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NUREG-2192, Revision 1

Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants

Draft Report for Comment

Office of Nuclear Reactor Regulation

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Any interested party may submit comments on this report for consideration by the NRC staff. Comments may be accompanied by additional relevant information or supporting data. Please specify the report number **NUREG-2192** in your comments and send them by the end of the comment period specified in the *Federal Register* notice announcing the availability of this report.

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Mail comments to: Houman Rasouli, Director, Program Management, Announcements and Editing Branch (PMAE), Office of Administration, Mail Stop: TWFN-7-A-60M, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

For any questions about the material in this report, please contact Emmanuel Sayoc, Project Manager, 301-415-4084, or by e-mail at Emmanuel.Sayoc@nrc.gov, and Carol Moyer, Sr. Materials Engineer, 301-415-2153, or by e-mail at Carol.Moyer@nrc.gov.

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ABSTRACT

This document provides guidance on the content of applications for renewal of the initial renewed operating license. The initial renewed operating license is the first renewed license issued under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," after the supersession or expiration of the original operating license issued under either 10 CFR Part 50 or Part 52 following the completion of construction under a construction permit issued under Part 50, or a combined license issued under Part 52. In this guidance document, the renewal of the initial renewed operating license is referred to as "subsequent license renewal" (SLR). The Draft NUREG-2192, Revision 1, "Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants, Draft Report for Comment," (SRP-SLR Revision 1, or simply SRP-SLR) provides guidance to the U.S. Nuclear Regulatory Commission (NRC) staff reviewers in the Office of Nuclear Reactor Regulation. These reviewers perform safety reviews of applications to renew nuclear power plant licenses in accordance with 10 CFR Part 54. The NRC regulations in 10 CFR 54.29 establish the standards for issuance of a renewed license. For nuclear power plants that have received a renewed license, the regulations in 10 CFR 54.31(d) state that "a renewed license may be subsequently renewed in accordance with all applicable requirements." In the Statements of Consideration for the final rule, "Nuclear Power Plant License Renewal," 56 (*Federal Register*) FR 64943, 64964-65 (December 13, 1991), the NRC stated that the requirements for subsequent renewal "include the provisions of [P]art 54 (unless the Commission subsequently adopts special provisions applicable only to subsequent renewals)." To date, the NRC has not adopted special provisions that apply only to subsequent renewal, so that the requirements in 10 CFR Part 54 continue to govern SLR.

The principal purposes of the SRP-SLR are to ensure the quality and uniformity of NRC staff reviews and to present a well-defined base from which to evaluate applicant programs and activities for the subsequent period of extended operation, following the first 20-year period of extended operation (i.e., the initial license renewal period). The SRP-SLR also is intended to make regulatory information widely available to enhance communication with interested members of the public and the nuclear power industry and to improve public and industry understanding of the NRC staff's review process. The safety review is based primarily on the information provided by the applicant in a SLR application. Each of the individual SRP-SLR sections addresses: (i) who performs the review, (ii) the areas of review, (iii) the basis for review, (iv) the method of review, and (v) the conclusions from the review.

This document is a companion document to Draft NUREG–2191, Revision 1, "Generic Aging Lessons Learned for Subsequent License Renewal Draft Report for Comment," (GALL-SLR Report, Revision 1, GALL-SLR Report, or simply GALL-SLR) that provides guidance for SLR applicants. The GALL-SLR Report contains the NRC staff's generic evaluation of plant aging management programs and establishes the technical bases for their adequacy. The guidance in this document and the GALL-SLR Report are for the use of future applicants for SLR. The NRC does not intend to impose the guidance in this document and the GALL-SLR on current holders of an initial operating license renewal. However, this document and the GALL-SLR Report encompass all of the guidance applicable to initial license renewal. Accordingly, both current holders of initial operating licenses as well as future applicants for initial license renewal may voluntarily choose to reference an aging management program in the GALL-SLR Report in their applications. However, such applicants should inform the NRC that they plan to demonstrate consistency with the GALL-SLR Report.

Drafts of the GALL-SLR Report, Revision 0, and SRP-SLR, Revision 0, were published for public comment in December 2015, and the comment period ended February 29, 2016. The staff received more than 300 pages of comments from interested stakeholders. The public comments received were reviewed and dispositioned by the staff and documented in NUREG-2222, “Disposition of Public Comments on the Draft Subsequent License Renewal Guidance Documents NUREG–2191 and NUREG–2192” (ADAMS Accession No. ML17362A143), in December 2017.

