examination results do not meet the acceptance criteria, an evaluation is performed to determine if the containment is acceptable without repair, the cause of the condition, and the nature and frequency of additional examinations to maintain component intended functions.

3. In 2011, Braidwood performed the 25th year interval Subsection IWL examinations of the concrete containment tendons. These examinations included testing to assess the loss of prestressing forces in select containment tendons, consistent with IWL requirements. The regression analyses document the results of all tendon prestress surveillance data through the 25th year interval. The trend lines were developed for each of the three tendon groups (dome, hoop, vertical) in accordance with NRC Information Notice 99-10, Attachment 3. The results of the regression analyses demonstrate that the predicted prestress for all three tendon groups at Braidwood Units 1 and 2, will remain above the respective minimum required values (MRV) until the next surveillance interval. The regression analyses for the three tendon groups will continue to be updated with individual measured results following each surveillance interval to ensure the intended function of the prestressing systems is maintained in accordance with design requirements. If, as a result of subsequent updates to the regression analysis, the predicted prestress forces for a tendon group fall below the respective MRV, the condition will be entered into the corrective action program for evaluation and determination of appropriate corrective action.

   This example provides objective evidence that the monitoring and trending of the prestressing forces in the tendons is performed and compared with the acceptance standards based upon the predicted force for that type of tendon over its life.

The operating experience relative to the ASME Section XI, Subsection IWL program did not identify an adverse trend in performance. The inspection methods being implemented by the program have been proven effective in detecting aging effects including concrete cracking and spalling, cracking, loss of bond, and loss of material (spalling, scaling), increase in porosity and permeability, loss of strength, loss of material, loss of material (spalling, scaling) and cracking, loss of preload and loss of sealing. Appropriate guidance for evaluation, repair, or replacement is provided for locations where degradation is found. Periodic self-assessments of the ASME Section XI, Subsection IWL program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that continued implementation of the ASME Section XI, Subsection IWL program will effectively identify degradation prior to failure or loss of intended function during the period of extended operation.

Conclusion

The enhanced ASME Section XI, Subsection IWL program will provide reasonable assurance that the identified aging effects are adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.31 ASME Section XI, Subsection IWF

Program Description

The ASME Section XI, Subsection IWF aging management program is an existing condition monitoring program that consists of periodic visual examination of ASME Section XI Class 1, 2, 3, and MC piping and component support members for signs of degradation such as loss of material, loss of mechanical function, and loss of pre-load in the following environments: air-indoor uncontrolled, air-outdoor, air with borated water leakage, and treated borated water. Bolting for component supports is also included with these component supports and inspected for loss of material and for loss of preload by inspecting for missing, detached, or loosened bolts and nuts in the following environments: air indoor, air outdoor and treated water. The program utilizes procedures that are consistent with industry guidance to ensure proper specification of bolting material, lubricant, and installation torque to prevent or minimize loss of bolting preload or other loss of structural integrity. Indications of degradation are entered in the corrective action program for evaluation or correction to ensure the intended function of the component support is maintained.

The current ASME Section XI, Subsection IWF program is implemented through corporate and station procedures, which provide inspection and acceptance criteria, and complies with ASME, Boiler and Pressure Vessel Code, Section XI, Subsection IWF 2001 Edition through the 2003 Addenda as approved in 10 CFR 50.55(a). In accordance with 10 CFR 50.55a(g)(4)(ii), the ISI program is updated each successive 120-month inspection interval to comply with the requirements of the latest edition of the ASME Code specified twelve months before the start of the inspection interval. The monitoring methods are effective in detecting the applicable aging effects and the frequency of monitoring is adequate to prevent significant degradation.

The ASME Section XI, Subsection IWF aging management program utilizes examinations that detect degradation before loss of intended function. Preventive measures associated with structural bolts are addressed in implementing procedures.

The program will be enhanced, as noted below to provide reasonable assurance that the ASME Section XI, Subsection IWF program aging effects will be adequately managed during the period of extended operation.

NUREG-1801 Consistency

The ASME Section XI, Subsection IWF aging management program will be consistent with the ten elements of aging management program XI.M1, "ASME Section XI, Subsection IWF," specified in NUREG-1801 with the following exceptions:

Exceptions to NUREG-1801

1. NUREG-1801 requires, as a preventive measure that can reduce the potential for SSC or IGSCC, using bolting material for high strength structural applications that have an actual measured yield strength limited to less than 1,034 megapascals (MPa) (150 kilo-pounds per square inch) (NUREG-1339). Site documentation indicates that the originally installed 5” diameter reactor coolant pump hold-down bolts at both Byron and Braidwood and the 1-1/2” diameter pressurizer hold-down bolts at only Braidwood have actual measured yield strength that is greater than 150 ksi and the originally installed 5” diameter reactor coolant pump hold-down bolts at both Byron and Braidwood have actual measured tensile strength that is greater than 170 ksi. **Program Element Affected: Preventive Measures (Element 2)**

   Justification for Exception

   NUREG-1801 provides guidance to use bolting material, for high strength structural applications, that has an actual measured yield strength limited to less than 150 ksi as delineated in NUREG-1339 and Reg Guide 1.65 Revision 1. SA 540, Class 1, Grade B24 and SA 540, Class 2, Grade B23 materials are described in these documents as high-strength, low alloy materials, which when tempered to a maximum tensile strength of less than 170 ksi, are relatively immune to stress corrosion cracking.

   The originally installed reactor coolant pump hold-down bolts, at both Byron and Braidwood, and the pressurizer hold-down bolts, at only Braidwood, material and quality control requirements were in accordance with the requirements of the 1974 edition of Subsection NF of the ASME Boiler and Pressure Vessel Code, Section III, with the Summer 1975 Addenda. The 5” diameter reactor coolant pump hold-down bolts at both Byron and Braidwood were fabricated from SA 540, Class 1, Grade B24 low alloy steel with a minimum yield strength of 150 ksi and a minimum tensile strength of 165 ksi. The 1-1/2” diameter pressurizer hold-down bolts at Braidwood were fabricated from SA 540, Class 2, Grade B23 low alloy steel with a minimum yield strength of 140 ksi and a minimum tensile strength of 155 ksi. The installed bolts were consistent with the existing Code design guidance when installed and are relatively immune to stress corrosion cracking.

   Other preventive measures listed in NUREG-1801 program XI.S3, "ASME Section XI, Subsection IWF" that can reduce the potential for cracking are met by the ASME Section XI, Subsection IWF program. These include:

   a) Metal-plated stud bolting is not used, which could cause degradation due to corrosion or hydrogen embrittlement.

b) An approved stable lubricant was applied to the bolts. The lubricant used does not contain molybdenum disulfide.

The BBS hold down bolt design configuration at the reactor coolant pump and pressurizer supports prevents SSC from occurring at the portion of the bolt below the bolt head where the bolt is in tension, since this portion of the bolt is not exposed to an environment that would initiate SCC. Therefore, volumetric examinations are not required to detect SCC in these hold down bolts. The hold down bolts for the reactor coolant pumps and pressurizer firmly connect the components to the component supports. Below the bolt head, the bolting materials and holes are not exposed to borated water leakage. The bolts were not installed in oversized holes with no initial bolt tension such as would be found at a sliding connection. The bolt heads bear tightly on the support surface, in standard holes, and were tightened to prevent sliding between the adjacent surfaces. The original installation torque used when installing the reactor coolant pump hold down bolts was designed to result in about 56% of the minimum tensile strength of the bolt material. The original installation of torque used when installing the pressurizer hold down bolts was designed to result in about 27% of the minimum tensile strength. This prevents borated water from seeping beneath the bolt head, which prevents the potential initiation of corrosion under the bolt head. This prevents the initiation of SCC beneath the bolt head since a borated water leakage environment will not exist below the bolt head. The top of the bolt head is exposed to an air with borated water leakage environment and potential losses of material due to corrosion would be readily identified during examinations that are currently performed as part of the ASME Section XI, Subsection IWF program.

Since the actual measured yield strength of some installed bolts may be greater than 150 ksi, the aging management review identified the bolt material as “High Strength Low Alloy Steel Bolting with Yield Strength of 150 ksi or Greater” and identified loss of material and potential cracking as an aging effect requiring management. There have been no recordable indications of degradation identified by ASME Section XI, Subsection IWF program examination of reactor coolant pump and pressurizer support bolting components. The reactor coolant pump and pressurizer supports, and the equipment hold down bolt heads, are examined per ASME Code, Section XI, Table IWF-2500-1. The current examination parameters include indications of corrosion and a loss of material at the bolt head which would indicate a potential for SSC to occur at the top of the bolt head due the presence of an air with borated water leakage environment.

As a result, the current ASME Section XI, Subsection IWF program examination techniques, which include performing VT3 visual examinations, are appropriate for identifying degradation of these bolts given the bolts were designed in accordance with the original design Code, the preventative measures described above were used during original design, fabrication, and installation, the specific bolting materials used, and the support configuration prevents water from seeping beneath bolt head. Therefore, the ASME Section XI, Subsection IWF program will provide reasonable assurance that the high strength bolts will perform their intended functions and will be effective in managing the degradation and subsequent potential cracking aging effect during the period of extended operation.

2. NUREG-1801 recommends, as a method of detecting aging effects, volumetric examination of high strength bolting material, with a diameter of greater than 1" and used in structural applications, which have actual measured yield strength greater than or equal to 150 ksi. Site documentation indicates that the originally installed 5" diameter reactor coolant pump hold-down bolts at both Byron and Braidwood and the 1-1/2" diameter pressurizer hold-down bolts at only Braidwood have actual measured yield strength that is greater than 150 ksi. There are no qualified standards to perform volumetric examinations on these high strength bolts at BBS. The 5" diameter hold down bolts for the reactor coolant pumps at BBS consist of cap screws where the bolt head is machined to allow for the insertion of a socket to tighten the bolt. This bolt head configuration does not allow for a recognized volumetric examination of the bolt. **Program Element Affected: Detection of Aging Effects (Element 4)**

   Justification for Exception

   NUREG-1801 provides guidance to use bolting material, for high strength structural applications, that has an actual measured yield strength limited to less than 150 ksi as delineated in NUREG-1339 and Reg Guide 1.65 Revision 1. The originally installed reactor coolant pump hold-down bolts at both Byron and Braidwood and the pressurizer hold-down bolts at only Braidwood material and quality control requirements were in accordance with the requirements of the 1974 edition of Subsection NF of the ASME Boiler and Pressure Vessel Code, Section III, with the Summer 1975 Addenda. The 5" diameter reactor coolant pump hold-down bolts at both Byron and Braidwood were fabricated from SA 540, Class 1, Grade B24 low alloy steel with a minimum yield strength of 150 ksi and a minimum tensile strength of 165 ksi. The 1-1/2" diameter pressurizer hold-down bolts at Braidwood were fabricated from SA 540, Class 2, Grade B23 low alloy steel with a minimum yield strength of 140 ksi and a minimum tensile strength of 155 ksi. Therefore, the installed bolts were consistent with the existing Code design when installed.

   Other preventive measures listed in NUREG-1801 program XI.S3, "ASME Section XI, Subsection IWF" that can reduce the potential for cracking are met by the ASME Section XI, Subsection IWF program. These include:

a) Metal-plated stud bolting is not used, which could cause degradation due to corrosion or hydrogen embrittlement.

b) An approved stable lubricant was applied to the bolts. The lubricant used does not contain molybdenum disulfide.

The BBS hold down bolt design configuration at the reactor coolant pump and pressurizer supports prevents SSC from occurring at the portion of the bolt below the bolt head where the bolt is in tension, since this portion of the bolt is not exposed to an environment that would initiate SCC. Therefore, volumetric examinations are not required to detect SCC in these hold down bolts. The hold down bolts for the reactor coolant pumps and pressurizer firmly connect the components to the component supports. Below the bolt head, the bolting materials and holes are not exposed to borated water leakage. The bolts were not installed in oversized holes with no initial bolt tension such as would be found at a sliding connection. The bolt heads bear tightly on the support surface, in standard holes, and were tightened to prevent sliding between the adjacent surfaces. The original installation torque used when installing the reactor coolant pump hold down bolts was designed to result in about 56% of the minimum tensile strength of the bolt material. The original installation of torque used when installing the pressurizer hold down bolts was designed to result in about 27% of the minimum tensile strength. This prevents borated water from seeping beneath the bolt head, which prevents the potential initiation of corrosion under the bolt head. This prevents the initiation of SCC beneath the bolt head since a borated water leakage environment will not exist below the bolt head. The top of the bolt head is exposed to an air with borated water leakage environment and potential losses of material due to corrosion would be readily identified during examinations that are currently performed as part of the ASME Section XI, Subsection IWF program.

Since the actual measured yield strength of some installed bolts may be greater than 150 ksi, the aging management review identified the bolt material as “High Strength Low Alloy Steel Bolting with Yield Strength of 150 ksi or Greater” and identified loss of material and potential cracking as an aging effect requiring management. There have been no recordable indications of degradation identified by ASME Section XI, Subsection IWF program examination of reactor coolant pump and pressurizer support bolting components. The reactor coolant pump and pressurizer supports, and the equipment hold down bolt heads, are examined per ASME Code, Section XI, Table IWF-2500-1. The current examination parameters include indications of corrosion and a loss of material at the bolt head which would indicate a potential for SSC to occur at the top of the bolt head due the presence of an air with borated water leakage environment.

As a result, the current ASME Section XI, Subsection IWF program examination techniques, which include performing VT3 visual examinations, are appropriate for identifying degradation of these bolts given the bolts were designed in accordance with the original design Code, the preventative measures described above were used during original design, fabrication, and installation, the specific bolting materials used, and the support configuration prevents water from seeping beneath bolt head. Therefore, the ASME Section XI, Subsection IWF program will provide reasonable assurance that the high strength bolts will perform their intended functions and will be effective in managing the degradation and subsequent potential cracking aging effect during the period of extended operation.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Add the MC supports for the transfer tube in the refueling cavity in the Containment Structure and refueling canal in the Fuel Handling Building to the scope of the program. **Program Elements Affected: Scope of Program (Element 1)**

2. Provide guidance for proper specification of bolting material, lubricant and sealants, and installation torque or tension to prevent or mitigate degradation and failure of structural bolting. **Program Elements Affected: Preventive Actions (Element 2)**

3. Provide procedural guidance, regarding the selection of supports to be inspected on subsequent inspections, when a support is repaired in accordance with the corrective action program. The enhanced guidance will ensure that the supports inspected on subsequent inspections are representative of the general population. **Program Elements Affected: Monitoring and Trending (Element 5)**

Operating Experience

The following examples of operating experience provide objective evidence that the ASME Section XI, Subsection IWF program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. In March of 2008, during implementation of the examinations for the ASME Section XI, Subsection IWF program at Unit 1, it was discovered that the cold load setting of a variable spring support for feedwater piping in the main steam isolation valve room was 7% lower than the design value. The condition was entered into the corrective action program for evaluation. A review by engineering personnel determined that the as-found value was acceptable based upon piping design tolerances and guidelines, so no additional supports required examination. In addition, engineering personnel determined that the support should be adjusted to be in

accordance with the design value. The support was adjusted to be in accordance with the design value and a VT-3 preservice examination was then completed by a qualified inspector with satisfactory results.

This example provides objective evidence that the ASME Section XI Inservice Inspection, Subsection IWF program is effective in detecting degrading conditions before a loss of function, and that the corrective action program is effective in evaluating degraded conditions and implementing corrective actions.

2. In March of 2008, during implementation of the examinations for the ASME Section XI, Subsection IWF program at Unit 1, an accumulation of boric acid residue was identified in the gap between the base plates and support plates of a steam generator support. The boric acid residue was preventing completion of the examination of the support members. No active leakage was identified that could be used to determine the source of the boric acid residue. It is postulated that the leakage source was from a previous leak that had been repaired. The steam generator support was cleaned to allow for examination of the support. The source of the boric acid could not be identified, even after removal of the boric acid residue. The examination of the steam generator support was then completed and no degradation was identified.

   This event provides objective evidence that degraded conditions are identified and corrective action is taken prior to a loss of intended function.

3. ASME Section XI, Subsection IWF program examinations of the accessible bolts for the NSSS supports at Unit 1 and Unit 2, have not identified any cracked or degraded bolts. The bolting materials used at these supports include ASTM A490 and SA 540 materials. Degraded high strength bolts, used in structural applications, have occurred at other sites as was identified in GL 80-046 and draft NUREG-0557. Bolts made of ASTM A490 and SA 540 materials, used in structural applications, have not been subject to age related stress corrosion cracking (SCC) and subsequent failures, unlike some of the other high strength bolt materials. Based upon recent findings at plants, where cracks were attributed to stress corrosion cracking on a small number of the total number of SA 540, grade B24, Class 1 bolts at supports that were underwater or subject to wash down during outages, this bolt material may be potentially susceptible to stress corrosion cracking when subject to extended wetting, which is not the applicable environment at BBS.

   This example provides objective evidence operating experience at other plants is used to determine whether enhancements are required to the ASME Section XI, Subsection IWF program.

<u>Braidwood Station</u>

1. In October of 2006, during implementation of the examinations for the ASME Section XI, Subsection IWF program at Unit 2, it was discovered that

there was no load on a variable spring support for chemical and volume control piping that attaches to a reactor coolant pump. The condition was entered into the corrective action program for evaluation. A review by engineering personnel determined that the condition had not resulted in exceeding the allowable pipe stresses or support loads and that the support should be adjusted to be in accordance with the design value. Corrective actions consisted of adjusting the support and expanding the scope of the IWF examinations to include adjacent supports and supports similar to the support that was discovered to be supporting no load. The support was adjusted and a VT-3 preservice examination was then completed by a qualified inspector with satisfactory results. The examination of the additional supports performed as a result of the scope expansion did not identify any recordable indications. During the next outage, the successive examination of the support was performed and did not identify any recordable indications.

This example provides objective evidence that degraded conditions are identified, evaluated, and appropriate actions are taken to maintain the intended function of the support components.

2. In August of 2009, during implementation of the examinations for the ASME Section XI, Subsection IWF program at Unit 2, it was discovered that a pipe clamp was loose on a support for feedwater pipe in the main steam isolation valve room. The condition was reported in the corrective action program, where corrective actions were specified to adjust the support and expand the scope of the IWF examinations to include adjacent supports and supports similar to the support with the identified deficiency. An evaluation determined that the condition had not resulted in degradation to the structural integrity of the supported piping, because the original load path still existed. The support was appropriately adjusted and a VT-3 preservice examination was then completed. The examination of the expanded scope supports did not identify any recordable indications. During the next outage, the successive examination was performed on the support and did not identify any recordable indications.

   This example provides objective evidence that degraded conditions are identified and appropriate corrective and follow-up actions are taken prior to a loss of intended function.

3. Work activities were initiated in 2012 to provide for the lubrication of the sliding surfaces of the upper lateral supports for all of the steam generators, for both Unit 1 and Unit 2. The sliding surfaces are at the shim packs between the embedded plates and the upper lateral support plate that contacts the embedded plates. The maintenance activity was created as a means to ensure proper lubrication and prevent binding and the potential for degradation such as wear of the sliding surfaces and was performed prior to any degradation being observed. No evidence of degradation such as wear or binding was observed during inspections. Molybdenum disulphide has been used as the lubricant at the sliding surfaces of the NSSS supports since construction. It is not used as a lubricant for bolts on these supports.

> Precautions are included in the instructions for applying the molybdenum disulphide to prevent contamination of adjacent surfaces, such as bolting.
>
> This example provides objective evidence that the ASME Section XI Inservice Inspection, Subsections IWF program is effective in preventing potential degradation before a loss of function.

The operating experience relative to the ASME Section XI, Subsection IWF program did not identify an adverse trend in performance. The piping and component supports inspections performed in accordance with the ASME Section XI, Subsection IWF program have found the supports to be in good condition. The inspection methods being implemented by the program have been proven effective in detecting aging effects including out of tolerance cold load settings, loose fasteners, cracking, loss of material, loss of mechanical function, loss of preload and reduction or loss of isolation function. Appropriate guidance for evaluation, repair or replacement, and subsequent follow-up inspection is provided for locations where degradation is found. Assessments of the ASME Section XI, Subsection IWF program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that continued implementation of the ASME Section XI, Subsection IWF program will effectively identify degradation prior to failure or loss of intended function during the period of extended operation.

Conclusion

The enhanced ASME Section XI, Subsection IWF program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.32 10 CFR Part 50, Appendix J

Program Description

The 10 CFR Part 50, Appendix J aging management program is an existing performance monitoring program that monitors leakage rates through the containment pressure boundary, including the containment liner, associated welds, penetrations, fittings, and other access openings, in order to detect age-related degradation of the containment pressure boundary. Corrective actions are taken if leakage rates exceed acceptance criteria. The Primary Containment Leakage Rate Testing Program (LRT) provides for aging management of pressure boundary degradation for electrical penetration assemblies, mechanical penetrations, penetration bellows and sleeves, the containment liner, bolting, personnel airlock, equipment hatch, and seals, gaskets, and moisture barriers, due to aging effects from the loss of material, loss of sealing, loss of leaktightness, loss of preload, or cracking in systems penetrating containment in air-outdoor, air with borated water leakage, condensation, and waste water environments.

Consistent with the current licensing basis, the containment leak rate tests are performed in accordance with the regulations and guidance provided in 10 CFR Part 50, Appendix J, Option B; Regulatory Guide 1.163, “Performance-Based Containment Leak-Test Program”; NEI 94-01 “Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J”; and ANSI/ANS 56.8, “Containment System Leakage Testing Requirements.”

Containment leak rate tests are performed to assure that leakage through the containment, and systems and components penetrating primary containment, does not exceed allowable leakage limits specified in the Technical Specifications. An integrated leak rate test (ILRT) is performed during a period of reactor shutdown at a frequency based on the historical performance of the overall containment system. Local leakage rate tests (LLRT) are performed on containment isolation valves and containment access penetrations at frequencies that comply with the requirements of 10 CFR 50 Appendix J, Option B.

NUREG-1801 Consistency

The 10 CFR Part 50, Appendix J aging management program is consistent with the ten elements of aging management program XI.S4, “10 CFR Part 50, Appendix J,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the 10 CFR Part 50, Appendix J program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. The cumulative maximum leakage test results at Byron Unit 1 in 2012 was 125.647 standard cubic feet per hour (SCFH), or 14.0% of the total allowable technical specification limit of 899.03 SCFH. The cumulative maximum leakage test results at Byron Unit 2 in 2012 was 122.889 SCFH, or 14.8% of the total allowable technical specification limit of 829.99 SCFH. The historical data indicates not only that equipment is being adequately maintained but also that the equipment maintenance has been capable of creating a significant safety margin between the technical specification allowable limits and the as-tested values. The test results show the effects of aging are effectively being managed for primary containment.

   This example provides objective evidence that the 10 CFR Part 50, Appendix J aging management program effectively manages leakage through the reactor containment, and, systems and components penetrating primary containment to ensure that the leakage rate does not exceed allowable leakage rate values as specified in the technical specifications or associated bases.

2. A Focused Area Self-Assessment (FASA) for the Byron 10 CFR Part 50, Appendix J program was conducted in May 2010. No issues were identified that affected the operability of plant equipment or that had regulatory impact. The purpose of the FASA was to evaluate compliance of the program with the regulatory requirements of 10 CFR Part 50, Appendix J Option B, Regulatory Guide 1.163, ANSI/ANS 56.8, NEI 94-01, and Exelon procedural requirements. Industry and plant operating experience was considered in performance of the assessment. The conclusion was that the program was considered acceptable with three standards deficiencies as well as twenty recommendations were identified. Activities were assigned to track resolution of the deficiencies and implementation of the recommendations.

   The self assessment provided objective evidence that industry and plant operating experience reviews are performed and that continuous improvement opportunities are entered into the corrective action program.

3. In April of 2005, a local leakage rate test (LLRT) was performed for the Unit 2 emergency personnel airlock door. The leakage on the outer airlock door seal exceeded the acceptance criteria for the emergency personnel airlock door. The airlock door has an elastomer door seal that is fitted into a groove on the door. The elastomer seal is compressed between the bulkhead surface and the door when the door is closed. The door seal has

two parallel knife edges that contact the metal surface of the bulkhead. The LLRT test pressurizes the annulus between the two knife edges and the bulkhead. Maintenance personnel identified that a door latch adjustment was required to correct the door sealing capability. The adjustment allows the door surface to more evenly align with the bulkhead surface. Maintenance personnel performed the corrective action to make the latch adjustment. The emergency personnel airlock door LLRT was then repeated with acceptable results.