On July 14, 2017 (82 FR 32588), the (NRC announced the issuance and availability of the following final SLR guidance documents:

- Final NUREG–2191, Revision 0, “Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report,” (GALL-SLR Report, Revision 0) (ADAMS Accession Nos. ML17187A031, and ML17187A204, for Volumes 1 and 2 respectively), and
- Final NUREG–2192, Revision 0, “Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants.” (SRP-SLR, Revision 0)(ADAMS Accession No. ML17188A158)

The disposition of the comments were published in GALL-SLR Report, Revision 0 and SRP-SLR, Revision 0. The staff also published NUREG-2221, “Technical Bases for Changes in the Subsequent License Renewal Guidance Documents NUREG–2191 and NUREG–2192” (Technical Basis Document) (ADAMS Accession No. ML17362A126) in December 2017, that documented all the technical changes made to the license renewal guidance documents for SLR (i.e., for operation from 60 years to 80 years), along with the technical bases for the changes.’

Subsequently, the NRC staff determined that certain revisions and updates to these guidance documents are warranted. These revisions and updates are presented in Revision 1 to the SRP-SLR and Revision 1 to the GALL-SLR. Comments on the revised documents will be considered, as appropriate, in the final versions of these documents. A draft supplement to the Technical Basis Document (NUREG-2221) was also published.

Paperwork Reduction Act Statement

This NUREG provides voluntary guidance for implementing the mandatory information collections in 10 CFR Part 51 that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). These information collections were approved by the Office of Management and Budget (OMB) under control number 3150-0021. Send comments regarding these information collections to the FOIA, Library, and Information Collections Branch (T6A10M), U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by email to Infocollects.Resource@nrc.gov, and to the OMB reviewer at: OMB Office of Information and Regulatory Affairs (3150-0021). Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street NW, Washington, DC 20503; email: oira_submission@omb.eop.gov.

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LIST OF CONTRIBUTORS

Division of New and Renewed Licenses, Office of Nuclear Reactor Regulation

Brian Smith	Division Director
Bernie Thompson	Deputy Division Director
L. Gibson	Branch Chief
S. Bloom	Branch Chief
A. Buford	Branch Chief
M. Mitchell	Branch Chief
A. Hiser	Senior Technical Advisor
J. Wise	Senior Technical Advisor
M. Sayoc	Project Manager
M. Yoo	Senior Project Manager
J. Hammock	Project Manager
B. Rogers	Senior Project Manager
B. Allik	Mechanical Engineer
I. Anchondo-Lopez	Materials Engineer
L. Alvarado	Materials Engineer
M. Benson	Materials Engineer
J. Collins	Senior Materials Engineer
D. Dijamco	Materials Engineer
C. Fairbanks	Senior Materials Engineer
B. Fu	Materials Engineer
T. Gardner	Physical Scientist
J. Gavula	Mechanical Engineer
E. Haywood	Materials Engineer
A. Johnson	Senior Materials Engineer
V. Kalikian	Materials Engineer
G. Makar	Materials Engineer
J. Medoff	Senior Mechanical Engineer
S. Min	Materials Engineering
C. Moyer	Senior Materials Engineer
E. Reichelt	Senior Materials Engineer
L. Terry	Materials Engineer
J. Tsao	Senior Materials Engineer

Division of New and Renewed Licenses, Office of Nuclear Reactor Regulation (Continued)	
D. Widrevitz	Materials Engineer
M. Yoder	Chemical Engineering
O. Yee	Materials Engineering
Other Divisions in the Office of Nuclear Reactor Regulation	
J. Colaccino	Branch Chief
W. Morton	Branch Chief
J. Paige	Branch Chief
J. Cintron-Rivera	Electrical Engineer
B. Lehman	Structural Engineer
A. Istar	Civil Engineer
M. Marshall	Senior Project Manager
M. McConnell	Senior Electrical Engineer
A. Prinaris	Civil Engineer
L. Ramadan	Electrical Engineer
M. Sadollah	Electrical Engineer
G. Thomas	Senior Civil Engineer
G. Wang	Civil Engineer

ABBREVIATIONS AND ACRONYMS

°	degree(s)
%	percent
AC	alternating current
ACAR	aluminum conductor aluminum alloy reinforced
ACI	American Concrete Institute
ACSR	aluminum conductor steel reinforced
ADAMS	Agencywide Documents Access and Management System
AMPs	aging management programs
AMR	aging management review
ANSI	American National Standards Institute
ART	adjusted reference temperature
ASME	American Society of Mechanical Engineers
ASME Code	American Society of Mechanical Engineers Boiler and Pressure Vessel Code
ATWS	anticipated transients without scram
B&W	Babcock & Wilcox
BTP	Branch Technical Position
BWR	boiling water reactor
BWRVIP	Boiling Water Reactor Vessel and Internals Project
CASS	cast austenitic stainless steel
CE	Combustion Engineering
CFR	*Code of Federal Regulations*
CFRP	carbon fiber reinforced polymer
CLB	current licensing basis
cm	centimeter (s)
CRD	control rod drive
CRDM	control rod drive mechanism
CST	condensate storage tanks
CUF	cumulative usage factor
day-in/yr	day-inch per year
DBA	design basis accident
DBEs	design basis events
DOR	Division of Operating Reactors
dpa	displacements per atom
EFPY	effective full power year
EMA	equivalent margins analysis
EPDM	ethylene propylene diene monosomer
EPR	ethylene propylene rubber
EPRI	Electric Power Research Institute
EPU	extended power uprate
EQ	environmental qualification

FERC	Federal Energy Regulatory Commission
ft	foot/feet
ft-lb	foot-pound
FR	*Federal Register*
FSAR	Final Safety Analysis Report
GALL	Generic Aging Lessons Learned
GALL-SLR	Generic Aging Lessons Learned for Subsequent License Renewal
GDC	General Design Criterion
GE	General Electric
GL	generic letter
GSI	generic safety issue
HELB	high-energy line break
HVAC	heating, ventilation, and air conditioning
I&C	instrumentation and control
IASCC	irradiation-assisted stress corrosion cracking
IEEE	Institute of Electrical and Electronics Engineers
IGSCC	intergranular stress corrosion cracking
in	inch(s)
IN	information notice
INPO	Institute of Nuclear Power Operations
IPE	individual plant examination
IPEEE	individual plant examination of external events
ISG	interim staff guidance
ISI	inservice inspection
J	Joule
kV	kilovolt(s)
LAI	Licensee Action Item
LBB	leak-before-break
LCOs	limiting conditions for operation
LOCA	loss of coolant accident
LRAs	license renewal applications
LWR	light-water reactor
MEB	metal enclosed bus
m	meter(s)
MeV	mega electron-volt(s)
MIC	microbiologically-induced corrosion
MRP	Materials Reliability Program
NDTT	nil-ductility transition temperature
NEI	Nuclear Energy Institute
N/cm^2	Newton(s) per square centimeter
NPS	nominal pipe size
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
OE	operating experience

PH	precipitation-hardened
PM	Project Manager
P-T	pressure-temperature
PTLRs	pressure-temperature limit reports
PTS	pressurized thermal shock
PVC	polyvinyl chloride
PWR	pressurized water reactor
PWSCC	primary water stress corrosion cracking
QA	quality assurance
RCP	reactor coolant pump
RT_{PTS}	reference temperature for pressurized thermal shock
RG	Regulatory Guide
RIPB	risk-informed, performance-based
RMI	reflective metal insulation
RIS	Regulatory Issue Summary
RPV	reactor pressure vessel
PT_{PTS}	reference temperature for pressurized thermal shock
RT_{MAX}	mean inner surface reference temperature for RPV axial welds
RT_{NDT}	nil-ductility reference temperature
RV	reactor vessel
RVI	reactor vessel internals
RWST	refueling water storage tank
SBO	station blackout
SC	structures and component(s)
SCC	stress corrosion cracking
SEEIN	Significant Event Evaluation and Information Network
SEs	safety evaluations
SER	safety evaluation report
SG	steam generator
SLR	subsequent license renewal
SLRA	subsequent license renewal application
SPEO	subsequent period of extended operation
SOC	Statements of Consideration
SRP	standard review plan
SRP-SLR	Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants
SS	stainless steel
SSCs	systems, structures, and components
TLAAs	time-limited aging analyses
TRs	technical or topical reports
TS	technical specifications
UFSAR	updated Final Safety Analysis Report
USE	upper-shelf energy
USI	unresolved safety issues