This example provides objective evidence that components exceeding the allowable leakage rate acceptance criteria are being entered into the corrective action program, corrective actions are taken to repair a condition that causes excessive leakage, and subsequently retested in accordance with the Primary Containment Leakage Rate Testing Program.

Braidwood Station

1. The cumulative maximum leakage test results at Braidwood Unit 1 in 2012 was 57.7 standard cubic feet per hour (SCFH), or 10.7% of the total allowable technical specification limit of 540.48 SCFH. The cumulative maximum leakage test results at Braidwood Unit 2 in 2012 was 44.1 SCFH, or 8.8% of the total allowable technical specification limit of 499.12 SCFH. The historical data indicates not only that equipment is being adequately maintained but also that the equipment maintenance has been capable of creating a significant safety margin between the technical specification allowable limits and the as-tested values. The test results show the effects of aging are effectively being managed for primary containment.

   This example provides objective evidence that the 10 CFR Part 50, Appendix J aging management program effectively manages leakage through the reactor containment, and, systems and components penetrating primary containment to ensure that the leakage rate does not exceed allowable leakage rate values as specified in the technical specifications or associated bases.

2. A Focused Area Self-Assessment (FASA) for the Braidwood 10 CFR Part 50, Appendix J program was conducted in 2012. No issues were identified that affected the operability of plant equipment or that had regulatory impact. The purpose of the FASA was to evaluate compliance of the program with the regulatory requirements of 10 CFR Part 50, Appendix J Option B, Regulatory Guide 1.163, ANSI/ANS 56.8, NEI 94-01, and Exelon procedure ER-AA-380. Industry and plant operating experience was considered in performance of the assessment. The conclusion was that the program was found to be in compliance with the regulatory requirements with no deficiencies identified. Seven recommendations and one strength were identified. Activities were assigned to track implementation of the recommendations.

   The self assessment provided objective evidence that industry and plant operating experience reviews are performed and that continuous improvement opportunities are entered into the corrective action program.

3. In October of 2008, a local leakage rate test (LLRT) was performed for the Unit 1 containment emergency hatch. The leakage on the inner airlock door seal exceeded the acceptance criteria for the emergency hatch. The airlock door has an elastomer door seal that is fitted into a groove on the door. The elastomer seal is compressed between the bulkhead surface and the door when the door is closed. The door seal has two parallel knife edges that contact the metal surface of the bulkhead. The LLRT test pressurizes the annulus between the two knife edges and the bulkhead. The door seal was inspected by engineering and maintenance personnel. The as found inspection revealed that the inner knife edge was not in full contact with the bulkhead. The outer knife edge mating surface was inspected and the knife edge was making full contact with the bulkhead. The corrective action that was performed was to make a wedge adjustment to the door latch assembly. The adjustment decreased the gap between the door and the bulkhead, which further compressed the elastomer gasket. The emergency hatch LLRT was repeated with acceptable results.

   This example provides objective evidence that components exceeding the allowable leakage rate acceptance criteria are being entered into the corrective action program, corrective actions are taken to repair a condition that causes excessive leakage, and subsequently retested in accordance with the Primary Containment Leakage Rate Testing Program.

The above examples provide objective evidence that the 10 CFR Part 50, Appendix J program is capable of ensuring that the leakage through containment, or systems and components penetrating these containments, does not exceed allowable leakage rates specified in the technical specifications, and that the integrity of the containment structure is being maintained. No instances of significant age-related degradation were documented. The data from the most recent running summary totals in 2012 show the total leakage has adequate margin at 14.0%, 14.8%, 10.7%, and 8.8% of the allowable technical specification limit at Byron and Braidwood Stations, Units 1 and 2, respectively. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where age-related degradation is found. Assessments of the 10 CFR Part 50, Appendix J aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that continued implementation of the 10 CFR Part 50, Appendix J aging management program will effectively identify age-related degradation prior to failure.

Conclusion

The existing 10 CFR Part 50, Appendix J program provides reasonable assurance that the identified aging effects are adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.33 Masonry Walls

Program Description

The Masonry Walls program is an existing program implemented as part of the Structures Monitoring (B.2.1.34) program. It is based on the guidance provided in IE Bulletin 80-11, “Masonry Wall Design," and NRC Information Notice 87-67, “Lessons Learned from Regional Inspections of Licensee Actions in Response to IE Bulletin 80-11," and is implemented through station procedures.

The Masonry Walls aging management program is a condition monitoring program that provides for inspection of masonry walls for loss of material and cracking and will be enhanced to inspect for shrinkage or separation and for gaps between the supports and masonry walls that could impact the intended function of the walls. Environments include air-indoor (uncontrolled), air with borated water leakage, and air-outdoor. The program relies on periodic visual inspections, conducted at a frequency not to exceed five years, to monitor and maintain the condition of masonry walls within the scope of license renewal so that the established design basis for each masonry wall remains valid during the period of extended operation. Unacceptable conditions, when found, are evaluated or corrected in accordance with the corrective action program. Masonry walls that are considered fire barriers are also managed by the Fire Protection (B.2.1.15) program.

The scope of the program will be enhanced to include masonry walls in structures that are not currently monitored. The enhancements are discussed below.

NUREG-1801 Consistency

The Masonry Walls program will be consistent with the ten elements of aging management program XI.S5,” Masonry Walls,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Add masonry walls in the following structures to the program scope:
    a. Radwaste and Service Building Complex
        i. Radwaste Building
        ii. Original Service Building

   b. Turbine Building Complex

   c. Switchyard Structures

      i. Relay House

   Program Elements Affected: Scope of Program (Element 1)

2. Provide additional guidance for inspection of masonry walls for shrinkage, separation, and for gaps between the supports and the masonry walls that could impact the intended function of the masonry walls. **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Acceptance Criteria (Element 6)**

3. Require that personnel performing inspections and evaluations meet the qualifications described in ACI 349.3R. **Program Elements Affected: Detection of Aging Effects (Element 4)**

Operating Experience

The following examples of operating experience provide objective evidence that the Masonry Walls program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron Station</u>

1. During December 2005, Structures Monitoring examinations included inspections of masonry walls in the Turbine Building. No significant deficiencies were identified. A few instances of acceptable hairline surface cracks were observed and at four locations, pieces of mortar were broken or missing. No significant cracks, gaps or other degradation was noted. The condition of the masonry wall was determined acceptable structurally and it was determined that the fire barrier function was not impacted. The identified deficiencies were entered into the corrective action program and corrective action consisted of entering work orders into the work management system for repairs to the mortar joints as well as continued monitoring under the structures monitoring program for any evidence of further degradation. The potential causes of the cracks were assessed as input to evaluate the deficiencies. In March of 2012, as part of follow-up inspections under the structures monitoring program, the masonry walls were examined again, and no significant changes in the previously observed conditions had occurred. The work orders for the mortar repairs have been planned and are being scheduled in accordance with the work management process.

   This example demonstrates that masonry walls are inspected as required by the Structures Monitoring program. When deficiencies are identified, the deficiencies, are evaluated for potential impact on intended function, documented in the corrective action program, monitored for any further degradation, and repairs are planned in accordance with the station work management process

2. In April 2011, Structures Monitoring inspections were performed on three masonry walls in the Auxiliary Building for Byron Unit 1. The examinations look for cracking in the mortar joints or blocks, as well as condition of the wall supports including cracked welds or loose or missing bolts and nuts or loss of material on the wall support members. No deficiencies were noted during the inspections.

   This example demonstrates that masonry walls are periodically monitored and inspected by the Structures Monitoring program.

3. During October 2011, Structures Monitoring inspections were performed in the Auxiliary Building at Byron Units 1 and 2. Three masonry walls were inspected, and deficiencies were noted as follows: general corrosion was noted on the wall support plates and anchor bolts on two of the walls, and general corrosion was noted on the base plate and anchor bolts for the block wall column support on the other wall. The conditions were entered into the corrective action program where they were evaluated for potential impact on the intended function of the masonry wall supports. The evaluations and review of design calculations concluded although there was some minor metal loss due to the surface corrosion, there was adequate margin in the calculations for material loss such that the design capacity of the supports were not impacted. The cause of the corrosion has been attributed to condensation that periodically accumulates on the floor within the supply fan rooms. Corrective actions consisted of monitoring the conditions for any further degradation and creating a work request and associated work orders to clean and coat the affected components to prevent any further degradation. The work orders are in the planning stage and scheduling of the work will be in accordance with the work management process.

   This example provides objective evidence that periodic inspections are performed to identify conditions that could affect the intended function of masonry wall supports. This example also demonstrates when adverse conditions are identified, they are entered into the corrective action program and appropriate corrective actions are taken to resolve the issues.

<u>Braidwood Station</u>

1. During September 2009, Structures Monitoring inspections were performed on four masonry walls in the Auxiliary Building at Braidwood. The results of the inspection indicated there were no significant spalling, popouts, cracks or efflorescence, no missing or loose support bolts and mortar joints were in acceptable condition. Localized cracking in one wall was noted where a minor shrinkage crack in the mortar joint was observed at the top two courses. This same condition was observed and documented in the previous inspection performed on this wall and the condition was noted as stable and acceptable in this subsequent inspection. In addition, minor shrinkage cracks and paint chipping was observed in the mortar joints on

another area of this same wall around a duct penetration. All four walls inspected were evaluated as being acceptable with no required corrective action.

This example demonstrates that masonry walls are periodically monitored and inspected by the Structures Monitoring program.

2. During December 2009, Structures Monitoring inspections were performed on three masonry walls in the Auxiliary Building at Braidwood. The results of the inspection indicated there were no significant spalling, popouts, cracks or efflorescence, no missing or loose support bolts. All three masonry walls inspected were determined acceptable and there was no observed degradation.

   This example demonstrates that masonry walls are inspected as required by the Structures Monitoring program.

3. In February 2010, Structures Monitoring inspections were performed on twelve masonry walls in the Auxiliary Building at Braidwood. The results of the inspection indicated there were no significant spalling, popouts, cracks or efflorescence, no missing or loose support bolts. Eleven of the twelve walls inspected revealed no degradation; one wall was noted to have a corner piece broken off a top block (surface damage). All masonry walls inspected were determined to be acceptable with no required corrective action.

   This example demonstrates that masonry walls are periodically monitored and inspected by the Structures Monitoring program.

The above examples provide objective evidence that the existing Masonry Walls program is capable of detecting the aging effects associated with this program. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Therefore, there is confidence that continued implementation of the Masonry Walls program will effectively identify degradation prior to loss of intended function.

Conclusion

The enhanced Masonry Walls program as implemented by the Structures Monitoring (B.2.1.34) program will provide reasonable assurance that cracking and loss of material aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.34 Structures Monitoring

Program Description

The Byron and Braidwood Structures Monitoring program is an existing condition monitoring program that was developed to implement the requirements of 10 CFR 50.65 and is based on NUMARC 93-01, Rev. 2 “Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,” and Regulator Guide 1.160, Rev. 2 “Monitoring the Effectiveness of Maintenance at Nuclear Power Plants.” The program includes elements of the Masonry Walls (B.2.1.33) program. As a result, the program elements incorporate the requirements of NRC IEB 80-11, “Masonry Wall Design,” and the guidance in NRC IN 87-67, “Lessons Learned from Regional Inspections of Licensee Actions in Response to IE Bulletin 80-11.” The structures and structural components are inspected by qualified personnel in accordance with station procedures which will be enhanced for consistency with ACI 349.3R. Concrete structures are inspected for indications of deterioration and distress including evidence of leaching, loss of material, cracking, and a loss of bond, as defined in ACI 201.1R, “Guide for Making a Condition Survey of Existing Buildings.” Steel components are inspected for loss of material due to corrosion. Masonry walls are inspected for cracking and loss of material. Elastomers will be monitored for hardening, shrinkage and a loss of sealing. Environments include air-outdoor, air-indoor (uncontrolled), concrete, condensation, treated water, raw water, waste water, water-flowing, and groundwater and soil.

The program also includes provisions for periodic testing and assessment of groundwater chemistry and inspection of accessible below grade concrete structures. A de-watering system is not relied upon to control settlement in the design of the BBS foundations.

Inspection frequency for the in-scope structures will not exceed 5 years, with provisions for more frequent inspections when conditions are observed that have a potential for impacting an intended function. Unacceptable conditions, when found, are evaluated or corrected in accordance with the corrective action program.

NUREG-1801 Consistency

The Structures Monitoring program will be consistent with the ten elements of aging management program XI.S6, “Structures Monitoring,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Add the following structures;
    a) Radwaste and Service Building Complex
        i. Radwaste Building
        ii. Original Service Building
    b) Turbine Building Complex
    c) Yard Structures
        i. Transformer foundations
        ii. Valve and line enclosures
    d) Fire protection structures-features
        i. Transformer fire barrier walls
        ii. Fuel oil storage tank berm
2. Add the following components and commodities;
    a) Blowout panels
    b) Building features – doors and seals, bird screens, louvers, windows
    c) Compressible joints and seals, gaskets and moisture barriers
    d) Concrete curbs
    e) Electrical cable trays, conduits and tube tracks
    f) Hatches and plugs
    g) Insulation including jacketing
    h) Manholes, handholes and duct banks
    i) Metal components, including metal decking for concrete slabs, miscellaneous steel, sump screens and trench covers, and scuppers around the spent fuel pool
    j) New fuel storage racks
    k) Offgas stack and flue
    l) Panels, racks, cabinets, and other enclosures
    m) Penetration seals and sleeves
    n) Pipe whip restraints, jet impingement shields, and spray shields
    o) Pipe, electrical and equipment component support members
    p) Sliding surfaces

q) Spent fuel pool gates

r) Sumps and liners

Program Elements Affected: Scope of Program (Element 1)

3. Monitor groundwater chemistry on a frequency not to exceed five (5) years for pH, chlorides, and sulfates and evaluate results exceeding the threshold criteria to assess impact, if any, on below-grade concrete. **Program Elements Affected: Scope of Program (Element 1), Parameters Monitored or Inspected (Element 3), Detection of Aging Affects (Element 4)**

4. Based on groundwater chemistry monitoring results, select and inspect every five (5) years a structure that will be used as a leading indicator for the condition of below grade concrete exposed to groundwater. **Program Elements Affected: Parameters Monitored or Inspected (Element 3), Detection of Aging Affects (Element 4)**

5. Require (a) evaluation of the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas and (b) examination of representative samples of the exposed portions of the below grade concrete, when excavated for any reason. **Program Elements Affected: Detection of Aging Affects (Element 4)**

6. Provide guidance for proper specification of high strength bolting material and lubricant to prevent or mitigate degradation and failure of structural bolting. **Program Elements Affected: Preventative Actions (Element 2)**

7. Revise storage requirements for high strength bolts to include recommendations of Research Council on Structural Connections (RSCS) Specification for Structural Joints Using High Strength Bolts, Section 2.0 **Program Elements Affected: Preventative Actions (Element 2)**

8. Clarify that loose bolts and nuts, and cracked high strength bolts are not acceptable unless accepted by engineering evaluations. **Program Elements Affected: Acceptance Criteria (Element 6)**

9. Include the potential for reduction in concrete anchor capacity due to local concrete degradation. **Program Elements Affected: Parameters Monitored or Inspected (Element 3)**

10. Require that personnel performing inspections and evaluations meet the qualifications specified within ACI 349.3R with respect to knowledge of in-service inspection of concrete and visual acuity requirements. **Program Elements Affected: Detection of Aging Affects (Element 4)**

11. Require acceptance and evaluation of structural concrete using quantitative criteria based on Chapter 5 of ACI 349.3R. **Program Elements Affected: Acceptance Criteria (Element 6)**
12. Perform inspection of elastomeric components such as vibration isolation elements and structural seals for cracking, loss of material and hardening. Visual inspections of elastomeric components are to be supplemented by feel or manipulation to detect hardening. **Program Elements Affected: Detection of Aging Affects (Element 4), Acceptance Criteria (Element 6)**
13. Monitor accessible sliding surfaces to detect loss of mechanical function or significant loss of material due to wear, corrosion, debris, dirt, distortion, or overload that could restrict or prevent sliding of surfaces as required by design. **Program Elements Affected: Detection of Aging Affects (Element 4), Acceptance Criteria (Element 6)**
14. Formalize requirements for the monitoring of the leak detection sight glasses associated with the refuel cavity, transfer canal, spent fuel pool, and refueling water storage tank on a periodic basis. **Program Elements Affected: Detection of Aging Affects (Element 4)**
15. Require visual inspections of submerged concrete structural elements by dewatering a structure or by a diver if the structure is not dewatered at least once every five (5) years (Byron only). **Program Elements Affected: Detection of Aging Affects (Element 4)**

Operating Experience

The following examples of operating experience provide objective evidence that the Structures Monitoring program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

Byron and Braidwood Stations

1. Integrity of the liner for spent fuel pools, fuel transfer canals, and refueling cavities has become a focus area in recent reviews for License Renewal Applications. Other domestic nuclear stations have had long standing issues with leakage through the liners of either the spent fuel pool or refueling cavity. The significance of leakage is the possible degradation of structural concrete and embedded steel due to boric acid intrusion and the uncontrolled release of tritiated water to the outside environment. Concerns regarding the functionality of the installed leakage chase system due to fouling of drain lines from boric acid crystals and other solids have also been an issue.

   NRC issued Information Notice 2004-05 “Spent Fuel Pool Leakage to Onsite Groundwater” to communicate the need to assure leak detection systems were free of obstructions and fully functional.

Byron and Braidwood have had issues with refueling cavity leakage in the past (late 1990's into early 2000) due to leakage of the cover plates over the reactor vessel nozzles. Corrective actions were implemented that included a design change of the cover plates, as well as on-going maintenance activities to perform retorquing of bolting prior to outage flood ups, and routine gasket replacements. The design changes were completed by 2002.

Other events in the past included a fuel transfer tube, expansion joint bellows leak found at Braidwood in 1987, which was repaired by corrective maintenance, and a spent fuel pool leak, also at Braidwood, which was found and weld repaired in the 1990's during replacement of the spent fuel racks.

Byron and Braidwood are currently planning to assure that the leak chase systems are free of obstructions and fully functional with activities captured through the corrective action program. Actions include pneumatic flow testing of each leak detection line to assure the lines are free of obstructions and fully functional. Revisions to routine inspection programs are also being planned to assure monitoring activities are documented and actions are in place to retest lines if leakage is detected. This will ensure leak chase lines remain free of obstructions and boric acid deposits do not impact the leak chase system in the future. Any leakage indications identified are entered into the corrective action program and evaluated for appropriate actions. This example provides objective evidence that Byron and Braidwood Stations are utilizing industry OE and implementing the industry specified actions

2. NRC Information Notice 2011-20, "Concrete Degradation by Alkali-Silica Reaction" was issued to inform the industry of the occurrence of alkali-silica reaction (ASR) induced concrete degradation associated with a seismic Category 1 structure at a domestic nuclear facility. A review of design and construction records was performed to determine susceptibility and applicability for ASR degradation at BBS. This aging effect and mechanism combination does not apply to BBS concrete structures. Concrete fine and course aggregates conform to ASTM C33. Petrographic examinations of aggregates used in the concrete were performed in accordance with ASTM C295, "Petrographic Examination of Aggregates for Concrete", and ASTM C289, "Potential Reactivity of Aggregates", to demonstrate that the aggregates do not adversely react within the concrete. In addition, concrete structures were constructed in accordance with ACI 318, per UFSAR Table 3.8-2. The above information, combined with the fact that cracking associated with expansion due to reaction with aggregates has not been observed on BBS concrete structures, supports the conclusion that cracking due to expansion and reaction with aggregates is not applicable to Byron and Braidwood. Nevertheless, the Structures Monitoring (B.2.1.34) program will continue to inspect and monitor concrete structures for cracking due to any mechanism. This example provides objective evidence that Byron and Braidwood Stations are utilizing industry OE and implementing the industry specified actions.

Byron Station

1. During a structures monitoring walkdown in 2004 at Byron, the structures monitoring engineer noted the Unit 1 and 2 Containment Chiller Compression (Surge) Tanks were not anchored to the concrete slab in the Auxiliary Building. These tanks are horizontal and supported by a structural steel stand. The tank is attached to the stand; however, the stand is not anchored to the floor. The shift manager was notified and the condition was entered into the corrective action program. The tanks themselves and the chilled water system are not safety related however the potential existed for safety related components to be impacted if the tanks over turned or moved during a seismic event. Immediate actions consisted of an evaluation of the area for potential safety related targets in the event the tanks overturned during a seismic event. The evaluation for Unit 1 determined there were no vulnerable targets to be impacted. The evaluation for Unit 2 determined there were several runs of conduit that potentially could be impacted during a seismic event. Temporary bracing to prevent tank impact was put in place as an interim corrective action until permanent anchorage of the tank could be completed. No other safety related equipment is located in this area. Loss of the surge tank function and its attached piping may also occur following a seismic event, resulting in a breach of the system and cause flooding due to the loss of water. A review of the flooding analysis was performed and for the location of the tanks, the analysis already assumes this event. The resulting flood level is less than 2 inches, therefore there were no flooding concerns associated with this condition. The cause of this condition was traced back to original plant construction. A review of historical data indicates that the tanks were installed prior to the finalization of the mounting details. Apparently, final mounting of the tanks was overlooked and never completed. Extent of condition consisted of a review of the anchorage details for similar tanks (Auxiliary Building Chiller Surge Tanks) and no problems were identified. In addition the anchorage of Control Room Chilled Water Surge Tanks were reviewed and are a different design, they are hung from the ceiling. Also Braidwood station was contacted and inspections there revealed that their Containment Chiller Surge tanks are properly anchored. Corrective action consisted of the design and installation of a modification to permanently anchor the tanks. Subsequent walkdown of the area by the engineer confirmed the proper anchorage of the tanks.

   This example provides objective evidence that the structures monitoring walkdowns are effective in identifying conditions that could potentially impact the intended function of a structure, that they are entered into the corrective action program, and that appropriate corrective actions are taken.

2. In 2009, during a routine structures monitoring walkdown inspection at Byron Unit 2, a water tight door leading to a sump room in the essential service water pump room was found to have sealing problems due to a misaligned gasket. In addition, there were other mechanical related problems that caused the door linkage to bind-up and prevent the door from being properly latched to secure the door in the closed position. The shift

manager was notified and the condition was entered into the corrective action program. Immediate actions consisted of realigning the gasket, temporarily freeing up the linkage, securely latching the door in the close position, and posting a caution sign on the door to prevent the door from being opened until permanent repairs could be made. The cause of the problem appeared to be the gasket length being too long and a loss of adhesion of the gasket thus allowing the gasket to sag and fall out of the retention channel as the door was closing. Normal use of the door over time with this condition appears to have caused the mechanical damage. A work order was planned and executed which inspected the door operating mechanism and made all the necessary part replacements and repairs to allow the door to operate properly. Upon completion of the work, the water tight door went through a thorough inspection in accordance with station procedures to ensure proper operations and then was returned to full service. No similar problems were observed on other water tight doors inspected during the walkdown.

This example provides objective evidence that when conditions are found that could potentially impact the intended function of structures, they are entered into the corrective action program and appropriate actions are taken.

3. On October 8, 2011, structures monitoring walkdowns were performed at Byron Units 1 and Unit 2 for three areas in the Auxiliary Building on elevations 451’, 459’ and 467’. The elements inspected included concrete, structural steel, masonry walls, equipment foundations, roofing, components supports and structural isolation gaps. The results of the walkdowns were as follows; no issues were identified in any of the concrete inspected, two issues were identified related to loose and missing bolts associated with the structural steel inspected, several masonry wall supports, component supports and equipment base plates were identified as having general corrosion, no issues were identified with the roofing inspected, and no issues were identified with the structural isolation gaps inspected. All of the issues identified were entered into the corrective action program where they were evaluated for impact and corrective action. Evaluation determined none of the conditions reported required any immediate or near term action. Corrective actions consisted of generating work requests to replace the missing bolt, tighten the loose bolts, and clean, coat and monitor the supports and base plate with the general corrosion.

   This example provides objective evidence that the Structures Monitoring program is effective in identifying conditions that could potentially impact the intended function of structures and systems and the conditions are entered into the corrective action program and appropriate actions are taken.

4. During June 2012 at Byron, work activities required an excavation on the east side of the Turbine Building Heater Bay. The structures monitoring engineer took advantage of the excavation to perform an opportunistic inspection of the exposed concrete below grade. The excavation was approximately five feet deep and exposed an eight foot section of the heater

bay foundation. The surface adjacent to heater bay foundation is paved mostly with asphalt and is salted consistent with the remainder of the site during the winter months for safety considerations. The groundwater environment at the heater bay foundation is considered to be similar to that of other areas across the site. Hammer soundings and examination of the exposed concrete revealed the concrete to be in good condition with no signs of degradation.