UV	ultraviolet
V	volt(s)
wt%	weight percent
XLPE	cross-linked polyethylene

INTRODUCTION

Draft NUREG–2192, Revision 1, “Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants, Draft Report for Comment,” (SRP-SLR, Revision 1, or simply SRP-SLR) provides guidance to U.S. Nuclear Regulatory Commission (NRC) staff reviewers in the Office of Nuclear Reactor Regulation (NRR). These reviewers perform safety reviews of applications to renew nuclear power plant licenses in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plant,” hereafter referred to as the Rule. The NRC regulations in 10 CFR 54.29 establish the standards for issuance of a renewed license. For nuclear power plants that have received a renewed license, the regulations in 10 CFR 54.31(d) state that “a renewed license may be subsequently renewed in accordance with all applicable requirements.” The NRC has stated in the Statements of Consideration, “Nuclear Power Plant License Renewal,” 56 FR 64943, 64964-65 (December 13, 1991), that the requirements for subsequent license renewal (SLR) “include the provisions of [P]art 54 (unless the Commission subsequently adopts special provisions applicable only to subsequent renewals).” To date, the NRC has not adopted special provisions that apply only to subsequent renewal, so that the requirements in 10 CFR Part 54 continues to govern SLR.

The principal purposes of the SRP-SLR are to ensure the quality and uniformity of the NRC staff review and to present a well-defined base from which to evaluate applicant programs and activities for the subsequent period of extended operation. The SRP-SLR also is intended to make regulatory information widely available to enhance communication with interested members of the public and the nuclear power industry and to improve their understanding of the NRC staff review process.

The safety review is based primarily on the information provided by the applicant in a subsequent license renewal application (SLRA). The NRC regulation in 10 CFR 54.4 defines what is within the scope of the License Renewal Rule. The NRC regulation in 10 CFR 54.21 requires each application to include an integrated plant assessment, current licensing basis (CLB) changes during review of the application by the NRC, an evaluation of time-limited aging analyses (TLAAs), and a Final Safety Analysis Report Supplement.

In addition to the technical information required by 10 CFR 54.21, an SLRA must contain general information (10 CFR 54.19), necessary technical specification changes (10 CFR 54.22), and environmental information (10 CFR 54.23). The application must be sufficiently detailed to permit the reviewers to determine: (i) whether there is reasonable assurance that the activities authorized by the renewed license will continue to be conducted in accordance with the CLB and (ii) whether any changes made to the plant’s CLB to comply with 10 CFR Part 54 are in accordance with the Atomic Energy Act of 1954 and NRC regulations. The technical information to be supplied in the SLRA is specified in 10 CFR 54.21.

Before submitting an SLRA, an applicant should have analyzed the plant to ensure that actions have been or will be taken to: (i) manage the effects of aging during the subsequent period of extended operation (this determination should be based on an assessment of the functionality of structures and components that are within the scope of SLR and that require an aging management review) and (ii) evaluate TLAAs. The SLRA is the principal document in which the applicant provides the information needed to understand the basis upon which the applicant has made this assurance.

The SRP-SLR references the Draft NUREG–2191, Revision 1, “Generic Aging Lessons Learned for Subsequent License Renewal Draft Report for Comment,” (GALL-SLR Report, Revision 1, GALL-SLR Report, or simply GALL-SLR), which evaluates existing programs generically, to document: (i) the conditions under which existing programs are considered adequate to manage identified aging effects without change and (ii) the conditions under which existing programs should be augmented for this purpose. The SRP-SLR, Revision 1, also includes the NRC staff’s resolutions of License Renewal Interim Staff Guidance (LR-ISG) from 2011 through 2016. Under the ISG process, the NRC staff, industry, or stakeholders can propose a change to certain license renewal guidance documents. The NRC staff evaluates the issue, develops the proposed ISG, issues it for public comment, evaluates any comments received, and, if necessary, issues the final ISG. The ISG is then used until the NRC staff incorporates the revised guidance into a formal license renewal guidance document revision. The LR-ISGs addressed in the SRP-SLR are listed as follows:

- LR-ISG-2011-01: “Aging Management of Stainless Steel Structures and Components in Treated Borated Water, Revision 1.” Agencywide Documents Access and Management System (ADAMS) Accession No. ML12286A275. December 18, 2012.
- LR-ISG-2011-02: “Aging Management Program for Steam Generators.” ADAMS Accession No. ML11297A085. December 21, 2011.
- LR-ISG-2011-03: “Generic Aging Lessons Learned (GALL) Report Revision 2 Aging Management Program (AMP) XI.M41,” “Buried and Underground Piping and Tanks.” ADAMS Accession No. ML12138A296. July 26, 2012.
- LR-ISG-2011-04: “Updated Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors.” ADAMS Accession No. ML12270A436. May 28, 2013.
- LR-ISG-2011-05: “Ongoing Review of Operating Experience.” ADAMS Accession No. ML12044A215. March 9, 2012.
- LR-ISG-2012-01: “Wall Thinning Due to Erosion Mechanisms.” ADAMS Accession No. ML12352A057. April 25, 2013.
- LR-ISG-2012-02: “Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation.” ADAMS Accession No. ML13227A361. November 14, 2013.
- LR-ISG-2013-01: “Aging Management of Loss of Coating or Lining Integrity for Internal Coatings/Linings on In-Scope Piping, Piping Components, Heat Exchangers, and Tanks.” ADAMS Accession No. ML14225A059. November 6, 2014.
- LR-ISG-2015-01: “Changes to Buried and Underground Piping and Tank Recommendations.” ADAMS Accession No. ML15308A018. January 28, 2016.
- LR-ISG-2016-01: “Changes to Aging Management Guidance for Various Steam Generator Components.” ADAMS Accession No. ML16237A383. November 30, 2016.

Subsequent to the issuance of GALL-SLR Report, Revision 0, and SRP-SLR, Revision 0, several more ISG’s, specifically referred to as Subsequent License Renewal Interim Staff Guidance (SLR-ISG), were proposed due to new or updated industry guidance, codes, or standards; relevant plant operating experience; incorporation of lessons learned from completed SLR application reviews; development of new aging management programs or aging management review items, and identification of required corrections and clarification to the guidance. Additional updates of similar category were identified subsequent to SLR-ISG issuance. The staff determined that a revision (Revision 1) to the GALL-SLR Report, Revision 0, and SRP-SLR, Revision 0, was warranted, to directly incorporate these additional updates and the issued SLR-ISGs listed below:

- SLR-ISG-2021-01-PWRVI: Updated Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors of Subsequent License Renewal Guidance. ADAMS Accession No. ML20217L203. January 18, 2021.
- SLR-ISG-2021-02-MECHANICAL: Updated Aging Management Criteria for Mechanical Portions of Subsequent License Renewal Guidance. ADAMS Accession No. ML20181A434. February 18, 2021.
- SLR-ISG-2021-03-STRUCTURES: Updated Aging Management Criteria for Structures Portions of Subsequent License Renewal Guidance. ADAMS Accession No. ML20181A381. February 18, 2021.
- SLR-ISG-2021-04-ELECTRICAL: Updated Aging Management Criteria for Electrical Portions of Subsequent License Renewal Guidance. ADAMS Accession No. ML20181A395. February 18, 2021.

The GALL-SLR Report should be treated as an approved topical report. The NRC reviewers should not re-review a matter described in the GALL-SLR Report, but should find an application acceptable with respect to such a matter when the application references the GALL-SLR Report and when the evaluation of the matter in the GALL-SLR Report applies to the plant. However, reviewers should ensure that the material presented in the GALL-SLR Report is applicable to the specific plant involved and that the applicant has identified specific programs, as described and evaluated in the GALL-SLR Report, if they rely on the report for SLR.

The SRP-SLR is divided into five major chapters:

Chapter 1 — Administrative Information

Chapter 2 — Scoping and Screening Methodology for Identifying Structures and Components Subject to Aging Management Review and Implementation Results

Chapter 3 — Aging Management Review Results

Chapter 4 — Time-Limited Aging Analyses

Chapter 5 — Technical Specifications Changes and Additions

APPENDIX A to the SRP-SLR list branch technical positions and provides review guidance related to use of operating experience for aging management programs. The SRP-SLR addresses various site conditions and plant designs and provides complete procedures for all of the areas of review pertinent to each of the SRP-SLR sections. For any plant-specific application, NRC reviewers may select and emphasize particular aspects of each SRP-SLR section, as appropriate for the application. In some cases, the major portion of the review of a plant program or activity may be conducted on a generic basis (with the owners' group of that plant type) rather than in the context of reviews of particular applications from utilities. In other cases, a plant program or activity may be sufficiently similar to that of a previous plant that a complete review of the program or activity is not needed. For these and similar reasons, reviewers need not carry out in detail all of the review steps listed in each SRP-SLR section in the review of every application.