This example provides objective evidence that the Structures Monitoring program performs opportunistic inspections to assess the condition of inaccessible concrete and is effective in identifying conditions that could potentially impact the intended function of structures and systems.

Braidwood Station

1. At Braidwood in 2005, during a walkdown of the exterior concrete surfaces of plant structures the following condition was observed by the structures monitoring engineer. An embedded steel plate located on the exterior surface of the U2 Refueling Water Storage Tank (RWST), 2SI01T approximately 4 inches by 4 inches in size was protruding from the concrete lined tank. The condition was entered into the corrective action program. The condition was evaluated by engineering and determined that the issue had no structural or operability concerns. The embedded plate was used as a support for a ladder that was no longer needed and subsequently removed from the tank. The affected concrete area was on the surface of the tank and did not adversely impact the structural integrity of the tank. Corrective action consisted of removing the plate and performing a concrete repair to the impacted area. The structures monitoring engineer subsequently re-inspected the area after the repair and did not note any other problems.

   This example provides objective evidence that the Structures Monitoring program is effective in identifying conditions that could potentially impact the intended function of structures and systems and the conditions are entered into the corrective action program and appropriate actions are taken.

2. A structures monitoring walkdown at Braidwood in 2006 was investigating the cause of water intrusion into the MSIV rooms. The walkdown identified degradation of the sealant material used in the isolation joints between the Main Steam Isolation Valve (MSIV) rooms and the Unit 1 and 2 Containment Buildings. The sealant material showed various signs of leakage as described below:

   – In the 2A/D MSIV Room, the vertical joint at the south corner of the wall near the floor seal opening showed signs of dry mineral deposits on the sealant up to 7 ft. above the floor. Similar deposits are observed on the floor joint in this area.

- In the 2B/C MSIV Room, the vertical joint at both corners of the room showed heavy mineral deposits, wet in-leakage, and local separation up to 8 ft. above the floor.
- In the 1A/D MSIV Room, the vertical joint at the north corner of the wall near floor seal opening showed signs of dry mineral deposits on the sealant up to 4 ft. above the floor.
- In the 1B/C MSIV Room, the joint at the floor was wet due to standing water.

The condition was entered into the corrective action program and evaluated for potential impact. Engineering determined there were no operability issues or immediate concerns and corrective action should consist of cleaning, inspecting and replacing the degraded sealant material as required to restore the isolation joints and prevent any further degradation. Work requests were prepared and the necessary work was completed to repair the joints. Subsequent inspections by the structures monitoring engineer verified the restoration of the isolation joints.

This example provides objective evidence that when conditions are found that could potentially impact the intended function of a structure, they are entered into the corrective action program and appropriate corrective actions are taken.

3. During a Structures Monitoring walkdown at Braidwood in 2006, a concrete expansion anchor was noted missing on a component support on the Station Heat System. The missing anchor was on the south east anchor on the base plate assembly. Based on an engineering review, the support still supported the piping weight; however, it did not meet the installation requirements for anchor plate assemblies according to design basis documents. Corrective action consisted of replacing the missing expansion anchor to restore the safety margin. Loose, damaged or missing anchors and bolting is just one part of the inspection criteria used whenever a structures monitoring walkdown is performed. A subsequent walkdown by the engineer confirmed the missing anchor had been replaced.

   This example provides objective evidence that the Structures Monitoring program is effective in identifying conditions that could potentially impact the intended function of structures and systems and the conditions are entered into the corrective action program and appropriate actions are taken.

The operating experience relative to the Structures Monitoring program did not identify an adverse trend in performance. The inspection methods being implemented by the program have been proven effective in detecting aging effects including change in material properties, change in material properties, loss of material, concrete cracking and spalling, cracking, cracking and distortion, cracking, loss of bond, and loss of material (spalling, scaling), increase in porosity and permeability, cracking, loss of material (spalling, scaling), increase in porosity and permeability, loss of strength, loss of material, loss of material (spalling, scaling) and cracking, loss of mechanical function, loss of preload, loss of sealing, reduction in concrete anchor capacity. Appropriate guidance for evaluation, repair, or replacement is provided for locations where degradation is found. Periodic self-assessments of the Structures Monitoring program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the Structures Monitoring program will effectively identify degradation prior to failure or loss of intended function during the period of extended operation.

Conclusion

The enhanced Structures Monitoring program will provide reasonable assurance that the identified aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.35 RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants

Program Description

The RG 1.127, Inspections of Water-Control Structures Associated with Nuclear Power Plants program is an existing program which includes the River Screen House and Essential Service Water Cooling Towers at Byron, and the Essential Service Cooling Pond and Lake Screen Structures at Braidwood. Structural components monitored under the program include structural bolting, reinforced concrete members, concrete anchors and embedments, steel components, miscellaneous steel components (trash rack bars), cooling tower elements (cooling tower fill, drift eliminators, and fiberglass support members), and earthen water-control structures (embankments, dikes). There are no dams or canals within the scope of the program. The program will be used to manage loss of material, loss of preload, cracking, loss of bond, loss of material (spalling, scaling) and cracking, increase in porosity and permeability, change in material properties, reduction in heat transfer, loss of strength, or loss of form. Environments include air-indoor uncontrolled; air-outdoor; raw water; and water flowing. Elements of the program are designed to detect degradation and unacceptable conditions, when found, are evaluated or corrected in accordance with the corrective action program. The aging management program is based on the guidance provided in NRC RG 1.127 and American Concrete Institute (ACI) 349.3R-02. Water control structures are monitored on a frequency consistent with RG 1.127. As a result of operating experience at Byron, a specific enhancement to manage the condition of the Byron Essential Service Water Cooling Towers was specified to provide reasonable assurance that the aging effects observed will be adequately managed.

The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, program is applicable to the River Screen House and Essential Service Water Cooling Towers at Byron, and the Essential Service Cooling Pond and Lake Screen Structures at Braidwood. The inspection of the water-control structures are performed at intervals no more than 5 years. Conformance to NRC's RG 1.127 was part of the original BBS design basis and is addressed in the procedures that monitor the in-service inspections of these structures.

NUREG-1801 Consistency

The RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, aging management program will be consistent with the ten elements of aging management program XI.S7, "RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Provide guidance for specification of structural bolting material, and lubricant to prevent or mitigate degradation and failure of structural bolting. **Program Elements Affected: Preventative Actions (Element 2)**

2. Revise storage requirements for structural bolting to include recommendations of Research Council on Structural Connections (RSCS) Specification for Structural Joints Using High Strength Bolts, Section 2.0. **Program Elements Affected: Preventative Actions (Element 2)**

3. Include the potential for reduction in concrete anchor capacity due to local concrete degradation. **Program Elements Affected: Parameters Monitored (Element 3)**

4. Include all aging affects addressed by ACI 349.3R in procedures and require acceptance and evaluation of structural concrete using quantitative criteria based on Chapter 5 of ACI 349.3R. **Program Elements Affected: Parameters Monitored (Element 3), Acceptance Criteria (Element 6)**

5. Clarify that loose bolts and nuts, and cracked bolts are not acceptable unless accepted by engineering evaluation. **Program Elements Affected: Parameters Monitored (Element 3), Acceptance Criteria (Element 6)**

6. Require that steel components subject to RG 1.127 are inspected for loss of material. **Program Elements Affected: Parameters Monitored (Element 3)**

7. Require inspectors work under the direction of a qualified engineer for submerged concrete inspections. **Program Elements Affected: Detection of Aging Effects (Element 4)**

8. Require special inspections also be performed in the event of large floods, hurricanes, and intense local rainfalls. **Program Elements Affected: Detection of Aging Effects (Element 4)**

9. Require increased inspection frequency if the extent of the degradation is such that the structure or component may not meet its design basis if allowed to continue uncorrected until the next normally scheduled inspection. **Program Elements Affected: Detection of Aging Effects (Element 4)**

10. Require (a) evaluation of the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence

of, or result in, degradation to such inaccessible areas and (b) examination of representative samples of the exposed portions of the below grade concrete, when excavated for any reason. **Program Elements Affected: Detection of Aging Effects (Element 4)**

11. Monitor raw water and groundwater chemistry at least once every five (5) years for pH, chlorides, and sulfates and verify that it remains non-aggressive, or evaluate results exceeding criteria to assess impact, if any, on submerged concrete. **Program Elements Affected: Detection of Aging Effects (Element 4)**

12. Based on groundwater chemistry monitoring results, select and inspect every five (5) years a structure that will be used as a leading indicator for the condition of below grade concrete exposed to groundwater. **Program Elements Affected: Detection of Aging Effects (Element 4)**

13. Require visual inspections of submerged concrete structural components by dewatering a structure or by a diver if the structure is not dewatered at least once every five (5) years. Maintenance procedures will be enhanced to require opportunistic inspection of submerged concrete structures when they are dewatered and made accessible. **Program Elements Affected: Detection of Aging Effects (Element 4)**

14. Require that degraded conditions be documented and trended until the condition is no longer occurring or until a corrective action is implemented. **Program Elements Affected: Monitoring and Trending (Element 5)**

15. Clarify parameters to be monitored and inspected at the Essential Service Water Cooling Towers to include visual inspection for loss of material and reduction of heat transfer for the cooling tower fill, and visual inspection with physical manipulation for change in material properties associated with the PVC drift eliminators and fiberglass support beams for the drift eliminators (Byron only). **Program Elements Affected: Parameters Monitored (Element 3)**

16. Manage the condition of the Byron Essential Service Water Cooling Towers (SXCTs) as follows:

    a. Monitor and trend inspection activities at the SXCTs on an increased frequency, with inspections of the entire tower on a three (3) year interval, and inspections of the fill support beams and air-inlet framing on a 1.5-year interval. The recommendations in Chapter 5 of ACI 349.3R will be used for quantitative acceptance and evaluation criteria.

    b. Develop a repair plan to address degradation of the SXCTs with specific emphasis and consideration for the fill support beams. Repairs that are required will be scheduled based on a ranking of the condition observed and the potential for the degradation to progress or propagate. **Program Elements Affected: Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5)**

Operating Experience

The following examples of operating experience provide objective evidence that the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron and Braidwood Stations</u>

1. NRC NUREG-1522: Assessment of Inservice Conditions of Safety-Related Nuclear Plant Structures, provided a compilation, from a number of sources, of information related to the condition of structures and civil engineering features at operating nuclear power plants in the United States. The results of the surveys revealed thirty-one (31) percent of the respondents reported freeze-thaw damage. BBS structures are located in a region where weathering conditions are considered severe, as shown in ASTM C33-90, Figure 1. In addition, NRC Information Notice 2013-04, Shield Building Concrete Subsurface Laminar Cracking Caused by Moisture Intrusion and Freezing, identifies the occurrence of laminar subsurface cracks in a reinforced concrete building that was caused by moisture intrusion and freezing. The loss of material (spalling, scaling) and cracking due to freeze-thaw is applicable to BBS concrete structures. However, these concrete structures were designed and constructed in accordance with ACI 318 and ACI 301 as listed in the UFSAR Table 3.8-2. The design provides for low permeability and adequate air entrainment such that the concrete has good freeze-thaw resistance. Air entrainment content conformed to the design requirements of ACI 211.1 and was determined by ASTM C231. For nominal 3/8” aggregate, the allowable limit for total air content was 7-9%. For nominal 3/4” aggregate, the allowable limit for total air content was 5-7%. For nominal 1” aggregate, the allowable limit for total air content was 4-6%. The air entrainment content for concrete requiring freeze-thaw resistance meets the minimum air entrainment requirements of Table CC-2231-2 of ASME Section III Division 2, which allows a variance of not more than 1.5% from the following values: 6% for 3/8” aggregate; 5% for 3/4” aggregate; and 4.5% for 1” aggregate.

   Operating experience review of structural concrete at BBS has not identified significant of loss of material (spalling, scaling) and cracking due to freeze-thaw of reinforced concrete structures within the scope of license renewal. Freeze-thaw degradation of localized areas on the surface of the reinforced concrete at the Byron Essential Service Water Cooling Towers has been identified, and is described in detail in the following section. This example provides objective evidence that Byron and Braidwood Stations are utilizing industry OE and implementing the industry specified actions.

Byron Station

1. Initial inspections at Byron in the 1997-1998 timeframe as well as more recent follow-up inspections between the years of 2005 and 2010 identified concrete degradation including cracking, delamination, spalling of various degrees and the presence of voids in the concrete fill support beams associated with the Essential Service Water Cooling Towers (SXCTs). The degraded conditions were entered into the corrective action program and addressed individually as they were reported. As a result of a collective assessment by the Structures Monitoring program engineer and an initiative related to long term asset management, an engineering consultant specializing in concrete degradation was retained in 2011 to perform an initial general inspection of the SXCTs. The purpose of the inspection was to determine if there were any identifiable significant concrete degradation issues and to obtain information that would aid in developing a scope of work for a comprehensive assessment of the SXCTs. Overall, the conditions observed by independent contractor during the initial general inspection were consistent with those recorded in the previous inspection reports (structures monitoring inspections), both in types of degradation and overall severity. The observed degradation was not significant, due to the relatively shallow depth of concrete degradation that was generally limited to the concrete cover over the reinforcing steel, the structural reinforcement limits the propagation of cracking further into the concrete structures, and the structural margins of affected concrete components. As a result, the observed degradation did not affect the integrity of the structure or the ability of the structure to perform its intended functions.

   As a result of the initial general inspection performed by the independent contractor a comprehensive inspection plan was developed and implemented in 2012, which included follow-up and an extent of condition evaluation. The inspection plan included an assessment of the overall condition of the SXCT structural components including the cold water basin walls, columns, diagonals, beams, plenum roof deck, fan stacks, and electric rooms. The assessment evaluated concrete quality and the cause of the noted degradation, investigated the presence of any additional voids in fill support beams, and evaluated the long-term durability of the concrete including any rebar degradation if detected. The noted concrete degradation was classified and assessed for any significant impact to structural integrity of the SXCTs. The inspection plan consisted of visual inspections of both the interior and exterior of a representative number of cells that make up the two cooling tower units. Additionally hammer soundings, exploratory openings to examine rebar, core bore samples, covermeter testing, and NDE was performed on a representative sample of the external and interior of the cells subject to the inspection. Laboratory testing included petrographic examinations, depth of carbonation testing, chloride content testing, and compressive strength testing. The inspections followed the recommendations of ACI 349.3R. In addition, the assessment also provided conceptual level recommendations, including priorities, for structural maintenance, repairs, and a periodic monitoring plan going forward.

The following is a summary of the findings provided in the inspection report:

- The SXCTs are in a serviceable to good condition and can be maintained serviceable over the next 35 years with periodic monitoring, maintenance and repair.
- The cause of the degradation observed at the fill support beams is related to the concrete. The concrete contains an absorptive coarse aggregate. The absorptive coarse aggregate absorbs moisture, which leads to cracking at the concrete surface when subject to freezing temperatures. The fill support beams are most susceptible to this condition (absorptive coarse aggregate) due to their exposure to moisture and freezing conditions.
- Operationally induced thermal cycling (thermal shock) during winter operation may lead to cracking at the unreinforced corners of certain members.
- Current practice of monitoring and repairing indentified degradation (grout repairs) is adequate for long-term maintenance of the concrete in most areas.
- Repairs to address degradation of fill support beams is currently adequate, however, there is a potential that this condition may accelerate in the future, warranting an action plan for performing global repairs on fill support beams and/or modification of the fill support beams, should current practices prove inefficient.
- No significant voids were present in the fill beams inspected.
- There was no indication of other typical degradation, due to mechanisms such as alkali-silica reactivity (ASR), significant corrosion of embedded reinforcing steel, cyclic freezing and thawing of non-air-entrained cement paste, aggressive chemical attack, abrasion, and erosion.

In summary, no conditions were identified that would challenge the near term structural capability of the SXCTs. Specific, localized degradation identified during the inspections that require repair were identified for corrective action.

Corrective actions based upon the results and recommendations provided in the inspection report consist of the following:

- Provide additional guidance in inspection procedures for the SXCTs based on the findings included in the comprehensive inspection report.
- Continue current monitoring and trending activities of the SXCTs. Increase the frequency of inspections of the entire tower to a 3-year interval, and the fill support beams and air-inlet framing to a 1.5-year interval.

- Develop a repair plan to address degradation of the SXCTs with specific emphasis and consideration for the fill support beams.
- Develop and implement mitigation actions that will minimize thermal cycling and freeze-thaw conditions at the SXCTs to reduce or minimize any future degradation.

In addition to the corrective actions specified above, enhancements related to monitoring and maintenance of the SXCTs have been included in the License Renewal RG 1.127 program to ensure the condition of the SXCTs is understood and maintained both prior to and during the period of extended operation.

This example demonstrates when adverse conditions are identified they are entered into the corrective action program and appropriate corrective actions are taken to evaluate and repair identified deficiencies.

2. On August 26, 2008, as part of routine inspection activities, diver inspections were conducted in the south intake bay of the River Screen House (RSH) at Byron. The scope of the inspections includes measurement of silt and debris in the bay and inspection of concrete surfaces and trash rack bar grills and attaching hardware as well as other mechanical equipment. The results of the inspection identified that the concrete surfaces, trash rack bar grills and attaching hardware inspected were all in good condition. The silt and debris at the RSH south intake structure exceeded the established acceptance criteria. The cause of the high silt levels was attributed to high river levels followed by relatively rapid receding river levels. This was based on historical performances of the inspection procedure and previous river levels changes. Corrective action consisted of de-silting the south bay and when de-silting of the south bay was complete as part of an extent of condition review, the north bay was inspected. Some silting was noted and removed from the north bay however the amounts were within the procedure specified acceptance criteria. In addition to the above actions, operator rounds were revised to initiate an issue report to have engineering evaluate the need for de-silting at the RSH whenever river level exceeds 676 feet. The change to the operator rounds has resulted in several proactive inspections at the RSH for the removal of silt buildup. This example provides objective evidence that periodic inspections are performed to identify conditions which could impact the intended function of these water control structures.

   This example also demonstrates when adverse conditions are identified they are entered into the corrective action program and appropriate corrective actions are taken to resolve the issues.

3. On 07/13/2010 a routine scheduled inspection was performed on the (North Basin) of the Essential Service Water Cooling Towers. This inspection utilizes a diver to inspect the water filled north basin area of the cooling towers. The basin and related equipment are inspected for silt accumulation, condition of concrete surfaces, trash rack grating, anti-vortex

box and all associated mounting hardware. Even though the average silt depth was only 2 inches, well below the acceptance criteria of six inches, arrangements were made to remove the accumulated silt. The concrete inspected revealed no deficiencies and the general condition of the concrete was noted as in good condition. The trash rack grating, anti- vortex box and all associated hardware was also noted to be in good condition. Heavy corrosion was noted on a non-safety related level transmitter support that had been previously reported into the corrective action program. As a follow-up to the heavy corrosion reported on the transmitter support, an assessment was performed by engineering and material changes are being made to the transmitter supports to use a material less susceptible to corrosion. Engineering changes and work order packages are in the process of being planned and scheduled to replace the transmitter supports.

This example provides objective evidence that periodic monitoring and inspection of the Essential Service Water Cooling Tower water filled basins are performed and are capable of identifying any degrading conditions that could impact the intended function of these water control structures.

<u>Braidwood Station</u>

1. In September 2011 the Braidwood Cooling Lake Hydrographic Survey surveillance was performed. The ultimate heat sink (UHS) is the area of the cooling lake in front of the lake screen house, and it is a part of the Essential Service Cooling Pond (ESCP). This area is excavated deeper than the surrounding lake bottom to maintain the water volume required for the UHS. The results of the September 2011 survey, performed to satisfy RG1.127 requirements, indicated a reduction in depth margin as compared to previously performed surveys. A review of historical data showed that the depth margin varied from survey to survey with no clear trend. The condition was entered into the corrective action program, the cause determined to be a build up of silt, mud and decaying vegetative growth over time, and resulted in the following corrective actions. First was to perform a visual inspection of the bottom of the UHS and determine the bottom condition with respect to presence of silt and or vegetation growth. This action was completed and revealed that the results of the survey were accurate and the reason was a build up of silt and mud. Second action was based on the results of the visual inspection, and would remove the accumulated mud and silt from the UHS to restore margin. This work was completed in February of 2013. The third action was to evaluate inclusion of the UHS parameter into the station’s margin management database. This action was completed in January of 2012. The inclusion of this parameter into the margin management database promotes effective margin management by ensuring concerns related to the margin are understood, identified, evaluated, prioritized and resolved to maintain and preserve design and operating margins to maintain nuclear safety.

   This example provides objective evidence that periodic monitoring of the water control structures are performed to identify any degradation or condition that could impact the intended function of the structure.

2. In April 2009, May 2010, and June 2011, diver inspections were performed in the 2C fore bay located at the lake screen house. The activities were periodic inspections to assess the condition of submerged equipment, as well as to identify excessive sedimentation and macro-biological fouling, and also to inspect the lake screen house forebay concrete both above and below the waterline. The concrete inspections covered the surfaces both above and below the waterline in the region upstream of the trash rack to the traveling screens as well as the regions between the traveling screens the circulating water pumps. The concrete inspections looked for any settlement, deflection, or distortion, any indications of exposed reinforcing steel, and any surface abnormalities such as voids, signs of erosion, and cracks. Conditions that do not meet the acceptance criteria are required to be reported in the corrective action program. The results of all three of the inspections revealed no degradation of any concrete inspected and sediment was found to be at acceptable levels. The other seven fore bays at the lake screen house undergo similar periodic inspections.

   This example provides objective evidence that periodic monitoring of the water control structures are performed to identify any degradation or condition that could impact the intended function of the structure.

3. In October 2006, as a result of routine periodic inspections of the complete perimeter of the cooling pond, vegetative growth was identified and reported in the corrective action program. The brush and small trees were reported as growing on and in the interior and exterior dikes and overflow spillway associated with the cooling pond. Corrective action consisted of removal of the brush and small trees that could contribute to damage and breakdown of the water control structure. This example provides objective evidence that periodic inspections and walkdowns are routinely performed to identify conditions which could impact the intended function of these water control structures.

   This example also demonstrates when adverse conditions are identified they are entered into the corrective action program and corrective actions are taken to protect and preserve the intended function of the water control structures.

The above examples provide objective evidence that the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, program is capable of detecting the aging effects. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions are taken to prevent recurrence. Appropriate guidance for evaluation, repair, or replacement is provided for locations where degradation is found. Therefore, there is confidence that continued implementation of the RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, program will effectively identify degradation prior to loss of intended function.

Conclusion

The enhanced RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants, aging management program will provide reasonable assurance that the aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.36 Protective Coating Monitoring and Maintenance Program

Program Description

The Protective Coating Monitoring and Maintenance Program is an existing condition monitoring program that provides for aging management of Service Level I coatings inside BBS containments in air with borated water leakage environments including selection, application, inspection, and maintenance. The program is comparable to RG 1.54, Revision 2. The failure of the Service Level I coatings could adversely affect the operation of the Emergency Core Cooling Systems (ECCS) by clogging the ECCS suction strainers. Proper maintenance of the Service Level I coating ensures that coating degradation will not impact the operability of the ECCS systems. The program includes a visual examination of all reasonably accessible Service Level 1 coatings inside containment during every refueling outage and includes assessment and repair for any condition that adversely affects the intended function of Service Level I coatings.

Service Level I coatings will prevent or minimize the loss of material due to corrosion but these coatings are not credited for managing the effects of corrosion for the carbon steel containment liners and components at BBS. This program ensures that the Service Level I coatings maintain adhesion so as to not affect the intended function of the ECCS suction strainers.

The program also provides controls over the amount of unqualified coating which is defined as coating inside the containment that has not passed the required laboratory testing, including irradiation and simulated Design Basis Accident (DBA) conditions. Unqualified coating may fail in a way to affect the intended function of the ECCS suction strainers. Therefore, the quantity of unqualified coating is controlled to ensure that the amount of unqualified coating in the containment is kept within acceptable design limits.

NUREG-1801 Consistency

The Protective Coating Monitoring and Maintenance Program aging management program will be consistent with the ten elements of aging management program XI.M1, "Protective Coating Monitoring and Maintenance Program," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Add recurring work orders requiring Service Level I coating inspections every refuel outage. **Program Element Affected: Detection of Aging Effects (Element 4)**

2. Require qualification of coating inspectors to ASTM D 5498. **Program Element Affected: Detection of Aging Effects (Element 4)**

3. Require qualification of personnel in accordance with ASTM D 7108. **Program Element Affected: Detection of Aging Effects (Element 4)**

4. Incorporate guidance for inspection and maintenance of Service Level I coatings per Regulatory Guide 1.54 and impose ASTM D 5163-08 requirements for Service Level I coatings condition assessment, reporting, evaluation, and documentation. **Program Elements Affected: Program Scope (Element 1); Parameters Monitored or Inspected (Element 3); Detection of Aging Effects (Element 4); Monitoring and Trending (Element 5); Acceptance Criteria (Element 6)**

5. Require thorough visual inspections of all coatings near sumps or screens associated with the Emergency Core Cooling System (ECCS) by the coatings inspector(s). **Program Element Affected: Detection of Aging Effects (Element 4)**

6. Specify instruments and equipment that may be needed for Service Level I coatings inspections. **Program Element Affected: Detection of Aging Effects (Element 4)**

Operating Experience

The following examples of operating experience provide objective evidence that the Protective Coating Monitoring and Maintenance Program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron Station</u>

Qualified inspectors perform Service Level I inspection inside containment every refuel outage for each unit. In addition, Service Level I coatings are inspected during IWE inspections, Structures Monitoring Program inspections, and through the corrective actions process for identification and timely correction of any discovered coating deficiencies. Review of recent Service Level 1 coatings inspections and repair documentation show that coatings deficiencies identified in the containment buildings have not been significant and are usually limited to minor peeling, blistering, delamination, and minor surface rust, which have not result in blocked ECCS strainers or sumps.

The following operating experience is one of many examples of the site coating coordinator performing an evaluation of the site qualified coating inspection on a Service Level I coating.

1. In April 2008, during a Unit 1 refuel outage, the site coatings coordinator performed an evaluation of the results of the Unit 1 containment coatings Level I inspection, which was performed by a Level III qualified coating inspector in accordance with the coatings program implementing procedures. This inspection covered 100% of the accessible Service Level I coatings in containment. The coatings coordinator concluded that there were no imminent coating concerns in the Unit 1 containment that would impeded the safe operation, safe shutdown, or startup of the plant. The overall condition of the coating systems in the Unit 1 containment were deemed good. However, several recommendations were made for repairs during future outages. The recommended repairs included restoration of level I coatings to several floor and wall areas, restoration of Level I coating on an electrical panel at the ‘B’ Reactor Coolant Pump, and restoration of Level I coating on the containment emergency hatch. The evaluation and recommendations were documented in the corrective actions program. Work requests were created and repairs were made in a subsequent refuel outage. In addition, it was noted by the coatings coordinator performing the evaluation of the inspection report acceptance criteria that there were confusing statements as to what constituted a “satisfactory” inspection versus an “unsatisfactory” inspection. As a result, the coatings coordinator was assigned an action tracking item to revise the inspection procedure acceptance criteria to provide clear definitions as to what constitutes “satisfactory” versus “unsatisfactory” inspection results.

   This operating experience demonstrates that service level I coatings at Byron are inspected during refuel outages by qualified coating inspectors, inspection results are evaluated using acceptance criteria by the coatings coordinator and the coatings are being properly maintained to ensure the operability of ECCS systems.

2. In August 2004, while reviewing a work order to apply Level I coating to several pipe supports in the containment building, Byron maintenance personnel identified that the supports were attached to pipes that contained fluid with temperatures in excess of 630 degrees F. The maintenance technician noted that the engineering design change package, which specified the application of coating to the supports, did not specify a particular Service Level I coating to use for this application. In addition, there were no Service Level I qualified coatings in stock approved for these relatively high temperature applications. The issue was entered into the corrective action program for resolution. The Byron coatings coordinator evaluated the issue concluding that the supports did require coating per station piping and supports design specifications. Engineering also identified a suitable coating for the application, which was previously used at another station for a similar high-temperature application. The coating identified was Carbozinc 11SG from Carboline. The coating was approved

for use at Byron and the supports were subsequently coated with the high temperature rated coating.

This operating experience demonstrates Byron's use of the corrective action process in documenting conditions adverse to quality with respect to the coatings program. It also demonstrates that appropriate communications exist between maintenance and engineering personnel to ensure Service Level I coatings are specified and applied to withstand the service environments expected for the applications so that operability of ECCS systems are not compromised by misapplication of an improper coating.

3. In September 2002, during work package preparations to apply Service Level I coatings to lead shielding boxes inside the Unit 1 containment during an upcoming refuel outage, maintenance planning personnel discovered that a previously coated lead shielding box that currently resided in the Unit 2 containment did not receive proper surface preparation before applying the Service Level I coating as required per the applicable work order. The issue was entered into the corrective action program and the coating was entered into the unqualified coating log for Unit 2. The issue was evaluated by the coatings coordinator. The coatings coordinator determined that the addition of the coating on the lead shield box in the unqualified coating log did not significantly affect the unqualified coating margins for the Unit 2 containment in the post-LOCA debris calculation and the lead shield box could remain inside the Unit 2 containment. As part of the corrective actions, maintenance personnel responsible for coatings work, were counseled on paying attention to detail to ensure proper surface preparation before applying Service Level I coatings.

   This operating experience demonstrates the use of the corrective action process in documenting conditions adverse to quality with respect to the coatings program. It also demonstrates the attention to detail on the part of station personnel involved with the application of Service Level I coatings in ensuring Service Level I coatings are applied correctly so that operability of ECCS systems are not compromised by the improper application of Service Level I coatings.

<u>Braidwood Station</u>

Qualified inspectors perform Service Level I inspection inside containment every refuel outage for each unit. In addition, Service Level I coatings are inspected during IWE inspections, Structures Monitoring Program inspections, and through the corrective actions process for identification and timely correction of any discovered coating deficiencies. Review of recent Service Level 1 coatings inspections and repair documentation show that coatings deficiencies identified in the containment buildings have not been significant and are usually limited to minor peeling, blistering, delamination, and minor surface rust, which have not result in blocked ECCS strainers or sumps.

The following operating experience is one of many examples of the site coatings coordinator performing an evaluation of the site qualified coating inspection on a Service Level I coating.

1. In May 2012, during a Unit 1 refuel outage, the site coatings coordinator performed an evaluation of the results of the Unit 1 containment coatings Service Level I inspection, which was performed by a Level III qualified coating inspector in accordance with the coatings program implementing procedures. This inspection covered 100% of the accessible Service Level I coatings in the Unit 1 containment. Several deficiencies were identified including several instances of corrosion. In all cases, the corrosion was evaluated and determined to be insignificant corrosion that would not impact the intended functions of the components and would be monitored, repaired as necessary, and trended by the coatings program in future outages. Recommendations for repairs during future outages included re-coating the liner plate in several locations where the top coat and primer coat were missing, coat areas of uncoated welds on Component Cooling lines that showed signs of rusting, coat uncoated piping field welds and pipe hangers associated with the Reactor Containment Fan Coolers (RCFC) plenums, clean and re-coat surface rust on several structural steel members, hangers, piping, and valves where corrosion was identified by the inspector. The evaluation and recommendations were documented in the corrective actions program and a work request was created to schedule the recommended repairs for a future outage.

   This operating experience demonstrates that service level I coatings at Braidwood are inspected during refuel outages by qualified coating inspectors, inspection results are evaluated by the coatings coordinator, and the coating maintenance initiated to ensure the operability of ECCS systems.

2. In May 2007, Westinghouse issued a Technical Bulletin (TB-06-15, Rev. 1) to communicate information regarding the design basis accident (DBA) qualifications of two specific original coating systems used on equipment inside the Braidwood containment that was supplied by Westinghouse. Historical documentation for Braidwood Station showed that these coatings were considered undocumented coatings and were included in the Braidwood quantity of unqualified coatings. Unqualified coatings are considered as part of the debris mix that reaches the Emergency Core Cooling System (ECCS) Sump screens. In the Technical Bulletin, Westinghouse concluded that the coating systems may be considered DBA-acceptable coatings for use inside PWR containments. Upon receiving the Technical Bulletin, the issue was entered it into the corrective action program for evaluation on the impact to the coating program. Braidwood Site Engineering further evaluated the subject coatings. The evaluation determined that since the coatings in question are near the Reactor Coolant piping and would be in the zone of influence upon a Reactor Coolant pipe break, the coatings would still be assumed to fail even though they were qualified. Therefore, as a result of the evaluation, the margins for loose

debris in the ECCS suction strainers under design bases accidents were not increased.

This operational experience demonstrates the use of the corrective action process to evaluate pertinent operating experience associated with the station coatings program and that the program owner makes changes as necessary to improve the program. It also demonstrates the adequacy of the coatings program and level of engagement of Braidwood personnel in tracking unqualified coatings impact to ECCS suction debris margins.

3. In April 2011, during a Unit 2 refuel outage, the station coatings inspector identified that Component Cooling piping in the Unit 2 containment contained unqualified coating. This inspection covered 100% of the accessible Service Level I coatings in the Unit 2 containment. It was known previously that this piping contained unqualified coatings, but after reviewing the Unit 2 containment unqualified coatings log it was discovered that a lesser amount of unqualified coating on this piping was listed in the log. The original log entry showing the amount of piping containing unqualified coating was an original entry made during the ECCS sump strainer modification and was based on an erroneous assumption from a walkdown of the identical piping in the unit 1 containment. The discovery was entered into the corrective action program and an evaluation of the Unit 2 unqualified coating margin was promptly performed to determine the significance of the issue. The evaluation performed a margin assessment and determined that adequate margin still existed to the ECCS suction strainer debris limits. The post-LOCA debris generation calculation was revised to reflect the actual discovered amount of unqualified coatings on the Component Cooling piping. As part of the corrective action process, an extent of condition evaluation was also performed to determine the risk to Unit 1 if similar conditions also existed with this same piping. Since Unit 1 was not in an outage, a walkdown could not be immediately performed to determine the impact. Therefore, the evaluator conservatively assumed that the same amount of Component Cooling piping also contained unqualified coatings in the Unit 1 containment. The results of the evaluation concluded that adequate margin remained to the ECCS suction strainer debris limits. The extent of condition evaluation was also entered into the corrective action program and a walkdown of the Unit 1 containment was scheduled for the next Unit 1 outage to confirm the assumptions made in the extent of condition evaluation. The results of the walkdown found that the actual amount of unqualified coatings on the subject piping was less than the amount depicted in the calculation and thus, there was actually more margin to the ECCS suction strainers debris limits. The post-LOCA debris generation calculation was revised accordingly prior to startup.

   This operational experience demonstrates the quality of coating inspections that are performed during refuel outages by the station coating inspectors. It also demonstrates the adequate use of the corrective action process in determining margins pertaining to the coatings program and the need for extent of conditions evaluations when issues adverse to quality are discovered during the implementation of this procedure.

The above examples provide objective evidence that the Protective Coatings Monitoring and Maintenance aging management program is capable of both detecting and trending the aging effects associated with Service Level I coatings. A review of the operating experience examples showed that inspections have not identified any instances of significant age-related deficiencies. Problems identified during the last several refuel outages would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for evaluation, repair, or replacement is provided for locations where degradation is found. Therefore, there is sufficient confidence that implementation of the Protective Coatings Monitoring and Maintenance aging management program will effectively identify loss of intended function during the period of extended operation.

Conclusion

The enhanced Protective Coating Monitoring and Maintenance Program will provide reasonable assurance that the loss of coating integrity aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.37 Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

Program Description

The Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program is a new condition monitoring program. This new program will provide reasonable assurance that the intended functions of the insulation materials used for non-EQ electrical cables and connections within the scope of license renewal exposed to adverse localized environments caused by heat, radiation or moisture will be maintained through the extended period of operation.

In most areas of BBS, the actual ambient environments (e.g., temperature, radiation, or moisture) are less severe than the plant design environment. However, in a limited number of localized areas, the actual environments may be more severe than the plant design environment for those areas.

Conductor insulation materials used in electrical cables and connections may degrade more rapidly than expected in these adverse localized environments. For BBS, adverse localized environments would be those areas that have temperature, radiation or moisture significantly higher than the plant design ambient conditions, and could appreciably increase the aging rate of the insulation materials used for cables or connections or have an adverse effect on operability. Adverse localized environments will be identified through an integrated approach, considering Environmental Qualification (EQ) of Electric Components program temperatures, radiation and moisture data, consultations with plant operations, maintenance and engineering staff, current temperature measurements, and industry and plant specific operating experience.

Most of the cables and connections exposed to adverse environments are accessible. Accessible electrical cables and connections installed in adverse localized environments will be visually inspected at least every 10 years for cable jacket and connection insulation surface anomalies such as embrittlement, discoloration, cracking, melting, swelling, or surface contamination, that could indicate incipient conductor insulation aging degradation from temperature, radiation, or moisture. If an unacceptable condition or situation is identified for a cable or connection, then by way of the corrective action program, a determination will be made as to whether the same condition or situation is applicable to inaccessible cables or connections. Repair, replacement, or extent of condition inspections will be initiated as appropriate.

This new aging management program applies to the insulation materials used for non-EQ cables and connections within the scope of license renewal at BBS. By definition, non-EQ cables and connections are either not exposed to harsh accident conditions or are not required to remain functional during or following an accident to which they are exposed. However, because EQ and non-EQ cables are not distinguishable by field inspection, no effort is necessary to separate EQ and non-EQ cables, in an area inspected, making the scope of cables inspected conservatively large. Therefore, by definition and the inspection scoping process, this program adequately incorporates the concern that deteriorated cable system failures might be induced during accident conditions.

The Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will be implemented prior to the period of extended operation. In addition, the first inspections will be completed prior to the period of extended operation.

NUREG-1801 Consistency

The Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will consistent with the ten elements of aging management program XI.E1, “Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

Byron and Braidwood Stations

1. Licensee Event Report, LER 50-250/2004-005-00 describes an occurrence of heat damage to cables that were routed in conduit near the reactor coolant system hot legs. This Operating Experience (OE) was entered into the corrective action program at Byron and Braidwood stations and was evaluated by engineering at both stations. During the review of this industry OE, the program owner confirmed that the design conditions described in the LER were not applicable to Byron and Braidwood due to differences in plant area configuration, cable specification, environmental ambient conditions, design and maintenance of HVAC systems, design of raceways, and monitoring of environmental conditions. Walkdowns during refuel outages at both Byron and Braidwood were also performed to specifically look for conditions similar to that described in the LER and corrective actions were completed for several minor issues. These minor issues were

related to flexible conduit found to be in close proximity to Reactor Coolant cold leg piping. The conduit was retrained away from the piping as a precautionary measure and It was determined that there was no age related degradation issues associated with heat damage to cables that were routed near high temperature areas.

This example provides objective evidence of the robustness of Byron and Braidwood insulation design and the effective utilization of industry operating experience in assessing the conditions of the insulation materials used in electrical cables and connections located in potentially adverse localized environments.

2. In September 2010, an industry operating experience review was performed at Byron and Braidwood for NRC Information Notice (IN) 2010-02, "Construction-Related Experience with Cables, Connectors and Junction Boxes." The Notice discusses three issues. The first two describe inadequacies in installation and design of cables, connectors and junction boxes. The third issue describes issues with cables subjected to adverse localized temperature environments, in excess of design temperatures. During the review of this industry OE, the program owner confirmed that design criteria requiring separation from heat sources, electrical calculations, and maintenance practices at Byron and Braidwood minimize the occurrence of heat-related cable issues at Byron and Braidwood. This evaluation also included a keyword search in previous and current corrective action programs at Byron and Braidwood for cable failures to ensure no cable failure related to the issues documented in the information notice have occurred at Byron or Braidwood. No related issues were found at Byron or Braidwood.

   This example provides objective evidence that existing design and installation practices minimize the occurrence of cable and connection insulation damage due to potentially adverse localized environments and the effective utilization of industry operating experience in assessing the conditions of the insulation materials used in electrical cables and connections located in potentially adverse localized environments.

<u>Byron Station</u>

1. In January 2010, during inspection of a ventilation damper actuator, Byron plant personnel discovered a cracked and brittle cable jacket on a control wire. There was no damage found to the underlying wire insulation. The issue was entered into the corrective action program and an immediate operability evaluation was performed by engineering and operations personnel. The work order for the damper inspection was revised to repair the cable jacket and the cable jacket was subsequently repaired by maintenance personnel. The cause of the cracking and embrittlement was attributed to aging of the cable jacketing.

   This example provides objective evidence that existing maintenance practices and the corrective action program effectively identify and correct observed cable jacket and insulation deficiencies before these deficiencies effect the component intended function.

Braidwood Station

1. In March 2011, Braidwood maintenance personnel identified localized heat damage to jacketing on a portion of the field cables that terminate at the load side of a circuit breaker associated with the pressurizer heater Motor Control Center (MCC). The issue was entered into CAP and an immediate operability evaluation was performed by engineering and operations personnel. The damaged portion of the cable was replaced by a similar cable type. This issue prompted engineering to recommend the performance of extent of condition (EOC) inspections of other similar MCC cabling. The EOC inspections consisted of performing thermography to determine if temperature anomalies exist with other similar cabling. These inspections found several other issues of heat damaged cable jacketing within pressurizer heater MCCs. These additional issues were entered into CAP, operability determinations were made, and repairs were made by maintenance personnel. Because more issues were found with similar cabling, an Equipment Apparent Cause (EACE) was performed as part of the corrective action program. The cause of the heat damage to the cables was attributed to the design layout of the MCCs leading to the lack of heat dissipation around the cabling and ultimately, in accelerated insulation degradation of the cables. The results of this EACE was the implementation of several corrective actions including establishing appropriate Preventative Maintenance (PM) to perform periodic replacement of the stab assembly and field cables for the pressurizer heater MCCs, investigation into long-term design enhancements to the MCC stab assembly and field cabling to alleviate the lack of heat dissipation condition, revisions to maintenance procedures to inspect the field cabling and stab assemblies to look for cable insulation and jacket degradation.

   This example provides objective evidence that existing maintenance practices and the corrective action program effectively identify and correct observed cable jacket deficiencies. In addition, this operating experience provides objective evidence that this program will be capable of monitoring, detecting, and initiating corrective actions to resolve aging effects associated with non-EQ electrical cables and connections.

The above examples provide objective evidence that the inspection methods that will be implemented by the Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will be capable of detecting signs of accelerated age related degradation. A review of the operating experience examples showed that the problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program will be performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will effectively identify degradation prior to the loss of intended function during the period of extended operation.

Conclusion

The new Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program will provide reasonable assurance that the reduced insulation resistance aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.38 Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits

Program Description

The Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits aging management program is a new condition monitoring program that will be used to manage aging of non-EQ cable and connection insulation of the in scope portions of the radiation monitoring system (Byron and Braidwood) and portions of the reactor protection system (Braidwood neutron monitoring only).

The in scope process radiation monitoring and neutron monitoring circuits are sensitive instrumentation circuits with high voltage, low-level current signals and are located in areas where the cables and connections could be exposed to adverse localized environments caused by temperature, radiation or moisture. These adverse localized environments can result in reduced insulation resistance causing increases in leakage currents. By reviewing the results obtained during normal calibration or surveillance, severe aging degradation may be detected prior to the loss of the cable and connection intended function.

Calibration testing will be performed for the in-scope process radiation monitoring circuits because the cables are included as part of the calibration circuit. A proven cable test will be performed for the in-scope neutron monitoring circuits. These calibration and cable tests will be performed prior to the period of extended operation. The first review of the results will be assessed for reduced insulation resistance prior to the period of extended operation and at least once every 10 years during the period of extended operation. Potential degradation of cable or connection insulation is evaluated in accordance with the corrective action program.

This new program will be implemented prior to the period of extended operation.

NUREG-1801 Consistency

The Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits aging management program will be consistent with the ten elements of aging management program XI.E2, “Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron Station</u>

1. In January 2010, a formal impact assessment of the Westinghouse Technical Bulletin TB-09-8, "Nuclear Instrumentation System Ex-Core Detector Cable Tape Enhancement" was performed by the subject matter expert at Byron in accordance with the Operating Experience (OPEX) Program. Technical Bulletin TB-09-8 states that some nuclear instrumentation system ex-core detector cable insulation tape was damaged during installation of the assembly or found worn after a period of operation due to vibration. The tape functions as low voltage electrical isolation between the cable sheaths and the detector well wall. Damage to the tape can allow the cable sheath to come in contact with the detector well wall and be a source of noise for the detectors. The noise introduced into the signal does not interfere with the overall signal transmission. The Technical Bulletin recommends adding a second layer of insulation tape to the installed detector cable sheaths that have an electrical isolation problem or to the spare detectors cable sheaths in inventory prior to installation. New detectors supplied after 2009 have a second layer of insulation tape installed at the factory.

   The impact assessment was documented in the corrective action program. Specifically, Byron only utilizes power range detectors from Westinghouse. The installed power range detectors do not have a second layer of tape installed on the cables. An internal OPEX search did not identify any noise problems associated with the power range detectors or any indication that the installed detector cables were damaged at Byron. Therefore, a second layer of tape was not required to be applied to the installed detector cables. However, the spare detector did not have two layers of tape installed on the detector cable. In March 2011, the spare detector at Byron had a second layer of fiberglass tape applied to the detector cable.

   This example provides objective evidence that industry operating experience is assessed and applied to plant maintenance practices. Furthermore, this example demonstrates that existing maintenance practices and the corrective action program effectively identifies and resolves observed problems in instrumentation circuits.

2. The radiation monitor system utilizes digital processing techniques to analyze data and control monitor functions. Some of the radiation monitoring channels utilizes an automatic radioactive check source function. On March 11, 2011, the Byron Unit 2 Auxiliary Building Ventilation Stack Wide Range Gas Monitor (2PR030) received a “check source failure” alarm. This condition was entered into the corrective action program. Troubleshooting identified that the manufacturer’s detector cable had an intermittent conductor break that precluded the detector signal from getting to the pre-amp. The cable break appeared to be due an existing manufacturing defect when it was installed into the plant. The cable was replaced and the radiation monitor was return to service. The radiation monitor performed normally afterwards.

   This example demonstrates the corrective action program is effective in evaluating and resolving problems with instrumentation cable and connections.

3. On May 1, 2006, during system trending by the radiation monitoring system manager, it was identified that the Byron Unit 1 Main Steam Line radiation detectors indications did not change over the previous 30 days. This was an unusual trend when compared to the same radiation monitors on Byron Unit 2 and Braidwood. The unusual trend was entered into the corrective action program and a work order was created to inspect the radiation monitor. Subsequent troubleshooting of the radiation monitor determined that an instrumentation circuit had drifted out of calibration. The instrument circuit was re-calibrated and the radiation monitor was returned to service. The radiation monitor performed normally afterwards.

   This example demonstrates that system manager performance monitoring practices will detect adverse trends and the corrective action program effectively identifies and resolves observed problems in instrumentation circuits prior to the loss of its intended function.

Braidwood Station

1. In January 2010, a formal impact assessment of the Westinghouse Technical Bulletin TB-09-8, "Nuclear Instrumentation System Ex-Core Detector Cable Tape Enhancement" was performed by the subject matter expert at Braidwood in accordance with the Operating Experience (OPEX) Program. Technical Bulletin TB-09-8 states that some nuclear instrumentation system ex-core detector cable insulation tape was damaged during installation of the assembly or found worn after a period of operation due to vibration. The tape functions as low voltage electrical isolation between the cable sheaths and the detector well wall. Damage to the tape can allow the cable sheath to come in contact with the detector well wall and be a source of noise for the detectors. The noise introduced into the signal does not interfere with the overall signal transmission. The Technical Bulletin recommends adding a second layer of insulation tape to the installed detector cable sheaths that have an electrical isolation problem or to the spare detectors cable sheaths in inventory prior to installation. New

detectors supplied after 2009 have a second layer of insulation tape installed at the factory.

Braidwood utilizes power range, source range and intermediate range detectors from Westinghouse. The installed detectors at Braidwood do not have a second layer of tape installed on the cables. This condition was entered into the corrective action program. Work instructions have been added to all of the Braidwood detector change out packages to verify two layers of tape are installed, or if not, add a second layer prior to installation. Including steps in the individual detector checkout and installation work orders ensures that the OPEX from the Technical Bulletin is addressed even if a pre-2009 detector is obtained from another utility in the future. An internal OPEX search at Braidwood for the extent of condition identified that the 2N32 source range detector experienced some noise problems, that is spiking, during a previous outage (October 2009). The 2N32 detector was replaced during the next outage (May 2011) with the second layer of insulation tape installed on the cable sheath. There are no further noise problems regarding the 2N32 source range detector at Braidwood.