The individual SRP-SLR sections address: (i) which organization within the NRC staff performs the review; (ii) areas of review; (iii) the basis for review; (iv) the method of review; and (v) the conclusions from the review. One of the objectives of the SRP-SLR is to assign review responsibilities to the appropriate NRR branches. Each SRP-SLR section identifies the branch that has the primary review responsibility for that section. In some review areas, the primary branch may require support, the branches assigned these secondary review responsibilities also are identified for each SRP-SLR section.

Each SRP-SLR section is organized into the following six subsections, generally consistent with NUREG–0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants” (March 2007, with individual sections subsequently revised as needed) (NRC 2021-TN8013).

1. **Areas of Review**

This section describes the scope of review, and contains a description of the systems, structures, components, analyses, data, or other information that is reviewed as part of the SLRA review. This section identifies the branch having the primary review responsibility and provides a discussion of the information needed or the review expected from other branches to permit the primary review branch to complete its review.

2. **Acceptance Criteria**

This section contains a statement of the purpose of the review, an identification of applicable NRC requirements, and the technical basis for determining the acceptability of programs and activities within the area of review of the SRP-SLR section. The technical bases consist of specific criteria, such as NRC regulatory guides, codes and standards, and branch technical positions.

Consistent with the approach described in GALL-SLR Report, the technical bases for some sections of the SRP-SLR can be provided in branch technical positions or appendices as they are developed and can be included in the SRP-SLR.

3. **Review Procedures**

This section discusses the review methodology utilized by the NRC staff. It is generally a step by-step procedure that the reviewer follows to verify that the applicable acceptance criteria have been met.

4. **Evaluation Findings**

This section presents the type of acceptable conclusion that may be reached for the particular review area (e.g., the reviewers’ determination as to whether the applicant has adequately identified the aging effects and the aging management programs credited with managing the aging effects). For each section, a conclusion of this type is included in the safety evaluation report, in which the reviewers present the results of their review. The safety evaluation report also contains a description of the review, including which aspects of the review were selected or emphasized; which matters were modified by the applicant, required additional information, items that will be resolved in the future, or remain unresolved; where the applicant’s program deviates from the criteria provided in the SRP-SLR; and the bases for any deviations from the SRP-SLR or exemptions from the regulations.

5. **Implementation**

This section discusses the NRC staff’s plans for using the SRP-SLR section.

6. **References**

This section lists the references used in the review process.

The SRP-SLR incorporates the NRC staff experience in the review of license renewal applications. It may be considered a part of a continuing regulatory framework development activity that documents the current methods of review and provides a basis for orderly modifications of the review process in the future. The SRP-SLR is revised and updated periodically, as needed, to incorporate experience gained during recent reviews, to clarify the content or correct errors, to reflect changes in relevant regulations, and to incorporate modifications approved by the NRR Division Director. Because individual sections will be revised as needed, the revision numbers and dates may not be the same for all sections.

1.0 ADMINISTRATIVE INFORMATION

1.1 Docketing of Timely and Sufficient Renewal Application

Review Responsibilities

Primary — Branch responsible for subsequent license renewal projects.

Secondary — Branches responsible for technical review, as appropriate.

1.1.1 Areas of Review

This section addresses: (i) the review of the acceptability of a subsequent license renewal application (SLRA) for docketing in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 2.101 (TN6204) and the requirements of 10 CFR Part 54 (TN4878) and (ii) whether an application is timely and sufficient, which allows the provisions of 10 CFR 2.109(b) to apply. Application of this regulation, written to comply with the Administrative Procedures Act (TN5459), means that the current license will not expire until the U.S. Nuclear Regulatory Commission (NRC) makes a final determination on the SLRA.

The review described in this section is not a detailed and comprehensive review of the technical aspects of the application. The docketing and subsequent finding of a timely and sufficient renewal application does not preclude the NRC staff from requesting additional information as the review progresses, and also does not imply the NRC’s final determination regarding the approval or denial of the renewal application. A plant’s current license will not expire upon the passing of the license’s expiration date if the renewal application was found to be timely and sufficient. During this time, and until a license renewal determination has been made by the NRC, the licensee must continue to perform its activities in accordance with the facility’s current licensing basis, including all applicable license conditions, orders, rules, and regulations.

To determine whether an application is acceptable for docketing, the following areas of the SLRA are reviewed.