This example provides objective evidence that industry operating experience is assessed and applied to plant maintenance practices. Furthermore, this example demonstrates that existing maintenance practices and the corrective action program effectively identifies and resolves observed problems in instrumentation circuits.

2. Braidwood utilizes the recommended Westinghouse’s predictive maintenance guide for incore detectors. The predictive maintenance activities are based on the field performance of the detectors, review of work history, and test result trend data, including signal cable resistance checks. In October 2010, the as-found resistance measurement taken between outside of the 1N32 source range signal cable connector to plant ground did not meet the procedure acceptance criteria. Specifically, the as-found resistance was low. Low resistance readings are an indication of a short from the signal cable outer shield to ground. This condition was entered into the corrective action program. Further troubleshooting of the 1N32 detector cable using TDR testing identified that location of the low resistance was near the detector inside the detector well. The maintenance technician was able to slightly manipulate the 1N32 detector carriage upper slide and detector cable while maintaining the detector in the “full-in” position. This adjustment of the detector cable eliminated the contact between the cable sheath and the detector well wall. This was proven by the acceptable as-left resistance measurement and the as-left TDR trace. An engineering evaluation assessed the impact to the intended functions of the signal cable system and concluded that the intended function of the cable was not adversely impacted by the apparent intermittent contact between the cable sheath and the detector well wall due to localized damage to the insulation tape. An additional layer of high temperature fiberglass tape was applied to the detector cable sheath in May 2012 which permanently resolved the condition.

This example provides objective evidence that this program will detect problems with instrumentation cable and connections prior to the loss of an intended function. This example also demonstrates the corrective action program is effective in evaluating and resolving problems with instrumentation cable and connections.

3. Recommendation 3 in SOER 93-1, Diagnosis and Mitigation of Reactor Coolant System Leakage Including Steam Generator Tube Ruptures states, in part, that for radiation monitoring systems that are used in emergency operating procedures, the results from the periodic detector background and source checks should be reviewed and trended to detect performance degradation. Accordingly, the radiation monitoring systems at Braidwood that are used in emergency operating procedures are managed in accordance with the Conduct of Plant Engineering Manual. Therefore, the performance of the radiation monitoring system is formally reviewed and trended with an established system monitoring plan developed in accordance with the System Performance Monitoring and Analysis standard. Specifically, the source check information is periodically downloaded from the main steam line radiation monitor’s microprocessors and analyzed by the radiation monitor system manager. The result of this analysis is documented annually in the radiation monitor system health report. No adverse trends have been identified regarding the Braidwood main steam line radiation monitors.

   This example provides objective evidence that industry operating experience is assessed and applied to plant performance monitoring practices. Furthermore, this example demonstrates that the system manager performance monitoring practices will detect adverse trends in instrumentation circuits prior to the loss of its intended function.

The above examples provide objective evidence that the inspection methods that will be implemented by the Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits aging management program will be capable of detecting aging effects including reduced insulation resistance. A review of the operating experience examples showed that the problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits aging management program will be performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits aging management program will effectively identify degradation prior to the loss of intended function during the period of extended operation.

Conclusion

The new Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits program will provide reasonable assurance that the reduced insulation resistance aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.39 Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

Program Description

The Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program is a new condition monitoring program that manages non-EQ, in scope, inaccessible or underground (e.g., in conduit, duct bank, or direct buried) power cables that are exposed to significant moisture. For this program, power is defined as greater than or equal to 400 V. Significant moisture is defined as periodic exposure to moisture that lasts more than a few days (e.g., cable wetting or submergence in water). Periodic exposures that last less than a few days (e.g., normal rain and drain) are not significant. Power cable exposure to significant moisture may cause reduced insulation resistance that can potentially lead to failure of the cable's insulation system.

The cables in the scope of this aging management program will be tested using a proven test for detecting reduced insulation resistance of the cable’s insulation system due to wetting or submergence, such as Dielectric Loss (Dissipation Factor or Power Factor), AC Voltage Withstand, Partial Discharge, Step Voltage, Time Domain Reflectometry, Insulation Resistance and Polarization Index, Line Resonance Analysis, or other testing that is state-of-the-art at the time the test is performed. Corrective actions such as more frequent testing or replacement of the affected cable are taken and a determination is made as to whether the same condition or situation is applicable to other accessible or inaccessible, in-scope power cables when test results do not meet acceptance criteria or operating experience suggests more frequent testing is necessary. The cables will be tested at least once every 6 years. The first tests will be completed prior to the period of extended operation.

Periodic actions will be taken to prevent inaccessible cables from being exposed to significant moisture. Manholes associated with the cables included in this aging management program will be inspected to assure cables are not wetted or submerged, cables and connections are intact without observable surface damage, cable support structures are intact, and drainage systems or dewatering devices and associated alarms, if installed, are operating properly. Corrective actions such as draining manholes, installation of permanent drainage systems, or installation of sump pumps and alarms are implemented when inspection results do not meet acceptance criteria. The frequency of inspections for accumulated water will be established and adjusted based on plant specific operating experience with cable wetting or submergence, including water accumulation over time and event driven occurrences such as heavy rain or flooding. Operation of dewatering devices, if installed, will be verified prior to any known or predicted heavy rain or flooding event. The inspections will occur at least annually.

The Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will be implemented prior to the period of extended operation. The first inspections and tests will be completed prior to the period of extended operation.

NUREG-1801 Consistency

The Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will be consistent with the ten elements of aging management program XI.E3, "Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron and Braidwood Stations</u>

1. In 2007, the NRC issued GL 2007-01, requesting failure histories and associated information describing cable inspection, testing and monitoring programs to detect the degradation of inaccessible power cables, for circuits that are in scope for Maintenance Rule. The purpose of the generic letter was to: inform licensees that the failure of certain power cables can affect the functionality of multiple accident mitigation systems or cause plant transients, inform licensees that the absence of adequate monitoring of cable insulation could result in abrupt failures, and request information about current associated test practices. The generic letter was entered into the Corrective Action Program (CAP) at Byron and Braidwood. The responses by Byron and Braidwood were documented in the Exelon corporate response to the generic letter. In reviewing plant specific operating experience related to inaccessible power cables, both Byron and Braidwood found no history of failures attributed to wetting or moisture intrusion of inaccessible or underground power cables. The review examined the plants' CAP, Maintenance Rule database, maintenance records, and circuit and raceway schedules to identify all power cable failures. In addition, both Byron and Braidwood described their cable condition monitoring program, which takes advantage of motor testing that is typically performed from the switchgear, performs insulation resistance

testing for non-motor loads, and performs walkdowns to look for cable stressors such as heat and physical damage.

This example provides objective evidence that both Byron and Braidwood have not had a history of failures associated with inaccessible power cables located in potential wetted environments. It also demonstrates the effective utilization of industry operating experience in assessing inaccessible power cables located in potential wetted environments.

2. In 2008, Significant Event Notification (SEN) 272 was issued, documenting how a degraded underground cable resulted in a phase-to-ground fault and loss of offsite power to safety-related buses at a nuclear power station. Significant aspects of the event include: loss of an offsite power supply resulting in plant shutdown, a 20-day forced outage to replace six damaged and 24 additional power cables, and periodic testing in lieu of cable replacements was not effective in predicting cable degradation or preventing cable failure. Both Byron and Braidwood entered the issue into their CAP and evaluated the operating experience presented in the SEN. The evaluations by Byron and Braidwood resulted in the development of strategies to periodically inspect manholes for standing water, pump out as necessary, and the development of long term plans to install permanent de-watering systems. Both Byron and Braidwood identified and documented their inaccessible medium voltage cables along with the cable functions, the associated potential consequence of failure, identified strategies for cable testing, and preparedness for cable replacement.

   This example provides objective evidence that industry operating experience related to inaccessible power cables is assessed and incorporated into Byron and Braidwood programs and practices.

<u>Byron Station</u>

1. In August 2011, during routine inspections of manholes at Byron, engineering personnel identified 5 feet of standing water in manhole 0B2 located near the Essential Service Water Cooling Tower. This manhole is in the scope for License Renewal. Corrosion was also identified with several of the manhole cable supports. The issue was entered into the corrective action program and an evaluation of the potential impact to safety related cable within the manhole was evaluated by engineering. The evaluation determined that there was no immediate cause for concern, but that actions should be taken to remove the water and seal conduit sleeves to avoid long-term cable degradation of the cables. The source of the water was determined to be from ground water intrusion and the issue was documented as part of the cable condition monitoring program for trending. The manhole was subsequently pumped down, supports were cleaned and coated, and the preventative maintenance (PM) frequency to inspect the manhole was increased from once per year to every 3 months. Subsequent follow-up inspections performed found no water in the manhole.

This example provides objective evidence that the station is periodically inspecting manholes for water, trending results, taking corrective actions to remove any found standing water, and adjusting PM frequencies based on inspection results.

2. In May 2010, during routine manholes inspections at Byron, engineering personnel identified approximately 3 feet of water inside manhole 1M. Looking inside the manhole engineering noted there was a 2 inch flexible conduit for a cable that was found partially submerged in water. In addition approximately 5 feet of safety-related cables was also found partially submerged in water. Surface Corrosion was noted on angle framing around the sump pit & manhole cover, conduit couplings, conduit sleeves, and embedded plates. However, very little corrosion was noted on the cable supports. There was a thin dirt film on the cables and the bottom of the manhole was also dirty. Manholes are inspected at least once per year as part of the preventative maintenance (PM) at Byron. The issue was entered into the CAP and the manhole was subsequently pumped down, cleaned, and painted. In addition, the PM inspection for this manhole was changed from yearly to once per 3 months and the previously submerged cable was megger tested satisfactorily. After 3 months, the manhole was inspected again. An insignificant amount of water was found at the bottom of the manhole.

   This example provides objective evidence that the station personnel are sensitive to the potential consequences of submerged inaccessible power cables and demonstrates the effective use of the PM program in identifying manholes with standing water and adjusting inspection frequencies based on operating experience. It also demonstrates the station's use of the CAP to document and resolve issues related to standing water in manholes.

Braidwood Station

1. In April 2003, during a review of several underground cable failures reported in industry operating experience, engineering personnel identified that Braidwood was also susceptible to underground cable failures due to similarities in cable design and configuration of underground ducts and manholes. The concern was entered into the CAP. As a result, the following corrective actions were taken: 1) A plan was created to install permanent manhole automatic de-watering systems for manholes deemed critical to plant operation, 2) A plan was created to periodically inspect manholes for water and to manually pump down any manholes found with standing water, 3) Industry accepted cable testing methodologies were evaluated for use at Braidwood. These corrective actions remain in place as follows: 1) Automatic de-watering pumps have been installed in three (3) in-scope manholes with plans approved to install pumps in three (3) more in-scope manholes, 2) Service Requests have been created to periodically inspect manholes, 3) Based on industry practices and Braidwood cable design, the station implemented several state-of-the-art testing methodologies in its cable testing program.

This example provides objective evidence that Braidwood personnel are sensitive to inaccessible power cable issues and demonstrates the effective identification of industry operating experience trends involving inaccessible power cable.

2. In October 2005, during the performance of Baker motor and cable testing of the 1A Feedwater pump motor at Braidwood, the test set tripped off when voltage was applied from the 6.9 kV switchgear feeder breaker cubicle. The issue was entered into the CAP. Upon further investigation and testing, it was determined that the ‘A’ phase conductor of the 3-conductor power cable had faulted. A follow up visual inspection found a hole in the cable where the cable had faulted. The faulted section of cable was replaced. Maintenance dissected the faulted portion of the cable by cutting the insulation back to the center conductor. A pit was discovered through the thin insulation between the shield and center conductor and some damage to the shield was evident. As part of the extent of condition (EOC) evaluation, the station performed testing on other similar design power cables for the Reactor Coolant pumps, Condensate and Condensate Booster pumps, and the Heater Drain pumps. All of these tests passed. The cause of the cable fault was determined to be from debris that had fallen into the cable tray some time in the past causing a crimp in the helical copper shield, which penetrated into and contacted the center conductor through the insulation that separates the shield from the conductor.

   Although this example did not involve an inaccessible in-scope power cable, it does provide objective evidence that state-of-the art cable testing using the Baker test set, which is also used for some inaccessible power cables at BBS, is effective in finding damaged or degraded cable insulation. It also demonstrates the station’s use of the CAP to thoroughly document issues related to degraded power cable, drive an issue to resolution, and evaluate extent of conditions.

The above examples provide objective evidence that the inspection and testing methods that will be implemented by the Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will be capable of detecting aging effects including reduced insulation resistance. A review of the operating experience examples showed that the problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will be performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will effectively identify degradation prior to the loss of intended function during the period of extended operation.

Conclusion

The new Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program will provide reasonable assurance that reduced insulation resistance will be adequately managed so that the intended functions of inaccessible power cables are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.40 Metal Enclosed Bus

Program Description

The Metal Enclosed Bus aging management program is an existing condition monitoring program that will be enhanced to manage aging of in scope metal enclosed buses during the period of extended operation. The internal portions of the bus enclosure assemblies are inspected for cracks, corrosion, foreign debris, excessive dust buildup, and evidence of water intrusion. The bus insulation is visually inspected for signs of reduced insulation resistance, such as embrittlement, cracking, chipping, melting, swelling, discoloration, or surface contamination, which may indicate overheating or aging degradation. The internal bus insulating supports are visually inspected for structural integrity and signs of cracks. External surfaces are visually inspected for loss of material due to general, pitting, and crevice corrosion. Enclosure assembly elastomers are visually inspected for surface cracking, crazing, scuffing, dimensional change, shrinkage, discoloration, hardening, and loss of strength. A sample of accessible bolted connections will be inspected for increased resistance of connection using resistance measurements. The sample will be of 20 percent of the accessible metal enclosed bus bolted connection population with a maximum sample size of 25.

Metal enclosed buses are to be free from unacceptable visual indications of surface anomalies which suggest degradation exists. Additionally, unacceptable indications of external or internal material condition or contamination should not be present. An unacceptable indication is defined as a noted condition that, if left unmanaged, could lead to a loss of intended functions. Enclosure assembly elastomers are to be free from unacceptable visual indications of degradation. The selected sample of bolted connections inspected by resistance measurements will be confirmed to be within the acceptance criteria established in program implementing procedures. Unacceptable results are subject to an evaluation under the corrective action program.

The inspections and resistance measurements are performed at least once every 10 years for indications of aging degradation. The Metal-Enclosed Bus aging management program will be enhanced prior to the period of extended operation.

NUREG-1801 Consistency

The Metal-Enclosed Bus aging management program will be consistent with the ten elements of aging management program XI.E4, “Metal-Enclosed Bus,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Specify that a sample size of 20 percent of the accessible bolted connection population with a maximum sample size of 25 to be inspected for increased resistance of connection by measuring the connection resistance using a micro-ohmmeter. **Program Elements Affected: Detection of Aging Effects (Element 4)**
2. Specify that the external surfaces of metal enclosed bus enclosure assemblies are to be inspected for loss of material due to general, pitting, and crevice corrosion. **Program Elements Affected: Acceptance Criteria (Element 6)**
3. Specify maximum allowed bus connection resistance values. **Program Elements Affected: Acceptance Criteria (Element 6)**

Operating Experience

The following examples of operating experience provide objective evidence that the Metal-Enclosed Bus program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. In May 1996, the Byron Unit 1 System Auxiliary Transformer (SAT) 142-2 4kV non-segregated metal enclosed bus (MEB) had a phase to ground fault. Byron Unit 1 was in Mode 5 for an outage. Byron Unit 2 was manually tripped due to the loss of Non-Essential Service Water and Station Air Compressors powered from the Unit 1 SAT. The event was entered into the corrective action program. The root cause determined that the phase to ground fault was due to a failed insulator. The insulator failure was caused by chronic water intrusion, that is, free water dripping on the insulator. The chronic water intrusion caused the eventual degradation of the insulator. The source of the water was rain water leaking through the insulator mounting bolt hole. The bolt hole was not properly sealed because a weld seam on the top of the duct prevented the insulator mounting head gaskets from sealing properly. A contributing cause was that the caulk in this region

was not regularly examined as part of the periodic MEB inspections. Corrective actions included adding an explicit examination of the caulk to the MEB inspection surveillances, stressing the significance of the caulked joint to the MEB inspectors. There has been no indication of free water intrusion into the MEBs since these procedures were implemented at Byron.

This example provides objective evidence that the station corrective action program provides an effective mechanism for correcting identified deficiencies to assure the continued operation of the metal enclosed bus.

2. In March 2008, the Byron Unit 2 System Auxiliary Transformer (SAT) 242-2 4kV non-segregated metal enclosed bus (MEB) had a phase to ground fault. This resulted in an isolation of both Unit 2 SATs and thus a Loss of Offsite Power to Byron Unit 2. Unit 2 remained on-line throughout this event. The event was entered into the corrective action program. The root cause investigation determined that the phase to ground fault was due to a failed insulator. The insulator failure was due to age-related degradation of the insulator material. The degradation of the insulator material resulted in internal corona discharges, which is internal arcing across the insulators two metal bases. There was no indication of free water intrusion. The failed insulator was replaced in kind with a new insulator. The remaining insulators in the affected MEB were high potential tested with satisfactory results. In order to prevent reoccurrence, high potential testing was incorporated into post maintenance testing procedures for all MEB. In addition, the MEB inspection procedures were strengthened to include an inspection of the boot seals, provide direction on the application of caulking, and provide direction on the application of the weather stripping on the removable cover. There have been no similar insulator failures experienced at Byron Station since the initial event in March 2008. No issues have been noted relating to the condition of the installed insulators.

   This example provides objective evidence that the station corrective action program provides an effective mechanism for correcting identified deficiencies to assure the continued operation of the metal enclosed bus. For clarity, the inadequate sealing of the bus duct that allowed free water to drip on the insulator caused the Byron Unit 1 May 1996 event insulator failure. Whereas, the Byron Unit 2 March 2008 event was caused by age-related degradation of an insulator. Thus, based on the causal comparison between the two events it is concluded that although both involved failure of similar insulators, the mechanisms of these failures were quite different.

3. In November 2009, Significant Event Report SER 5-09 was issued for a 6.9 kV non-segregated bus failure at a nuclear power station. In response to this industry operating experience, Byron evaluated the lessons learned from this event. The results of the evaluation were incorporated into the maintenance practices that perform inspections of all MEB at Byron. For example, the Byron MEB maintenance procedure did not explicitly direct that the flexible connection bolt torques be verified during the MEB inspection. This issue was entered into the corrective action program. As a result of this operating experience, the MEB maintenance procedure was

revised to specifically verify the flexible connection bolt torques during the MEB inspection.

This example provides objective evidence that the corrective action and operating experience programs are being used to improve condition monitoring of the metal enclosed bus and prevent events that have occurred at other plants.

Braidwood Station

1. In November 2009, Significant Event Report SER 5-09 was issued for a 6.9 kV non-segregated bus failure at a nuclear power station. Braidwood has not experienced any failure with their metal enclosed bus (MEB). In response to this industry operating experience, Braidwood evaluated the lessons learned from this event. The results of the evaluation were incorporated into the maintenance practices that perform inspections of all MEB at Braidwood. For example, the MEB maintenance practices allowed the use of Robotic Inspections of the inside portions of the MEB. The videos that were made from the robot inspections were not sufficient to identify potential degraded conditions affecting reliability of the MEB. Specifically, the maintenance technicians could not discern the condition of the insulators from the video pictures because not all of the insulators were visible, nor were all of the bus segment junctions visible. In addition, the bus segment resistances were not verified, the bus segment bolt torque values were not verified, and not all of the supporting hardware was visible. This issue was entered into the corrective action program. As a result of this operating experience, the MEB maintenance work orders were revised to remove the option to perform robotic inspections of the Braidwood MEBs.

   This example provides objective evidence that industry operating experience is being used to improve condition monitoring of the metal enclosed bus and prevent events that have occurred at other plants.

2. In May 2010, during periodic maintenance inspections of the Braidwood Unit 2 System Auxiliary Transformer (SAT) 242-2 4kV non-segregated metal enclosed bus (MEB), a sample of bolted connections were torque-checked in response to a recommendation made in SER 5-09, 6.9-kV Nonsegregated Bus Failure and Complicated Scram. The as-found bolt torque checks on 16 out of 36 bolted connections on the MEB bus segment were below the minimum acceptance criteria. This issue was entered into the corrective action program. All of the 16 connections were tightened to the required torque value. The cause of the low as-found bolt torques values is most likely due to the bolted joint relaxing over time. The extent of condition inspections made by engineering and maintenance included all of the remaining SAT MEB segment connections. All locked washers connected to the bolting were flattened which indicates that the bolts were more than hand tight. There were no evidence of insulation degradation or overheating found on the MEB segment joints. Maintenance verified and if necessary, tightened all of the remaining MEB segment connector bolts to their proper torque value. There were no connections found that would

have prevented the MEB from performing its intended function. The MEB completed it post maintenance high potential test satisfactorily and has been in continuous service since the May 2010 outage.

This example provides objective evidence that the corrective action and operating experience programs ensure that best practices for condition monitoring are implemented so that degraded conditions are identified and corrected prior to equipment failure.

3. In November 2010, during periodic maintenance inspections of the Braidwood Unit 1 Unit Auxiliary Transformer (UAT) 141-1 6.9kV non-segregated metal enclosed bus (MEB), maintenance technicians discovered and reported a discoloration on a bus segment joint connection vertical MEB section. This issue was entered into the corrective action program. The cause of the discoloration was determined to be minor corrosion on the bus connections, most likely due to exposure to outdoor air. The connections were cleaned to remove the corrosion. The extent of condition investigation of the remaining connections and bus segments in the MEB found no other adverse or abnormal conditions. The post maintenance high potential test on the MEB was completed satisfactorily and has been in continuous service since the November 2010 outage.

   Although the 6.9 kV MEB is not in the scope of license renewal, this example provides objective evidence that the maintenance technicians recognize and report abnormal condition found during MEB inspections. This example also provides objective evidence that the corrective action and operating experience programs ensure that best practices for condition monitoring are implemented so that degraded conditions are identified and corrected prior to equipment failure.

The above examples provide objective evidence that the Metal-Enclosed Bus aging management program is effective in detecting aging effects including increased resistance of connection, loss of material, reduced insulation resistance and surface cracking, crazing, scuffing, dimensional change, shrinkage, discoloration, hardening and loss of strength. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Metal-Enclosed Bus aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that continued implementation of the Metal-Enclosed Bus aging management program will effectively identify degradation prior to failure or loss of intended function during the period of extended operation.

Conclusion

The enhanced Metal-Enclosed Bus program will provide reasonable assurance that the identified aging effects are adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.41 Fuse Holders (Byron Only)

Program Description

The Fuse Holders (Byron Only) aging management program is a new condition monitoring program that applies to fuse holders within the scope of license renewal located outside of active devices that are susceptible to increased resistance of connection due to chemical contamination, corrosion, and oxidation or fatigue caused by ohmic heating, thermal cycling, electrical transients, frequent manipulation, or vibration. Fuse holders located inside an active device are not within the scope of this program. This program will be used to manage aging of the metallic portions of fuse holders. Fuse holders subject to increased resistance of connection or fatigue, will be tested, by a proven test methodology, such as thermography, contact resistance testing, or other appropriate testing method, at least once every 10 years for indications of aging degradation. Unacceptable results will be subject to an evaluation under the corrective action program. Visual inspection is not part of this program.

The new Fuse Holders (Byron Only) aging management program will be implemented at Byron prior to the period of extended operation. The first tests for license renewal will be completed prior to the period of extended operation.

No fuse holders at Braidwood are required to be managed by this aging management program because there are no in-scope fuse holders located outside of active devices susceptible to aging effects at Braidwood.