1.1.1.1 Docketing and Sufficiency of Application

The SLRA is reviewed for acceptability for docketing as a sufficient application in accordance with 10 CFR 2.101 (TN6204), 10 CFR Part 51 (TN250), and 10 CFR Part 54 (TN4878).

1.1.1.2 Timeliness of Application

The timeliness of an SLRA is reviewed in accordance with 10 CFR 2.109(b).

1.1.2 Acceptance Criteria

1.1.2.1 Docketing and Sufficiency of Application

The NRC staff determines acceptance for docketing and sufficiency on the basis of the required contents of an application, established in 10 CFR 2.101, 10 CFR 51.53(c), 54.17, 54.19, 54.21, 54.22, 54.23, 54.29, and 54.4. An application is sufficient if it contains the reports, analyses, and other documents required in such an application.

1.1.2.2 Timeliness of Application

In accordance with 10 CFR 2.109(b) (TN6204), if the licensee of a nuclear power plant licensed under 10 CFR 50.21(b) or 50.22 (TN249) files a sufficient application for renewal of either an operating license or a combined license at least 5 years before the expiration of the existing license, the existing license will not be deemed to have expired until the application has been finally determined.

1.1.3 Review Procedures

A licensee may choose to submit plant-specific reports addressing portions of the License Renewal Rule requirements for NRC review and approval prior to submitting a renewal application. An applicant may incorporate (by reference) these reports or other information contained in previous applications for licenses or license amendments, statements, or correspondence filed with the NRC, provided that the references are clear and specific. However, the final determination of the sufficiency for docketing of a renewal application is made only after a formal SLRA has been submitted to the NRC.

For each area of review, the NRC staff should implement the following review procedures.

1.1.3.1 Docketing and Sufficiency of Application

Upon receipt of a tendered application for subsequent license renewal (SLR), the reviewer should determine whether the applicant has provided the required administrative, technical, and environmental information. The reviewer should use the review checklist provided in Table 1.1-1 to determine whether the application is reasonably complete and conforms to the requirements outlined in 10 CFR Part 54 (TN4878).

Items I.1 through I.10 in the checklist address administrative information. For the purpose of this review, the reviewer checks the “Yes” column if the required information is included in the application. Item VI in the checklist addresses timeliness of the application.

Items II, III, and IV in the checklist address scoping, technical information, the Final Safety Analysis Report Supplement, and technical specification changes, respectively. Chapters 2.0, 3.0, 4.0, and 5.0 of the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) provide information regarding the technical review. Although the purpose of the docketing and sufficiency review is not to determine the technical adequacy of the application, the reviewer should determine whether the applicant has provided reasonably complete information in the application to address the renewal rule requirements. The reviewer may request assistance from appropriate technical review branches to determine whether the application provides sufficient information to address the items in the checklist so that the NRC staff can begin their technical review. The reviewer should check the “Yes” column for a checklist item if the applicant has provided reasonably complete information in the application to address the checklist item.

Item V of the checklist addresses environmental information. The environmental review by NRC staff reviews the supplement to the environmental report prepared by the applicant in accordance with the guidelines in NUREG–1555 (NRC 2000-TN3549), “Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal”. The reviewer checks the “Yes” column if the renewal application contains environmental information consistent with the requirements of 10 CFR Part 51 (TN250).

The application should address each item in the checklist in order to be considered reasonably complete and sufficient. If the reviewer determines that an item in the checklist is not applicable, the reviewer should include a brief statement that the item is not applicable and provide the basis for the statement.

If information in the application for a checklist item is either not provided or not reasonably complete and no justification is provided, the reviewer should check the “No” column for that checklist item. Except for Item VI as discussed in Section 1.1.3.2, checking any “No,” column indicates that the application is not acceptable for docketing as a sufficient renewal application unless the applicant modifies the application to provide the missing or incomplete information.

If the reviewer concludes, and management concurs, that the application is not acceptable for docketing as a sufficient application, the letter (typically preceded by a management call between the NRC staff and the applicant) to the applicant should clearly state that: (i) the application is not sufficient and is not acceptable for docketing and (ii) the current license will expire at its expiration date. The letter also should include a description of the deficiencies found in the application and offer an opportunity for the applicant to supplement its application to provide the missing or incomplete information. The reviewer should review the supplemented application, if submitted, to determine whether it is acceptable for docketing as a sufficient application.