NUREG-1801 Consistency

The Fuse Holders (Byron Only) aging management program will be consistent with the ten elements of aging management program XI.E5, “Fuse Holders,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Fuse Holders (Byron Only) program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron Station</u>

1. In October 2005, the Byron Unit 2 generator excitation regulator supply breaker lost indication when it was closed from the main control board for

post maintenance testing. This occurrence was entered into the corrective action program. Subsequent investigation discovered that one of two fuses in the control power trip circuit was loose. The actual fuse block was found in good condition. However, the fuse that was loose appeared to be "out of round" as it would alternately tighten and then loosen when rotated in the fuse block clips. The extent of condition investigation found the remaining fuses in the control circuit to be tight and remain tight when rotated. In addition, the CAP database was researched for applicable internal operating experience. The research, going back to mid-2001, found no other cases of loose fuses that were caused by an "out of round" condition. Furthermore, an industry operating experience review of NUREG-1760, Aging Assessment of Safety-Related Fuses Used in Low- and Medium-Voltage Applications in Nuclear Power Plants, determined that the breaker control power fuses are not susceptible to age related failures. Thus, this "out of round" fuse appeared to be an isolated event. The “out-of-round” fuse was replaced with a new fuse that was not “out-of-round.” The generator excitation regulator supply breaker was subsequently tested and operated satisfactorily. There has been no subsequent failure of the Byron Unit 2 generator excitation regulator supply breaker indication. This event was communicated to the operators and maintenance technicians to heighten their awareness of fuse holder metallic clamps issue. This communication served to re-enforce the requirement in fuse control procedure to verify the fuse clips are tight and make firm contact with the fuse end caps when re-installing/replacing fuses.

Although the generator excitation regulator supply breaker is not in the scope of license renewal and this operating experience example is not directly attributed to age degradation, this example does provide objective evidence that Byron personnel are sensitive to fuse holder issues and demonstrates the effective use of both internal and industry operating experience trends to determine the extent of condition of plant issues involving fuses and fuse holders.

2. In May 2006, a regularly scheduled thermography scan of a circulating water motor exciter panel at Byron discovered an elevated temperature on a fuse block inside the panel. This condition was entered into the corrective action program. The condition was evaluated in accordance with procedure the Thermography Program Guide. The observed temperature rise was moderate and stable, thus no immediate action was required. A work request was created to replace the fuse block. The fuse block was replaced in September 2006 during a scheduled circulating water pump outage. The cause of the high resistance connection appeared to be a loose metallic clamp. Subsequent thermography scans have found no abnormalities on the circulating water motor exciter panel fuse block.

   Although the circulating water exciter cabinet is not in the scope of license renewal, this example provides objective evidence that existing maintenance practices, detection methods, acceptance criteria, and the corrective action program effectively identifies and correct deficiencies with the metallic portions of fuse holders prior to the loss of their intended function.

3. In March 2001, the Byron predictive maintenance program established routine thermography images of the essential service water make up diesel battery chargers in accordance with industry best practices. The battery charger dc output fuse holders are informally included in this battery charger thermography activity. New thermography images of the battery chargers have been taken annually. The new thermography images are evaluated to ensure the absence of individual component abnormalities, including the battery charger dc output fuse holders, or other anomalies that causes elevated temperatures, such as a high resistance contact on an electrical connection. No abnormalities have been observed on the essential service water make up diesel battery chargers or the battery charger output fuse holders over the last 10 years.

   This example provides objective evidence that the existing maintenance practices utilized in this new aging management program will effectively manage the aging of the metallic portions of the in scope fuse holders.

The above examples provide objective evidence that the inspection methods that will be implemented by the Fuse Holders (Byron Only) program will be capable of detecting aging effects including increased resistance of connection and fatigue. A review of the operating experience examples showed that the problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Fuse Holders (Byron Only) program will be performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is confidence that the current design, installation, and maintenance practices along with implementation of the new Fuse Holders (Byron Only) aging management program will effectively identify degradation prior to failure.

Conclusion

The new Fuse Holders (Byron Only) program will provide reasonable assurance that the increased resistance of connection and fatigue aging effects will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.1.42 Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

Program Description

The Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program is a new condition monitoring program. The program consists of a representative sample of electrical connections within the scope of license renewal, which is tested at least once prior to the period of extended operation to confirm that there are no aging effects requiring management during that period. Testing may include thermography, contact resistance testing, or other appropriate testing methods without removing the connection insulation, such as heat shrink tape, sleeving, insulating boots, etc. The one-time test provides additional confirmation to support industry operating experience that shows that electrical connections have not experienced a high degree of failures and that existing installation and maintenance practices are effective.

A representative sample of non-EQ electrical cable connections will be selected for one-time testing considering application (medium and low voltage), circuit loading (high loading), connection type, and location (high temperature, high humidity and vibration). The sample tested will be 20 percent of the population with a maximum sample size of 25 connections. The technical basis for the sample selected will be documented per station procedures.

The Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program does not implement visual inspections of cable connection insulation materials as an alternative to thermography, nor does this program implement connection resistance measurement for accessible cable connections that are covered with heat shrink tape, sleeving, insulating boots, etc.

The new Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will be implemented prior to the period of extended operation. The one-time tests will be completed prior to the period of extended operation.

NUREG-1801 Consistency

The Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will be consistent with the ten elements of aging management program XI.E6, "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program will provide confirmation that the intended functions of electrical cable connections are maintained consistent with the current licensing basis for the period of extended operation:

Byron Station

1. In September 2009, operations personnel noticed changing conditions associated with the Unit 2 group D pressurizer heaters. Investigation by operations personnel determined that two 480 Vac MCC breakers, which feed pressurizer heaters A6A and A2B, were tripped open. The breakers were reset and the issue was entered into the corrective action program. Troubleshooting by maintenance personnel identified loose connections of the cable terminated to the load side of the breaker feeding the A2B heater. The connections were tightened and thermography was performed to ensure the integrity of the connections. No cause was identified for the breaker feeding A6A heater. An extent of condition evaluation and operational experience search revealed previous similar events with poor/loose connections associated with pressurizer heater MCC breakers. To determine the cause of the breaker trips, a common cause evaluation (CCA) was performed by the system manager, who investigated a total of eleven (11) issues associated with tripped pressurizer heater breakers. The CCA determined that installation deficiencies were causing the increased failure rate of these breakers. Installation deficiencies included lugs not being captured by the screw connecting the lug to the breaker terminal, insufficient lug crimps, nutserts installed incorrectly, and looseness in lug connections resulting in non-flush connections. Each of these deficiencies led to high resistance connections, which resulted in premature breaker trips. In addition, the CCA determined that the majority of the installations with deficient connections were performed by a personnel working for a particular site maintenance contractor company. Corrective actions were initiated to correct the installation deficiencies, address extent of conditions, provide lessons learned in training programs, and revise procedures to preclude future issues.

   This example provides objective evidence that the corrective action program is being effectively utilized to document issues, determine extent of conditions and common causes, and correct deficiencies to prevent recurring problems associated with cable connections.

2. In October 2005, an issue was entered into the corrective action program by maintenance personnel for repeated problems with Reactor Coolant Loop hot leg narrow range RTD wire butt splices. An investigation into several of

the failed splices revealed that the splices were not adequate in providing a low resistance connection for these low voltage, low current RTD circuits. The splices were crimp-type butt splices with an overall heat shrink sleeve. An extent of condition evaluation resulted in the identification that all of the Reactor Coolant loop RTD circuit lead wires were susceptible to problems with crimp-type butt splices. To correct the issues and to prevent reoccurrence, a design change was processed by engineering to add solder to the butt splices for the RTD circuits to alleviate high resistance connection problems.

This example provides objective evidence that operating experience is used at Byron to improve maintenance practices related to cable connections to preclude equipment unavailability or failure.

3. In July 2004, during performance of routine thermography, maintenance personnel identified a warm connection on one phase of a 480 Vac contactor associated with the cooling fans of the 2W main power transformer. The issue was entered into the corrective action program. In accordance with thermography procedures, the condition was rated as a Watch List (Blue) level with follow up thermography inspections to be performed weekly for two weeks then increased further if no changes in severity are evident. Several follow up thermography inspections showed no change in the severity of the condition. However, as a conservative measure, the contactor with its associated warm connection was replaced and the thermography temperatures returned to normal. The cause of the warm thermography readings was attributed to a high resistance connection on one phase of the contactor.

   This example provides objective evidence that the thermography program at Byron is adequate in effectively identifying cable connection issues. It also provides objective evidence of the station’s effective use of the corrective action program in documenting issues related to cable connections, performing appropriate interim actions, and taking conservative correct actions to preclude equipment unavailability or failure.

<u>Braidwood Station</u>

1. In March 2007, during routine thermography inspections, it was discovered that the temperature of the upper connection of a fuse block in Rod Drive cabinet 2RD04E was elevated indicating a possible loose connection of the wiring to the fuse block. The discovery was entered into the corrective action program. The issue was evaluated by engineering personnel and determined to not be an immediate concern. Engineering recommended the frequency of thermography inspections of the fuse and associated connections be increased from semiannually to monthly and trended. A plan was also put in place to replace the wiring connected to the fuse block during the next refuel outage or forced outage. Follow up thermography readings were trended for several months with no significant increase in the temperature of the fuse block connection and the wiring was replaced during the refuel outage. Investigation into the cause of the elevated

connections temperatures revealed a defective crimped connection on the wire lug. As part of extent of condition review, other similar Rod Drive fuses in Rod Drive cabinets and associated connections were scanned with thermography. No further issues were discovered.

This example provides objective evidence that the thermography program is adequate in effectively identifying cable connection issues. It also provides objective evidence of the station's effective use of the corrective action program in documenting issues related to cable connections, performing appropriate interim actions, and taking conservative correct actions to preclude equipment unavailability or failure prior to the loss of intended functions.

2. In March 2003, an issue report (IR) was written based on lessons learned from a recent Byron outage regarding a loose electrical connection on a fuel transfer system control console. The console vendor had inspected the connections on the console at Byron and re-soldered the ones that were loose. Braidwood pro-actively inspected the connections on their console, which was an identical model as the Byron console, and found no loose connections.

   This example provides objective evidence of Braidwood personnel use of internal operating experience to identify potential issues associated with electrical connections to preclude equipment unavailability or failure.

3. In April 2003, while performing repairs of damaged connectors inside a Reactor Protection Solid State Protection System panel, it was discovered that the wrong crimp tool was used by maintenance personnel. The tool used was not the recommended tool for the size wire per the vendor literature. The issue was entered into the corrective action program and an evaluation was made as to the adequacy of the crimped connections. As part of the evaluation, engineering and maintenance personnel performed a test on a mock-up wire and connector using the same crimp tool as was used for the panel connection repairs. It was found that the connection was adequate in providing a low resistance connection and was robust when a pull test was performed on the connection. Based on the mock-up test, the connections were allowed to remain installed in the plant. The cause of the wrong crimp tool being used was the lack of instructions in the work instruction package and the unfamiliarity of maintenance personnel with the variety of crimp tools available for the type of connections to be installed in the panel. The corrective actions taken to alleviate similar mistakes in the future included the performance of just-in-time training of maintenance personnel in the selection and use of the crimp tools for these type of connections and the creation of a work standard that contains the specific vendor crimper and die selection chart to be used for these type of connections.

   This operating experience provides objective evidence that processes controlling maintenance are assessed and corrected as improvement opportunities are identified by personnel.

The above examples provide objective evidence that the new one-time inspection and testing of Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will be capable of detecting aging effects due to thermal cycling of metallic parts of electrical cable connections. A review of operating experience showed that problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided if degradation is found. Therefore, there is confidence that the implementation of the Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements aging management program will confirm that either increased resistance of connection is not occurring or that the existing preventive maintenance program is effective such that a periodic inspection program is not required.

Conclusion

The new Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program is a one-time program that will be implemented prior to the period of extended operation. The program will provide reasonable assurance that the program will detect the presence or note the absence of increased resistance of metallic parts of electrical cable connections to aging effects due in order to confirm the effectiveness of the existing preventive maintenance program. This program will provide reasonable assurance that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.2.2 Plant Specific Aging Management Programs

There are no plant specific programs credited for managing the effects of aging.

B.3 NUREG-1801 Chapter X Aging Management Programs

This section provides summaries of the NUREG-1801 Chapter X programs credited for managing the effects of aging.

B.3.1.1 Fatigue Monitoring

Program Description

The Fatigue Monitoring aging management program is an existing preventive program that manages cumulative fatigue damage of the reactor pressure vessel (RPV) components, reactor coolant pressure boundary (RCPB) piping components, and other components subject to air-indoor uncontrolled, air with borated water, condensation, diesel exhaust, neutron flux, reactor coolant, treated water, treated borated water, and steam. The Fatigue Monitoring aging management program manages cumulative fatigue damage of piping components, piping elements, bolting, reactor vessels, reactor vessel internals, supports, and heat exchangers. The program reviews the temperature and pressure profiles of the actual operational transients and counts them in the appropriate design transient category.

The Fatigue Monitoring aging management program monitors and tracks critical thermal and pressure transients to ensure each analyzed component does not exceed the number of allowable cycles, thus ensuring that the cumulative usage factor (CUF) for each analyzed component does not exceed the design limit of 1.0 through the period of extended operation. The number of allowable cycles is based on the design fatigue analyses transient inputs. The program requires comparison of the actual operational transient parameters to the applicable design transient definitions to assure the actual operational transients are bounded. If an allowable cycle limit is approached or the severity of an actual operational transient is not bounded by the applicable design transient definition, then this condition is entered into and addressed within the corrective action program to ensure that the design CUF limit is not exceeded. The fatigue cycle monitoring data was used to project the numbers of cycles that will occur during 60 years. These projections show that the current 40 year allowable cycle limits will not be exceeded in 60 years. Therefore, the current 40 year cycle limits will be maintained for the period of extended operation. The Fatigue Monitoring aging management program will be enhanced to monitor additional plant transients that are significant contributors to cumulative fatigue damage.

Maintaining the number of cumulative cycles below the analyzed allowable cycle limits assures that the fatigue analyses remains valid. If a cycle limit is approached or the severity of an actual operational transient is not bounded by the applicable design transient definition, the condition is entered into the corrective action program. Fatigue analyses exists for BBS reactor pressure vessels (RPV) components and reactor coolant pressure boundary (RCPB) piping components in accordance with ASME Section III, Class 1 fatigue design requirements per the current licensing basis. This includes the analyses provided in the original stress reports as well as subsequent analyses developed to evaluate design changes, power rerates, and operational events. These Class 1 fatigue analyses have been identified as Time-Limited Aging Analyses (TLAAs) that are evaluated in Section 4.0 of the Byron and Braidwood License Renewal Application. In addition, components designed in accordance with ASME Section III, Class 2 and 3 and ANSI B31.1 requirements have been identified as having implicit fatigue Time-Limited Aging Analyses (TLAAs).

In addition, the program will be enhanced to evaluate the cumulative fatigue damage effect of the reactor coolant environment on reactor pressure vessel (RPV) components and reactor coolant pressure boundary (RCPB) piping components by performing environmentally assisted fatigue analyses for critical locations selected accordance with NUREG/CR-6260 guidance. Additional plant-specific component locations in the reactor coolant pressure boundary will be evaluated if they are more limiting than those considered in NUREG/CR-6260. Environmentally-adjusted cumulative usage factors (CUF_{en}) were computed for each wetted material within the analyzed component or system to assure the limiting case was analyzed. The resulting 60-year CUF_{en} values did not exceed the limit of 1.0. If a CUF_{en} allowable cycle limit is approached, the condition will be entered into and addressed within the corrective action program.

The program will also be enhanced to evaluate the effects of the reactor coolant system water environment on the reactor vessel internal components with existing fatigue CUF analyses to satisfy the evaluation requirements of ASME Code, Section III, Subsection NG-2160 and NG-3121.

NUREG-1801 Consistency

The Fatigue Monitoring aging management program will be consistent with the ten elements of aging management program X.M1, “Fatigue Monitoring,” specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. Address the cumulative fatigue damage effects of the reactor coolant environment on component life by evaluating the impact of the reactor coolant environment on critical components for the plant identified in NUREG/CR-6260. Additional plant-specific component locations in the reactor coolant pressure boundary will be evaluated if they are more limiting than those considered in NUREG/CR-6260. **Program Elements Affected: Scope of Program (Element 1), Preventive**

Actions (Element 2), Parameters Monitored/Affected (Element 3), Acceptance Criteria (Element 6); Corrective Actions (Element 7)

2. Monitor and track additional plant transients that are significant contributors to component fatigue usage. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored/Affected (Element 3), Acceptance Criteria (Element 6), Corrective Actions (Element 7)**

3. Evaluate the effects of the reactor coolant system water environment on the reactor vessel internal components with existing fatigue CUF analyses to satisfy the evaluation requirements of ASME Code, Section III, Subsection NG-2160 and NG-3121. **Program Elements Affected: Scope of Program (Element 1), Preventive Actions (Element 2), Parameters Monitored/Affected (Element 3), Acceptance Criteria (Element 6), Corrective Actions (Element 7)**

Operating Experience

The following examples of operating experience provide objective evidence that the Fatigue Monitoring program will be effective in ensuring that the intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron Station</u>

1. In April 2008, during review of Byron Unit 1 plant transient data, engineering observed a large temperature increase of 171°F in approximately one (1) hour in the pressurizer surge line. Since the Byron Technical Specifications and UFSAR chapter 3.9 limit Pressurizer heat-up rate to less than 100 F in an hour, engineering questioned whether the observed temperature increase in pressurizer surge line was applicable to Pressurizer Tech Spec requirements. Research of the Byron design basis showed that pressurizer surge line temperature transients had been analyzed by Westinghouse in 2002. The existing analysis concluded that during plant heatup and cooldown, the pressurizer surge line can undergo temperature changes as observed in the 2008 Byron transient. The analysis concluded that the surge line temperature transients affected only the pressurizer surge line and not the Pressurizer. The effects on the pressurizer surge line were bounded by the surge line stratification study and 2008 observed surge line temperature variations were within the analyzed limits.

   This example provides objective evidence that the Fatigue Monitoring aging management program challenges potential discrepancies with respect to transient severity; investigates their potential impact; and utilizes the corrective action program for investigation.

2. In 2012, Byron Unit 2 experienced a loss of offsite power. During this event the charging system auxiliary pressurizer spray line was valved in to provide pressurizer spray flow in support of the reactor shutdown. During the event, the auxiliary pressurizer spray line water temperature difference exceeded

the 320°F differential temperature in the Technical Specifications. This condition was entered into the corrective action program and evaluated in accordance with the Fatigue Monitoring aging management procedure. The transient was evaluated against the pressurizer "Auxiliary Spray Actuation" design transient definition and was confirmed to exceed the 320 °F differential temperature. Therefore, this event was counted as an occurrence against the "Auxiliary Spray Actuation" transient category. The design cycle limit for this transient category is 10 occurrences. Thus, the identified transients with no prior occurrences, was still within the allowable limit of 10 cycles. Review of the Class 1 fatigue analysis showed that the bounding differential temperature of 625 °F is specified as an input to Byron specific fatigue analysis, for a total of 10 cycles. Therefore, the fatigue effects of the 2012 operational transient was analyzed and determined to be bounded by the existing Byron plant design basis.

This example provides objective evidence that the Fatigue Monitoring aging management program effectively monitors plant transients; utilizes the corrective action program; performs evaluations to ensure that actual operational transients are bounded by design transient definitions; and actual occurrence of operational transient cycles are counted against the appropriate cycle transient category.

Braidwood Station

1. In 2006, while performing the Braidwood operational transient cycle counting surveillance, the Fatigue Monitoring program engineer identified some potential design transient definition discrepancies in the site procedure. This condition was entered into the corrective action program. The potential discrepancies had no immediate effect on either of the Braidwood Unit 1 and 2 fatigue monitoring cycle counts. After review of: historical records, technical specifications, the UFSAR, and design basis fatigue analyses procedure changes that clarified design transient definitions and provided additional guidance were recommended. The procedure change recommendations and guidance were approved by corporate and Westinghouse subject experts. The recommendations and guidance were then incorporated into the site Fatigue Monitoring program procedure.

   This example provides objective evidence that the Fatigue Monitoring aging management program challenges discrepancies; investigates their potential impact; utilizes the corrective action program; and implements program improvements.

2. In August 2011, the Fatigue Monitoring program engineer reviewed an INPO operating experience (OE) report, that was entered into the corrective action program, that identified another PWR had been operating with a Chemical and Volume Control System (CVCS) letdown flow rate of 120 gpm when their fatigue design basis analysis assumed a normal letdown flow operation at 75 gpm. The OE report stated that the operation of

letdown flow rate at 120 gpm resulted in non-conservative design transient assumptions for Class 1 fatigue analysis.

The program engineer recognized that the two Braidwood units also normally operate with the letdown flow rates at the maximum allowable flow rate 120 gpm and not the designed flow rate of 75 gpm. Review of fatigue analysis revealed that letdown operation at 120 gpm is an evaluated transient. The fatigue analysis assumes that the letdown flow is increased to 120 gpm in one step from the normal design value of 75 gpm, and kept at the 120 gpm for 6 hours, and then returned to the design flow of 75 gpm in one step. This event is assumed approximately twice a day or 24,000 times during the 40 year design life of the plant. At Braidwood, the temperature changes due to: the increase in the letdown flow rate from 75 to 120 gpm; the long-term letdown operation at 120 gpm; and the eventual decrease in the letdown flow rate from 120 to 75 gpm would constitute one occurrence in the cycle count. Therefore, the existing fatigue analysis bounded the normal operation of the Chemical and Volume Control System (CVCS) letdown flow at a continuous rate of 120 gpm.

This example provides objective evidence that the Fatigue Monitoring aging management program is proactive in reviewing and evaluating industry operating experience and utilizes the corrective action program for resolution of identified issues.

The above examples provide objective evidence that the existing Fatigue Monitoring aging management program effectively monitors, tracks, and counts operational transients to prevent the aging effect of cumulative fatigue damage. A review of the operating examples showed that inspections have not identified any instances of significant age-related degradation. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions are taken to prevent recurrence. Appropriate guidance for re-evaluation, repair, or replacement is provided for locations where cumulative fatigue damage may approach established limits. Assessments of the Fatigue Monitoring program aging management are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is confidence that implementation of the Fatigue Monitoring aging management program will effectively identify age-related degradation prior to failure.

Conclusion

The enhanced Fatigue Monitoring program will provide reasonable assurance that the cumulative fatigue damage aging effect will be adequately managed so that the intended function(s) of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.3.1.2 Concrete Containment Tendon Prestress

Program Description

The Concrete Containment Tendon Prestress aging management program is an existing program that is predicated on the ASME Section XI, Subsection IWL requirements. The program is based on the 2001 Edition, through the 2003 Addenda, of the ASME Boiler and Pressure Vessel Code, Section XI and includes confirmatory actions that monitor loss of containment tendon prestressing forces during the current term and will continue through the period of extended operation.

The program requires measurement of prestressing forces on an initial 2% sample of each tendon group (dome, hoop, vertical) every five years, as specified in IWL-2400. One tendon in each group sample is identified as a common, or control, tendon and is tested during each successive surveillance. The remaining tendons in the sample are obtained by randomly selecting tendons from amongst all of those that have not been previously examined. The initial sample size, which may be expanded if unacceptable conditions are found, is established as specified in Table IWL-2521-1.

Assessments of the results of the tendon prestressing force measurements are performed in accordance with ASME Section XI, Subsection IWL to confirm adequacy of the prestressing forces. The assessment consists of the establishment of acceptance criteria and trend lines. The acceptance criteria consist of predicted values on the forces in individual tendons and the minimum required prestressing force or value (MRV). The predicted value, or predicted lower limit (PLL), for individual tendons is developed consistent with the guidance presented in Regulatory Guide 1.35.1. As long as individual tendon forces remain above 95% of predicted values, there is definitive evidence that actual prestressing force loss is not significantly greater than that allowed for in the original design calculations.

Trend lines, one for each tendon group, are constructed using the measured tendon forces and represent the changes in mean vertical, hoop and dome prestressing forces with time. Trend line regression analysis is consistent with NRC Information Notice 99-10. As long as the trend lines do not fall below the MRV's prior to the next scheduled surveillance, the tendon prestress force is acceptable. In accordance with the requirements of 10 CFR 50.55a(b)(2)(viii)(B), an evaluation will be performed if the trend lines predict the prestressing forces in the containment to be below the MRV before the next scheduled inspection.

A new analysis was performed for Byron and Braidwood Stations based on actual measured forces to establish the trend of prestressing forces through the end of the period of extended operation. The analysis evaluates force trends by group (dome, hoop, vertical) and shows that group mean forces will not fall below applicable MRV's prior to the end of the period of extended operation. However, as tendon force trends may vary with time, the conclusions regarding long-term performance of the post-tensioning system are subject to change.

As a result, the regression analyses are periodically updated to account for data acquired during future surveillances.

Loss of containment tendon prestressing forces is a Time-Limited Aging Analysis (TLAA) evaluated in accordance with 10 CFR 54.21(c)(1)(iii). This program is credited for managing loss of containment tendon prestressing forces through the period of extended of operation.

NUREG-1801 Consistency

The Concrete Containment Tendon Prestress aging management program is consistent with the ten elements of aging management program X.S1, “Concrete Containment Tendon Prestress,” specified in NUREG-1801 with the following enhancement:

Exceptions to NUREG-1801

None.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

1. For each surveillance interval, the predicted lower-limit, minimum required value, and trending lines will be developed for the period of extended operation as part of the regression analysis for each tendon group. **Program Element Affected: Monitoring and Trending (Element 5)**

Operating Experience

The following example of operating experience provides objective evidence that the Concrete Containment Tendon Prestress program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

Byron and Braidwood Stations

1. In 2009 and 2011, Byron and Braidwood, respectively, performed the 25th year interval ASME Section XI, Subsection IWL, examinations of the concrete containment tendons. These examinations included testing to assess the loss of prestressing forces in select containment tendons, consistent with IWL requirements. The regression analyses document the results of all tendon prestress surveillance data through the 25th year interval. The trend lines were developed for each of the three tendon groups (dome, hoop, vertical) in accordance with NRC Information Notice 99-10, Attachment 3. In 2013, these analyses were revised to extend the trend lines for 60 years.

> The results of the extended regression analyses developed in 2013, demonstrated that the predicted prestress for all three tendon groups at Byron and Braidwood Stations, Units 1 and 2, will remain above the respective minimum required values (MRV) for the period of extended operation. Therefore, monitoring of the results of containment tendon prestress to date indicate that the prestressing systems will continue to maintain their intended function through the period of extended operation without the need for tendon retensioning. The regression analyses for the three tendon groups will continue to be updated with individual measured results following each surveillance interval to ensure the intended function of the prestressing systems is maintained. If, as a result of subsequent updates to the regression analysis, the predicted prestress forces for a tendon group fall below the respective MRV, the condition will be entered into the corrective action program for evaluation and determination of appropriate corrective action. Additional details are provided in Section 4.5 of the Byron and Braidwood, Units 1 and 2 License Renewal Application.

The operating experience relative to the Concrete Containment Tendon Prestress program did not identify an adverse trend in performance. The inspection methods being implemented by the program have been proven effective in detecting loss of containment tendon prestress. Appropriate guidance for evaluation, repair, or replacement is provided for locations where degradation is found. Assessments of the Concrete Containment Tendon Prestress program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is sufficient confidence that implementation of the Concrete Containment Tendon Prestress program will effectively identify degradation prior to failure or loss of intended function during the period of extended operation.

Conclusion

The enhanced Concrete Containment Tendon Prestress program will provide reasonable assurance that that the loss of containment tendon prestress will be adequately managed so that the intended functions of components within the scope of license renewal are maintained consistent with the current licensing basis during the period of extended operation.

B.3.1.3 Environmental Qualification (EQ) of Electric Components

Program Description

The Environmental Qualification (EQ) of Electric Components is an existing program that manages the aging of electrical equipment within the scope of 10 CFR 50.49, "Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants." The program includes electric equipment important to safety, which are composed of various polymeric and metallic materials. This electric equipment is subject to adverse environments caused by heat, radiation, oxygen, moisture, or voltage. The program establishes, demonstrates, and documents the level of qualification, qualified configurations, maintenance, surveillance and replacements necessary to meet 10 CFR 50.49. A qualified life is determined for equipment within the scope of the program and appropriate mitigative actions such as replacement or refurbishment are taken prior to or at the end of the qualified life of the equipment so that the aging limit is not exceeded. The various aging effects addressed by this program are adequately managed so that the intended functions of components within the scope of 10 CFR 50.49 are maintained consistent with the current licensing basis during the period of extended operation.

NUREG-1801 Consistency

The Environmental Qualification (EQ) of Electric Components aging management program is consistent with the ten elements of aging management program X.E1, "Environmental Qualification (EQ) of Electric Components," specified in NUREG-1801.

Exceptions to NUREG-1801

None.

Enhancements

None.

Operating Experience

The following examples of operating experience provide objective evidence that the Environmental Qualification (EQ) of Electric Components program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

<u>Byron Station</u>

1. In June 2011, a periodic Focused Area Self Assessment was completed for the Environmental Qualification (EQ) of Electric Components program. The assessment concluded that the EQ Program continues to meet regulatory requirements for documentation, administrative controls, preventive

maintenance, procurement, receipt inspection, and personnel knowledge and performance. Several minor deficiencies with the EQ Program related documents were found and entered into the corrective action program.

This example provides objective evidence that the Environmental Qualification (EQ) of Electric Components program undergoes periodic self assessment and improvement and will continue to adequately manage electrical components subject to the requirements of environmental qualification through the period of extended operation.

2. In March 2006, it was discovered that an EQ requirement regarding the reactor containment fan cooling (RCFC) motors had inadequate maintenance work orders in the work management process. Specifically, the EQ binder states that all RCFC fan motor shaft inboard bearings be replaced prior to exceeding 21.8 years of service. Although there were work orders to replace the shaft inboard bearing, due dates for replacing bearing were not established in the work management process. Thus, there were no work orders scheduled in the work management process to replace the shaft bearings. This issue was entered into the corrective action program. The investigation determined that none of the RCFC motor inboard shaft bearings exceeded their qualified service life because they all have been in service less than 18 years. The RCFC fan motor shaft bearing work orders were assigned specific due dates and scheduled in the work management process. The extent of condition investigation reviewed other EQ binders and found that they all had work orders with appropriate due dates in the work management process. This confirmed that this issue was limited to only the RCFC motors. Thus, the apparent cause of this issue was an individual human performance error. The RCFC fan motor shaft bearings have either been or will be replaced prior to exceeding their qualified life as scheduled in the work management process.

   This example provides objective evidence that when issues are discovered with environmental qualification replacement tasks, the corrective action program will identify the causes and implement corrective actions to prevent recurrence demonstrating that the Environmental Qualification (EQ) of Electric Components program will adequately manage electrical components subject to the requirements of environmental qualification through the period of extended operation.

Braidwood Station

1. In March 2012, a periodic Focused Area Self Assessment was completed for the Environmental Qualification (EQ) of Electric Components program. The assessment concluded that the EQ Program continues to meet regulatory requirements for documentation, administrative controls, preventive maintenance, procurement, receipt inspection, and personnel knowledge and performance. The results of the assessment were entered into the corrective action program to track recommendations. A performance improvement recommendation was identified to adjust a component replacement frequency in the work management process to

better align with the actual service life determined in the component EQ documentation based on as found field data. The actual operating environment in the field is less severe than the component service life assumed in the EQ program.

This example provides objective evidence that the Environmental Qualification (EQ) of Electric Components program undergoes periodic self assessment and improvement and will continue to adequately manage electrical components subject to the requirements of environmental qualification through the period of extended operation.

2. In 2004, the hydrogen monitoring system was replaced with new equipment. In February 2012, it was discovered that the work requests for the maintenance work orders to replace the EQ capacitors in the new hydrogen monitoring system were never created in the work management process. This issue was entered into the corrective action program. The initial investigation determined that the capacitors were installed between October and December 2004 as part of the modification to replace the hydrogen monitoring system with a new system. Capacitors in the new hydrogen monitoring system have a qualified life of 11.44 years from the date of installation. Therefore, the capacitors had not exceeded their qualified life since they have been installed for approximately 7 years at the time of discovery. The follow-up extent of condition investigation consisted of a 100 per cent review of the EQ maintenance work orders for all of the hydrogen monitoring system components as well as other modification packages completed in 2004. No other issues were found. This confirmed that this issue was limited to only the EQ capacitors in the new hydrogen monitoring system. The maintenance work order requests to replace the EQ capacitors in the new hydrogen monitoring system were created with an 11 year frequency and a due date of 4/15/2014 based on the installation date of the new hydrogen monitoring system. The cause of this issue was determined to be an individual human performance error since the remaining hydrogen monitoring system maintenance work orders and other installed modification maintenance work orders were successfully established in the work management process.

   This example provides objective evidence that if issues are discovered with environmental qualification replacement tasks, the corrective action program will identify the causes and implement corrective actions to prevent recurrence demonstrating that the Environmental Qualification (EQ) of Electric Components program will adequately manage electrical components subject to the requirements of environmental qualification through the period of extended operation.

The above examples provide objective evidence that the Environmental Qualification (EQ) of Electric Components aging management program is effective in assuring that intended functions are maintained consistent with the current licensing basis. A review of the Environmental Qualification (EQ) of Electric Components aging management program operating experience did not show any adverse trend in performance. Problems identified would not cause significant impact to the safe operation of the plant, and adequate corrective actions were taken to prevent recurrence. Assessments of the Environmental Qualification (EQ) of Electric Components aging management program are performed to identify the areas that need improvement to maintain the quality performance of the program. Therefore, there is confidence that continued implementation of the Environmental Qualification (EQ) of Electric Components program will prevent failure prior to refurbishment, replacement or requalification during the period of extended operation.

Conclusion

The existing Environmental Qualification (EQ) of Electric Components program provides reasonable assurance that various aging effects are adequately managed so that the intended function of electric components subject to the requirements of environmental qualification are maintained consistent with the current licensing basis during the period of extended operation.

Appendix C

Response to Applicant/Licensee Action Items
for
Inspection and Evaluation Guidelines
for
Pressurized Water Reactor (PWR) Vessel Internals
(MRP-227-A)

Appendix C

Please refer to Table 1.5-1 for an explanation of how station-specific differences are identified throughout the License Renewal Application.

Introduction:

Electric Power Research Institute (EPRI) has published the NRC-approved version of Materials Reliability Program (MRP) Report 1022863 (MRP-227-A), “Pressurized Water Reactor (PWR) Internals Inspection and Evaluation Guidelines.” This report was developed to provide inspection and evaluation guidelines as part of an aging management program for PWR reactor vessel internal components.

The NRC safety evaluation for the PWR reactor vessel internals inspection and evaluation guidelines is included in MRP-227-A, in which the NRC staff determined that MRP-227-A is acceptable for use in PWR Vessel Internals aging management programs in LRAs. The safety evaluation includes eight (8) plant-specific applicant/licensee action items. Included in these items is a request to provide a plant-specific PWR reactor vessel internals inspection plan.

These eight (8) plant-specific applicant/licensee action items and the BBS PWR reactor vessel internals inspection plan are addressed in Appendix C.

Applicant/Licensee Action Item 1: NRC SER Section 4.2.1, Applicability of FMECA and Functionality Analysis Assumptions

Applicant/Licensee Action Item	**Byron and Braidwood Response**
Each applicant/licensee is responsible for assessing its plant's design and operating history and demonstrating that the approved version of MRP-227 is applicable to the facility. Each applicant/licensee shall refer, in particular, to the assumptions regarding plant design and operating history made in the FMECA and functionality analyses for reactors of their design (i.e., Westinghouse, CE, or B&W) which support MRP-227 and describe the process used for determining plant-specific differences in the design of their RVI components or plant operating conditions, which result in different component inspection categories. The applicant/licensee shall submit this evaluation for NRC review and approval as part of its application to implement the approved version of MRP-227	BBS has assessed the plant design and operating histories and has determined that MRP-227-A is applicable to all four (4) units. MRP-227-A, Section 2.4 has three (3) assumptions and are addressed as follows: 1. Thirty (30) years of operation with high leakage core loading patterns followed by implementation of a low-leakage fuel management strategy for the remaining 30 years of operation: All four (4) BBS units implemented a low-leakage fuel management strategy prior to operating for 30 years, therefore, this assumption is satisfied. 2. Base load operation: All four (4) BBS units were originally designed for load following operation. The BBS units operated as load following units until 1996 from which time all units continue to operate as base load units. The operating histories of all four (4) units were reviewed by the original equipment manufacturer. It was determined that since all four (4) operated within the original plant design assumptions and that the majority of plant operation will be at base load, the assumption of base load operation is satisfied.

Applicant/Licensee Action Item 1 (continued)	Byron and Braidwood Response
	3. No design changes beyond those identified in general industry guidance or recommended by the original vendors: BBS has not made any modifications to any of the vessel internals beyond those identified in general industry guidance or recommended by the original vendor, therefore, this assumption is satisfied. In addition to the assumptions specified in Section 2.4 of MRP-227-A, plant design parameters and operating histories were evaluated, by the original equipment manufacturer, against the assumptions regarding neutron fluence, temperature, materials, and stress values specified in MRP-191, “Screening, Categorization, and Ranking of Reactor Internals Components for Westinghouse and Combustion Engineering PWR Design” and MRP-232, “Aging Management Strategies for Westinghouse and Combustion Engineering PWR Internals.” This evaluation confirmed that the conclusions determined in the MRP-191 failure modes, effects, and criticality analysis (FMECA) and the MRP-232 functionality analyses are applicable to all four (4) BBS units.

Applicant/Licensee Action Item 2: NRC SER Section 4.2.2, PWR Vessel Internal Components Within the Scope of License Renewal

Applicant/Licensee Action Item	**Byron and Braidwood Response**
Each applicant/licensee is responsible for identifying which RVI components are within the scope of LR for its facility. Applicants/licensees shall review the information in Tables 4-1 and 4-2 in MRP-189, Revision 1, and Tables 4-4 and 4-5 in MRP-191 and identify whether these tables contain all of the RVI components that are within the scope of LR for their facilities in accordance with 10 CFR 54.4. If the tables do not identify all the RVI components that are within the scope of LR for its facility, the applicant or licensee shall identify the missing component(s) and propose any necessary modifications to the program defined in MRP-227, as modified by this SE, when submitting its plant-specific AMP. The AMP shall provide assurance that the effects of aging on the missing component(s) will be managed for the period of extended operation.	BBS are Westinghouse designed plants, therefore, MRP-189, “Screening, Categorization, and Ranking of B&W-Designed PWR Internals” and Table 4-5 of MRP-191 are not applicable to BBS. BBS and the original equipment manufacturer reviewed the information in MRP-191, Table 4-4, and determined that there are no additional components contained in the BBS design. All of the components determined to be within the scope of license renewal are listed in MRP-191, Table 4-4. The review did identify several components that were made of a different grade of austenitic stainless steel than specified in MRP-191, however, none of these differences impacted the recommendations in MRP-227-A. Two (2) components in the Upper Internals Assembly were identified as being fabricated from cast austenitic stainless steel (CASS) rather than forged 304 stainless steel as specified in MRP-191, Table 4-4. The two (2) components are the Upper Instrumentation Conduit and Supports: Brackets, clamps, terminal blocks, and conduit straps (Byron and Braidwood) and the Upper Support Plate Assembly: Upper support plate, Flange, and Upper support ring or skirt (Byron only). Due to the material difference, a failure modes, effects, and criticality analysis (FMECA) using the process defined in MRP-191, Section 6, was performed for these components.

Applicant/Licensee Action Item 2 (continued)	Byron and Braidwood Response
	For the Upper Instrumentation Conduit and Supports: Brackets, clamps, terminal blocks, and conduit straps, installed at Byron and Braidwood, the FMECA analysis determined that the FMECA Group changed from 0 to 1 due to the inclusion of the degradation mechanism of loss of fracture toughness due to thermal aging embrittlement. Per MRP-191, Section 7, components designated as FMECA Group 0 or 1 are ranked as Category A components which equate to “No Additional Measures” components in MRP-227-A . Since the MRP-191 category is unchanged there is no impact on the current recommendations provided in MRP-227-A. For the Upper Support Plate Assembly: Upper support plate, Flange, and Upper support ring or skirt installed in Byron Units 1 and 2 a single casting is utilized rather than a welded assembly made up of the three (3) components: Upper support plate, Flange, and Upper support ring or skirt. The changes considered during the FMECA included the addition of the degradation mechanism of loss of fracture toughness due to thermal aging embrittlement, the removal of stress corrosion cracking due to welds (single casting), and the identification that the highest fatigue location is in the upper support plate and not in the upper support ring or skirt. Based on these changes, the FMECA Group for the Upper support plate changed from 0 to 2, the Flange changed from 0 to 1, and the Upper support ring or skirt changed from 2 to 1. Based on these FMECA Group ratings, the Upper support plate was determined to be a “Non-Category A” component, the Flange remained a Category A component, and the Upper support ring or skirt changed from a Category B to Category A component. Since the Upper support plate at Byron Units 1 and 2 is categorized as a “Non-Category A” component, further evaluation per the guidance of MRP-232 is required to determine the plant specific disposition. Based on the certified

Applicant/Licensee Action Item 2 (continued)	Byron and Braidwood Response
	material test reports (CMTRs) and using the guidance specified in the NRC letter of May 19, 2000, “License Renewal Issue No. 98-0030, Thermal Aging Embrittlement of Cast austenitic Stainless Steel Components” (NRC ADAMS Accession No. ML003717179) it was determined the single piece castings, which includes the Upper support plate, used in Byron Units 1 and 2 are not susceptible to loss of fracture toughness due to thermal aging embrittlement. Taking into consideration that the component is not susceptible to loss of fracture toughness due to thermal aging embrittlement, the component was categorized as a “No Additional Measures” component consistent with the original categorization. It should be noted that the Upper Support Plate Assembly which consists of the Upper support plate, Flange, and Upper support ring or skirt, is classified as a core support structure and subject to inspection under ASME Section XI, therefore, the existing requirement for Upper Support Assembly: Upper support ring or skirt as an Existing Program component remains applicable. The PWR Vessel Internals AMP is described in LRA Appendix B, Section B.2.1.7.

Applicant/Licensee Action Item 3: NRC SER Section 4.2.3, Evaluation of the Adequacy of Plant-Specific Existing Programs	
Applicant/Licensee Action Item	**Byron and Braidwood Response**
Applicants/Licensees of CE and Westinghouse are required to perform plant-specific analysis either to justify the acceptability of an applicant's/licensee's existing programs, or to identify changes to the programs that should be implemented to manage the aging of these components for the period of extended operation. The results of this plant-specific analyses and a description of the plant-specific programs being relied on to manage aging of these components shall be submitted as part of the applicant's/licensee's AMP application. The CE and Westinghouse components identified for this type of plant-specific evaluation include: CE thermal shield positioning pins and CE in-core instrumentation thimble tubes (Section 4.3.2 in MRP-227), and Westinghouse guide tube support pins (split pins)(Section 4.3.3 in MRP-227).	BBS are Westinghouse designed plants. The original equipment alloy X-750 CRGT split pins were proactively replaced at the Byron and Braidwood Stations, Unit 1 and 2 with cold worked 316 stainless steel split pins based on industry guidance. The cold worked 316 stainless steel split pins are less susceptible to PWSCC. As stated in MRP-232, "Material Reliability Program: Aging Management Strategies for Westinghouse and Combustion Engineering PWR Internals", Section 4.2.5.2; "The most reliable management approach for eliminating concerns over guide support pin cracking is a proactive replacement with Type 316 CW SS support pins." The replacement split pins were designed for a 40 year life, with a 100% capacity factor and were installed after each of the reactors had operated for at least 20 years. Therefore, the current design life is through the end of the period of extended operation. It is also stated in MRP-232 that the failure of the CRGT support pins does not challenge safe plant operation, nor does such failures compromise control rod functionality. The main issue with the failure of the CRGT split pins was determined to be damage from the loose parts. BBS started replacing split pins in 2005, however, other utilities have installed cold worked 316 stainless steel split pins as early as 1997, therefore a failure at another plant would be expected before a potential failure at a BBS plant. No plants have experienced any failures of cold worked 316 stainless steel split pins to date. Currently there is no vendor specific requirements to inspect the replacement CRGT split pins, however through the station's participation in industry groups and the evaluation of industry operating experience this position may change as warranted. The PWR Vessel Internals AMP is described in LRA Appendix B, Section B.2.1.7.

Applicant/Licensee Action Item 4: NRC SER Section 4.2.4, B&W Core Support Structure Upper Flange Stress Relief	
Applicant/Licensee Action Item	**Byron and Braidwood Response**
The B&W applicants/licensees shall confirm that the core support structure upper flange weld was stress relieved during original fabrication of the Reactor Pressure Vessel in order to confirm the applicability of MRP-227, as approved by the NRC, to their facility. If the upper flange weld has not been stress relieved, then this component shall be inspected as a “Primary” inspection category component. If necessary, the examination methods and frequency for non-stress relieved B&W core support structure upper flange welds shall be consistent with the recommendations in MRP-227, as approved by the NRC, for Westinghouse and CE upper core support barrel welds. The examination coverage for this B&W flange weld shall conform to the staff’s imposed criteria as described in Section 3.3.1 and 4.3.1 of this SE. The applicant’s/licensee’s resolution of this plant-specific action item shall be submitted to the NRC for review and approval.	This item is not applicable to BBS; there are no actions for Westinghouse internals identified in this action item, only for B&W internals.

Applicant/Licensee Action Item 5: NRC SER Section 4.2.5, Application of Physical Measurements as part of I&E Guidelines for B&W, CE, and Westinghouse RVI components	
Applicant/Licensee Action Item	**Byron and Braidwood Response**
Applicants/licensees shall identify plant-specific acceptance criteria to be applied when performing the physical measurements required by the NRC-approved version of MRP-227 for loss of compressibility for Westinghouse hold down springs, and for distortion in the gap between the top and bottom core shroud segments in CE units with core barrel shrouds assembled in two vertical sections. The applicant/licensee shall include its proposed acceptance criteria and an explanation of how the proposed acceptance criteria are consistent with the plant's licensing basis and the need to maintain the functionality of the component being inspected under all licensing basis conditions of operation during the period of extended operation as part of their submittal to apply the approved version of MRP-227.	BBS are Westinghouse designed plants and use hold down springs fabricated from 403 stainless steel. The requirement to perform physical measurements of the hold down spring specified in MRP-227-A, Table 5-3 is only applicable to hold down springs made from 304 stainless steel, therefore, this item is not applicable to BBS. Hold down springs fabricated from 403 stainless steel are classified as "No Additional Measures" per MRP-191, Table 6-5.

Applicant/Licensee Action Item 6: NRC SER Section 4.2.6, Evaluation of Inaccessible B&W Components

Applicant/Licensee Action Item	Byron and Braidwood Response
MRP-227 does not propose to inspect the following inaccessible components: the B&W core barrel cylinders (including vertical and circumferential seam welds), B&W former plates, B&W external baffle-to-baffle bolts and their locking devices, B&W core barrel-to-former bolts and their locking devices, and B&W core barrel assembly internal baffle-to-baffle bolts. The MRP also identified that although the B&W core barrel assembly internal baffle-to-baffle bolts are accessible, the bolts are non-inspectable using currently available examination techniques. Applicants/licensees shall justify the acceptability of these components for continued operation through the period of extended operation by performing an evaluation, or by proposing a scheduled replacement of the components. As part of their applicant to implement the approved version of MRP-227, applicants/licensees shall provide their justification for the continued operability of each of the inaccessible components and, if necessary, provide their plan for the replacement of the components for NRC review and approval.	This item is not applicable to BBS; there are no actions for Westinghouse internals identified in this action item, only for B&W internals.

Applicant/Licensee Action Item 7: NRC SER Section 4.2.7, Plant-Specific Evaluation of CASS Materials

Applicant/Licensee Action Item	**Byron and Braidwood Response**
The applicants/licensees of B&W, CE, and Westinghouse reactors are required to develop plant-specific analyses to be applied for their facilities to demonstrate that B&W IMI guide tube assembly spiders and CRGT spacer castings, CE lower support columns, and Westinghouse lower support column bodies will maintain their functionality during the period of extended operation or for additional RVI components that may be fabricated from CASS, martensitic stainless steel or precipitation hardened stainless steel materials. These analyses shall also consider the possible loss of fracture toughness in these components due to thermal and irradiation embrittlement, and may also need to consider limitations on accessibility for inspection and the resolution/sensitivity of the inspection techniques. The requirement may not apply to components that were previously evaluated as not requiring aging management during the development of MRP-227. That is, the requirement would apply to components fabricated from susceptible materials for which an individual licensee has determined aging management is required, for example during their review performed in accordance with Applicant/Licensee Action Item 2. The plant-specific analysis shall be consistent with the plant's licensing basis and the need to maintain the functionality of the components being evaluated under all licensing basis conditions of operation. The applicant/licensee shall include the plant-specific analysis as part of their submittal to apply the approved version of MRP-227.	BBS are Westinghouse designed plants. The Lower Support Assembly: Lower Support Column Bodies at BBS are fabricated from forged Type 304 stainless steel. Therefore, a plant-specific analysis is not necessary for the Lower Support Assembly: Lower Support Column Bodies. The BBS plant-specific scoping review determined that there are no reactor vessel internal components within the scope of license renewal and which require aging management (e.g., components classified as Primary, Expansion, or Existing Program) due to fabrication from susceptible cast austenitic stainless steel, martensitic stainless steel, or precipitation hardened stainless steel. As discussed in Applicant/Licensee Action Item 2, the Byron Units 1 and 2 cast upper support plate assembly was evaluated and determined to not be susceptible to a loss of fracture toughness due to thermal and irradiation embrittlement. The hold down springs are fabricated from 403 martensitic stainless steel. These components are in compression and classified as "No Additional Measures" per MRP-191, Table 6-5. Therefore, a plant-specific analysis is not required for any reactor vessel internal components at BBS.

Applicant/Licensee Action Item 8: NRC SER Section 4.2.8, Submittal of Information for Staff Review and Approval

Applicant/Licensee Action Item	Byron and Braidwood Response
Applicants/licensees shall make a submittal for NRC review and approval to credit their implementation of MRP-227, as amended by this SE, as an AMP for the RVI components at their facility. This submittal shall include the information identified in Section 3.5.1 of the SE, which states, In addition to the implementation of MRP-227 in accordance with NEI 03-08, applicants/licensees whose licensing basis contain a commitment to submit a PWR RVI AMP and/or inspection program shall make a submittal for NRC review and approval to credit their implementation of MRP-227, as amended by this SE. An applicant's/licensee's application to implement MRP-227, as amended by this SE shall include the following items (1) and (2). Applicants who submit applications for LR after the issuance of this SE shall, in accordance with NUREG-1801, Revision 2, submit the information provided in the following items (1) through (5) for staff review and approval.	
1. An AMP for the facility that addresses the 10 program elements as defined in NUREG-1801, Revision 2, AMP XI.M16A.	1. The AMP that addresses the ten program elements as defined in NUREG-1801, Revision 2, AMP XI.M16A, is submitted as LRA Appendix B, Section B.2.1.7.

Applicant/Licensee Action Item 8 (continued)	Byron and Braidwood Response
2. To ensure the MRP-227 program and the plant-specific action items will be carried out by applicants/licensees, applicants/licensees are to submit an inspection plan which addresses the identified plant-specific action items for staff review and approval consistent with the licensing basis for the plant. If an applicant/licensee plans to implement an AMP which deviates from the guidance provided in MRP-227, as approved by the NRC, the applicant/licensee shall identify where their program deviates from the recommendations of MRP-227, as approved by the NRC, and shall provide a justification for any deviation which includes a consideration of how the deviation affects both “Primary” and “Expansion” inspection category components.	2. The PWR reactor vessel internals inspection plan with plant-specific activities for the primary components, expansion components, existing program components, and examination acceptance and expansion criteria is provided in Tables A through D of this Appendix. The BBS inspection plan for the BBS PWR Vessel Internals components is consistent with the guidance specified in MRP-227-A for corresponding components. It should be noted that the Alignment and Interfacing Components: Internals Hold Down Spring at BBS are fabricated from 403 stainless steel and are classified as No Additional Measures per the guidance of MRP-191, Table 7.2.
3. The regulation at 10 CFR 54.21(d) requires that an FSAR supplement for the facility contain a summary description of the programs and activities for managing the effects of aging and the evaluation of TLAAs for the period of extended operation. Those applicants for LR referencing MRP-227, as approved by the NRC, for their RVI component AMP shall ensure that the programs and activities specified as necessary in MRP-227, as approved by the NRC, are summarily described in the FSAR supplement.	3. The UFSAR Supplement is included in LRA Appendix A, Section A.2.1.7 and includes a summary of the program and activities specified as necessary for the PWR Vessel Internals (B.2.1.7) program.

Applicant/Licensee Action Item 8 (continued)	Byron and Braidwood Response
4. The regulation at 10 CFR 54.22 requires each applicant for LR to submit any TS changes (and the justification for the changes) that are necessary to manage the effects of aging during the period of extended operation as part of its LR application (LRA). For the plant CLBs that include mandated inspection or analysis requirements for RVI either in the operating license for the facility or in the facility TS, the applicant/licensee shall compare the mandated requirements with the recommendations in the NRC-approved version of MRP-227. If the mandated requirements differ from the recommended criteria in MRP-227, as approved by the NRC, the conditions in the applicable license conditions or TS requirements take precedence over the MRP recommendations and shall be complied with.	4. No technical specification changes are required for BBS based on MRP-227-A and the associated safety evaluation.

Applicant/Licensee Action Item 8 (continued)	Byron and Braidwood Response
5. Pursuant to 10 CFR 54.21(c)(1), the applicant is required to identify all analyses in the CLB for their RVI components that conform to the definition of a TLAA in 10 CFR 54.3 and shall identify these analyses as TLAAs for the application in accordance with the TLAA identification requirement in 10 CFR 54.219(c)(1). MRP-227 does not specifically address the resolution of TLAAs that may apply to applicant/licensee RVI components. Hence, applicants/licensees who implement MRP-227, as approved by the NRC, shall still evaluate the CLB for their facilities to determine if they have plant-specific TLAAs that shall be addressed. If so, the applicant's/licensee's TLAA shall be submitted for NRC review along with the applicant's/licensee's application to implement the NRC-approved version of MRP-227. For those cumulative usage factor (CUF) analyses that are TLAAs, the applicant may use the PWR Vessel Internals Program as the basis for accepting these CUF analyses in accordance with 10 CFR 54.21(c)(1)(iii) only if the RVI components in the CUF analyses are periodically inspected for fatigue-induced cracking in the components during the period of extended operation. The periodicity of the inspections of these components shall be justified to be adequate to resolve the TLAA. Otherwise, acceptance of these TLAAs shall be done in accordance with either 10 CFR 54.21(c)(1)(i) or (ii), or in accordance with 10 CFR 54.21(c)(1)(iii) using the applicant's program that corresponds to NUREG-1801, Revision 2, AMP X.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary Program." To satisfy the evaluation requirements of ASME Code, Section III, Subsection NG-2160 and NG-3121, the existing fatigue CUF analyses should include the effects of the reactor coolant system water environment.	5. Reactor vessel internals TLAAs are addressed in LRA Section 4.3.5 and do not credit the PWR Vessel Internals (B.2.1.7) program. The Fatigue Monitoring (B.3.1.1) program is credited for managing the reactor vessel internals TLAAs during the period of extended operation. As discussed in Appendix B, the Fatigue Monitoring (B.3.1.1) program will be enhanced to evaluate the effects of the reactor coolant system water environment on the reactor vessel internal components with existing fatigue CUF analyses to satisfy the evaluation requirements of ASME Code, Section III, Subsection NG-2160 and NG-3121.

PWR Vessel Internals Inspection Plan

The PWR Vessel Internals Inspection Plan for BBS is provided in Tables A through D. Table A specifies the vessel internal components classified as Primary components and is based on MRP-227-A, Table 4.3. Table B specifies the vessel internal components classified as Expansion components and is based on MRP-227-A, Table 4.6. The examination acceptance and expansion criteria are provided in Table C and is based on MRP-227-A, Table 5.3. Table D specifies the components that are classified as Existing Program components.

Table A - BBS Primary Components (based on MRP-227-A Table 4.3)				
BBS Specific Item	**Aging Effect**	**Expansion Link**	**Examination Method/Frequency**	**Examination coverage**
Baffle-to-Former Assembly: Accessible Baffle-to-Former Bolts	Cracking Loss of Fracture Toughness Loss of Preload Changes in Dimensions	Lower Support Assembly: Lower Support Column Bolts, Baffle-to-Former Assembly: Barrel-to-Former Bolts	Baseline volumetric (UT) examination between 25 and 35 EFPY, with subsequent examination on a ten-year interval.	100% of accessible bolts. Heads accessible from the core side. UT accessibility may be affected by complexity of head and locking device designs. A minimum of 75% of the total population (examined + unexamined), including coverage consistent with the Expansion criteria in Table C, must be examined for inspection credit. See MRP-227-A Figures 4-23 and 4-24.
Baffle-to-Former Assembly: Baffle and Former Plates	Cracking Loss of Fracture Toughness Changes in Dimensions	None.	Visual (VT-3) examination to check for evidence of distortion, with baseline examination between 20 and 40 EFPY and subsequent examinations on a ten-year interval.	Core side surfaces. See MRP-227-A Figures 4-24, 4-25, 4-26, and 4-27.

Table A - BBS Primary Components (based on MRP-227-A Table 4.3)

BBS Specific Item	**Aging Effect**	**Expansion Link**	**Examination Method/Frequency**	**Examination coverage**
Control Rod Guide Tube (CRGT) Assemblies: CRGT Guide Plates (cards)	Loss of Material Cracking Loss of Fracture Toughness Changes in Dimensions	None.	Visual (VT-3) examination no later than two (2) refueling outages from the beginning of the license renewal period of extended operation, and no earlier than two (2) refueling outages prior to the start of the license renewal period of extended operation. Subsequent examination on a ten-year interval.	20% examination of the number of CRGT assemblies, with all guide cards within each selected CRGT assembly examined. See MRP-227-A Figure 4-20.
Control rod Guide Tube (CRGT) Assemblies: CRGT Lower Flange Welds (accessible)	Cracking Loss of Fracture Toughness Changes in Dimensions	Bottom-Mounted Instrumentation System: Bottom-Mounted Instrumentation (BMI) Column Bodies Upper Internals Assembly (Upper Core Plate), Lower Support Assembly: Lower Support Forging	Enhanced visual (EVT-1) examination to determine the presence of crack-like surface flaws in flange welds no later than two (2) refueling outages from the beginning of the license renewal period of extended operation and subsequent examination on a ten-year interval.	100% of outer (accessible) CRGT lower flange weld surfaces and adjacent base metal on the individual periphery CRGT assemblies. A minimum of 75% of the total identified sample population must be examined. See MRP-227-A Figure 4-21.

Table A - BBS Primary Components (based on MRP-227-A Table 4.3)

BBS Specific Item	Aging Effect	Expansion Link	Examination Method/Frequency	Examination coverage
Core Barrel Assembly: Lower Core Barrel Flange Weld	Cracking Loss of Fracture Toughness Changes in Dimensions	None.	Periodic enhanced visual (EVT-1) examination, no later than two (2) refueling outages from the beginning of the license renewal period of extended operation and subsequent examination on a ten-year interval.	100% of one side of the accessible surfaces of the selected weld and adjacent base metal. A minimum of 75% of the total weld length (examined + unexamined), including coverage consistent with the Expansion criteria in Table C, must be examined from either the inner or outer diameter for inspection credit.
Core Barrel Assembly: Upper Core Barrel Flange Weld	Cracking Loss of Fracture Toughness Changes in Dimensions	Lower support Assembly: Lower Support Column Bodies (non-cast), Core Barrel Assembly: Core Barrel Outlet Nozzle Welds	Periodic enhanced visual (EVT-1) examination, no later than two (2) refueling outages from the beginning of the license renewal period of extended operation and subsequent examination on a ten-year interval.	100% of one side of the accessible surfaces of the selected weld and adjacent base metal. A minimum of 75% of the total weld length (examined + unexamined), including coverage consistent with the Expansion criteria in Table C, must be examined from either the inner or outer diameter for inspection credit. See MRP-227-A Figure 4-22.

Table A - BBS Primary Components (based on MRP-227-A Table 4.3)				
BBS Specific Item	**Aging Effect**	**Expansion Link**	**Examination Method/Frequency**	**Examination coverage**
Core Barrel Assembly: Upper and Lower Core Barrel Cylinder Girth Welds	Cracking Loss of Fracture Toughness Changes in Dimensions	Core Barrel Assembly: Core Barrel Axial Welds	Periodic enhanced visual (EVT-1) examination, no later than two (2) refueling outages from the beginning of the license renewal period of extended operation and subsequent examination on a ten-year interval.	100% of one side of the accessible surfaces of the selected weld and adjacent base metal. A minimum of 75% of the total weld length (examined + unexamined), including coverage consistent with the Expansion criteria in Table C, must be examined from either the inner or outer diameter for inspection credit. See MRP-227-A Figure 4-22.

Table B – BBS Expansion Components (based on MRP-227-A Table 4.6)

Item	**Aging Effect**	**Primary Link**	**Examination Method/Frequency**	**Examination coverage**
Baffle-to-Former Assembly: Barrel-to-Former Bolts	Cracking Loss of Fracture Toughness Loss of Preload Changes in Dimensions	Baffle-to-Former Assembly: Accessible Baffle-to-Former Bolts	Volumetric (UT) examination. Re-inspection every ten (10) years following initial	100% of accessible bolts. Accessibility may be limited by presence of neutron pads. A minimum of 75% coverage of the entire examination area or volume, or a minimum sample size of 75% of the total population of like components of the examination is required (including both the accessible and inaccessible portions). See MRP-227-A Figure 4-23
Bottom-Mounted Instrumentation System: Bottom-Mounted Instrumentation (BMI) Column Bodies	Cracking Loss of Fracture Toughness Changes in Dimensions	Control rod Guide Tube (CRGT) Assemblies: CRGT Lower Flange Welds (accessible)	Visual (VT-3) examination of BMI column bodies as indicated by difficulty of insertion/withdrawal of flux thimbles. Re-inspection every ten (10) years following initial inspection. Flux thimble insertion/withdrawal to be monitored at each inspection interval.	100% of BMI column bodies for which difficulty is detected during flux thimble insertion/withdrawal. See MRP-227-A Figure 4-35.

Table B – BBS Expansion Components (based on MRP-227-A Table 4.6)				
Item	**Aging Effect**	**Primary Link**	**Examination Method/Frequency**	**Examination coverage**
Core Barrel Assembly: Core Barrel Axial Welds	Cracking Loss of Fracture Toughness Changes in Dimensions	Core Barrel Assembly: Upper and Lower Core Barrel Cylinder Girth Welds	Enhanced visual (EVT-1) examination. Re-inspection every ten (10) years following initial inspection.	100% of one side of the accessible surfaces or the selected weld and adjacent base metal. A minimum of 75% coverage of the entire examination area or volume, or a minimum sample size of 75% of the total population of like components of the examination is required (including both the accessible and inaccessible portions). See MRP-227-A Figure 4-22.
Core Barrel Assembly: Core Barrel Outlet Nozzle Welds	Cracking Loss of Fracture Toughness Changes in Dimensions	Core Barrel Assembly: Upper Core Barrel Flange Weld	Enhanced visual (EVT-1) examination. Re-inspection every ten (10) years following initial inspection.	100% of one side of the accessible surfaces or the selected weld and adjacent base metal. A minimum of 75% coverage of the entire examination area or volume, or a minimum sample size of 75% of the total population of like components of the examination is required (including both the accessible and inaccessible portions). See MRP-227-A Figure 4-22.

Table B – BBS Expansion Components (based on MRP-227-A Table 4.6)				
Item	**Aging Effect**	**Primary Link**	**Examination Method/Frequency**	**Examination coverage**
Lower Internals Assembly: Lower Support Forging	Cracking Loss of Fracture Toughness Changes in Dimensions	Control rod Guide Tube (CRGT) Assemblies: CRGT Lower Flange Welds (accessible)	Enhanced visual (EVT-1) examination. Re-inspection every ten (10) years following initial inspection.	100% of accessible surfaces. A minimum of 75% coverage of the entire examination area or volume, or a minimum sample size of 75% of the total population of like components of the examination is required (including both the accessible and inaccessible portions). See MRP-227-A Figure 4-33.
Lower Support Assembly: Lower Support Column Bodies (non-cast)	Cracking Loss of Fracture Toughness Changes in Dimensions	Core Barrel Assembly: Upper Core Barrel Flange Weld	Enhanced visual (EVT-1) examination. Re-inspection every ten (10) years following initial inspection.	100% of one side of the accessible surfaces or the selected weld and adjacent base metal. A minimum of 75% coverage of the entire examination area or volume, or a minimum sample size of 75% of the total population of like components of the examination is required (including both the accessible and inaccessible portions). See MRP-227-A Figure 4-34.

Table B – BBS Expansion Components (based on MRP-227-A Table 4.6)				
Item	**Aging Effect**	**Primary Link**	**Examination Method/Frequency**	**Examination coverage**
Lower Support Assembly: Lower Support Column Bolts	Cracking Loss of Fracture Toughness Loss of Preload Changes in Dimensions	Baffle-to-Former Assembly: Accessible Baffle-to-Former Bolts	Volumetric (UT) examination. Re-inspection every ten (10) years following initial	100% of accessible bolts or as supported by plant-specific justification. A minimum of 75% coverage of the entire examination area or volume, or a minimum sample size of 75% of the total population of like components of the examination is required (including both the accessible and inaccessible portions). See MRP-227-A Figures 4-32 and 4-33.
Upper Internals Assembly (Upper Core Plate)	Cracking Loss of Fracture Toughness Changes in Dimensions	Control rod Guide Tube (CRGT) Assemblies: CRGT Lower Flange Welds (accessible)	Enhanced visual (EVT-1) examination. Re-inspection every ten (10) years following initial inspection.	100% of accessible surfaces. A minimum of 75% coverage of the entire examination area or volume, or a minimum sample size of 75% of the total population of like components of the examination is required (including both the accessible and inaccessible portions).

Table C - BBS Examination Acceptance and Expansion Criteria (based on MRP-227-A Table 5.3)				
Item	**Examination Acceptance Criteria**	**Expansion Link(s)**	**Expansion Criteria**	**Additional Examination Acceptance Criteria**
Control Rod Guide Tube (CRGT) Assembly: CRGT Guide Plates (cards)	Visual (VT-3) examination. The specific relevant condition is wear that could lead to loss of control rod alignment and impede control assembly insertion.	None	None.	None.

Table C - BBS Examination Acceptance and Expansion Criteria (based on MRP-227-A Table 5.3)

Item	**Examination Acceptance Criteria**	**Expansion Link(s)**	**Expansion Criteria**	**Additional Examination Acceptance Criteria**
Control Rod Guide Tube (CRGT) Assembly: CRGT Lower Flange Welds (accessible)	Enhanced visual (EVT-1) examination. The specific relevant condition is a detectable crack-like surface indication.	a. Bottom-Mounted Instrumentation System: Bottom-Mounted Instrumentation (BMI) Column Bodies b. Upper Internals Assembly (Upper Core Plate) and Lower Internals Assembly: Lower Support Forging	a. Confirmation of surface-breaking indications in two (2) or more Control Rod Guide Tube (CRGT) Assembly: CRGT Lower Flange Welds, combined with flux thimble insertion/withdrawal difficulty, shall require visual (VT-3) examination of Bottom-Mounted Instrumentation System: Bottom-Mounted Instrumentation (BMI) Column Bodies by the completion of the next refueling outage. b. Confirmation of surface-breaking indications in two (2) or more Control Rod Guide Tube (CRGT) Assembly: CRGT Lower Flange Welds shall require EVT-1 examination of Upper Internals Assembly (Upper Core Plate) and Lower Internals Assembly: Lower Support Forging within three (3) fuel cycles following the initial observation.	a. For Bottom-Mounted Instrumentation System: Bottom-Mounted Instrumentation (BMI) Column Bodies, the specific relevant condition for the VT-3 examination is completely fractured column bodies. b. For Upper Internals Assembly (Upper Core Plate) and Lower Internals Assembly: Lower Support Forging, the specific relevant condition is a detectable crack-like surface indication.

Table C - BBS Examination Acceptance and Expansion Criteria (based on MRP-227-A Table 5.3)

Item	**Examination Acceptance Criteria**	**Expansion Link(s)**	**Expansion Criteria**	**Additional Examination Acceptance Criteria**
Core Barrel Assembly: Upper Core Barrel Flange Weld	Periodic enhanced visual (EVT-1) examination. The specific relevant condition is a detectable crack-like surface indication.	a. Core Barrel Assembly: Core Barrel Outlet Nozzle Welds b. Lower Support Assembly: Lower Support Column Bodies (non-cast)	a. The confirmed detection and sizing of a surface-breaking indication with a length greater than two (2) inches in the upper core barrel flange weld shall require that the EVT-1 examination be expanded to include the core barrel outlet nozzle welds by the completion of the next refueling outage. b. If extensive cracking in the core barrel outlet nozzle welds is detected, EVT-1 examination shall be expanded to include the upper six (6) inches of the accessible surfaces of the non-cast lower support column bodies within three (3) fuel cycles following the initial observation.	a and b. The specific relevant condition for the expansion Core Barrel Assembly: Core Barrel Outlet Nozzle Welds and Lower Support Assembly: Lower Support Column Bodies (non-cast) examination is a detectable crack-like surface indication.
Core Barrel Assembly: Lower Core Barrel Flange Weld	Periodic enhanced visual (EVT-1) examination. The specific relevant condition is a detectable crack-like surface indication.	None.	None.	None.

Table C - BBS Examination Acceptance and Expansion Criteria (based on MRP-227-A Table 5.3)

Item	**Examination Acceptance Criteria**	**Expansion Link(s)**	**Expansion Criteria**	**Additional Examination Acceptance Criteria**
Core Barrel Assembly: Upper and Lower Core Barrel Cylinder Girth Welds	Periodic enhanced visual (EVT-1) examination. The specific relevant condition is a detectable crack-like surface indication.	Core Barrel Assembly: Core Barrel Axial Welds	The confirmed detection and sizing of a surface-breaking indication with a length greater than two (2) inches in the upper (lower) Core Barrel Assembly: Upper and Lower Core Barrel Cylinder Girth Welds shall require that the EVT-1 examination be expanded to include the upper (lower) Core barrel Assembly: Core Barrel Axial Welds by the completion of the next refueling outage.	The specific relevant condition for the expansion upper (lower) Core Barrel Assembly: Core Barrel Axial Welds examination is a detectable crack-like surface indication.

Table C - BBS Examination Acceptance and Expansion Criteria (based on MRP-227-A Table 5.3)

Item	Examination Acceptance Criteria	Expansion Link(s)	Expansion Criteria	Additional Examination Acceptance Criteria
Baffle-to-Former Assembly: Baffle-to-Former Bolts	Volumetric (UT) examination. The examination acceptance criteria for the UT of the Baffle-to-Former Assembly: Baffle-to-Former Bolts shall be established as part of the examination technical justification.	a. Lower Support Assembly: Lower support Column Bolts b. Baffle-to-Former Assembly: Barrel-to-Former Bolts	a. Confirmation that more than 5% of the Baffle-to-Former Assembly: Baffle-to-Former Bolts actually examined on the four (4) baffle plates at the largest distance from the core (presumed to be the lowest dose locations) contain unacceptable indications shall require UT examination of the Lower Support Assembly: Lower support Column Bolts within the next three (3) fuel cycles. b. Confirmation that more than 5% of the Lower Support Assembly: Lower support Column Bolts actually contain unacceptable indications shall require UT examination of the Baffle-to-Former Assembly: Barrel-to-Former Bolts.	a and b. The examination acceptance criteria for the UT of the Lower Support Assembly: Lower support Column Bolts and the Baffle-to-Former Assembly: Barrel-to-Former Bolts shall be established as part of the examination technical justification.

Table C - BBS Examination Acceptance and Expansion Criteria (based on MRP-227-A Table 5.3)

Item	**Examination Acceptance Criteria**	**Expansion Link(s)**	**Expansion Criteria**	**Additional Examination Acceptance Criteria**
Baffle-to-Former Assembly: Barrel-to-Former Plates	Visual (VT-3) examination. The specific relevant conditions are evidence of abnormal interaction with fuel assemblies, gaps along high fluence shroud plate joints, or vertical displacement of shroud plates near high fluence joints.	None.	None.	None.

Table D - BBS Existing Program Components	
Item	Program
Alignment and Interfacing Components: Upper Core Plate Alignment Pins	ASME Section XI Category B-N-3
Core Barrel Assembly: Core Barrel Flange	ASME Section XI Category B-N-3
Lower Internals Assembly: Clevis Insert Bolts	ASME Section XI Category B-N-3
Lower Internals Assembly: Lower Core Plate and Extra-Ling (XL) Lower Core Plate	ASME Section XI Category B-N-3
Reactor Vessel Internals Components (Manway Cover, Nuts, and Pins)	ASME Section XI Category B-N-3
Upper Internals Assembly: Upper Support Ring or Skirt	ASME Section XI Category B-N-3
Bottom Mounted Instrument System: Flux Thimble Tubes	Flux Thimble Tube Inspection
Control Rod Guide Tube Assemblies: Guide Tube Support Pins	Guide Tube Support Pins (split pins) replaced with cold worked 316 stainless steel split pins. Design life of the replacement split pins cover the period of extended operation.

APPENDIX D Technical Specification Changes

(No Changes Required - This Appendix is not used)