If the reviewer is able to answer “Yes” to the applicable items in the checklist, the application is acceptable for docketing as a sufficient renewal application. The applicant should be notified by letter that the application is accepted for docketing. Normally, the letter should be issued within 30 days of receipt of a renewal application. A notice of acceptance for docketing of the application and notice of opportunity for a hearing regarding renewal of the license is published in the *Federal Register*.

When the application is acceptable for docketing as a sufficient application, the NRC staff begins its technical review. For SLRAs, the NRC maintains the docket number of the current operating license for administrative convenience.

1.1.3.2 Timeliness of Application

If a sufficient application is submitted at least 5 years before the expiration of the current operating license, the reviewer checks the “Yes” column for Item VII in the checklist. If the supplemented application, as discussed in Section 1.1.3.1, is submitted at least 5 years before the expiration of the current operating license, the reviewer checks the “Yes” column for Item VI in the checklist.

If the reviewer checks the “No” column in Item VI in the checklist, indicating that a sufficient renewal application has not been submitted at least 5 years before the expiration of the current operating license, the letter (typically preceded by a management call between the NRC staff and the applicant) to the applicant should clearly state that: (i) the application is not timely, (ii) the provisions in 10 CFR 2.109(b) (TN6204) have not been satisfied, and (iii) the current license will expire on the expiration date in the absence of other licensing action (e.g., issuance of an exemption). The Item in Section VI of the checklist is only included to determine if the application meets the criteria for timely renewal, not to determine the sufficiency of the application. Thus, if the application is otherwise determined to be acceptable for docketing, the technical review can begin.

1.1.4 Evaluation Findings

The reviewer determines whether sufficient and adequate information has been provided to satisfy the provisions outlined in Section 1.1.3.1, “Docketing and Sufficiency of Application” above. Depending on the results of this review, one of the following conclusions is included in the NRC staff’s letter to the applicant:

- On the basis of its review, as discussed above, the NRC staff has determined that the applicant has submitted sufficient information that is acceptable for docketing, in accordance with 10 CFR 54.19, 54.21, 54.22, 54.23, 54.4 (TN4878), and 51.53(c) (TN250). However, the NRC staff’s determination does not preclude the request for additional information as the review proceeds.
- On the basis of its review, as discussed above, the NRC staff has determined that the application is *not acceptable* for docketing as a timely and/or sufficient renewal application.

1.1.5 Implementation

NRC staff follows the methods described above to evaluate the sufficiency of the application for docketing.

1.1.6 References

1. NRC. NUREG–1555, “Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal.” Revision 1. Agencywide Documents Access and Management System (ADAMS) Accession No. ML13106A246. Washington, DC: U.S. Nuclear Regulatory Commission. June 2013. NRC 2000-TN3549

Table 1.1-1 Acceptance Review Checklist for Subsequent License Renewal Application Acceptability for Docketing

		Yes	No
I.	**General Information**		
	1. Application identifies specific unit(s) applying for subsequent license renewal	☐	☐
	2. Filing of renewal application 10 CFR 54.17(a) is in accordance with:		
	A. 10 CFR Part 2, Subpart A; 10 CFR 2.101	☐	☐
	B. 10 CFR 50.4		
	a. Application is addressed to the Document Control Desk as specified in 10 CFR 50.4(a)	☐	☐
	b. A signed original application and hard copies are provided to the Document Control Desk. One copy is provided to the appropriate Regional Office and one copy to the Regional Inspectors in accordance with the NRC docketing requirement in 10 CFR 50.4.	☐	☐
	c. Form of the application meets the requirements of 10 CFR 50.4(c)	☐	☐
	C. 10 CFR 50.30		
	a. Application is filed in accordance with 10 CFR 50.4 [10 CFR 50.30(a)(1)]	☐	☐
	b. Application is submitted under oath or affirmation [10 CFR 50.30(b)]	☐	☐
	3. Applicant is eligible to apply for a license and is not a foreign-owned or foreign-controlled entity [10 CFR 54.17(b)]	☐	☐
	4. Application is not submitted earlier than 20 years before expiration of current license [10 CFR 54.17(c)]	☐	☐
	5. Application states whether it contains applications for other kinds of licenses [10 CFR 54.17(d)]	☐	☐
	6. Information incorporated by reference in the application is contained in other documents previously filed with the Commission, and the references are clear and specific [10 CFR 54.17(e)]	☐	☐
	7. Restricted data or other defense information, if any, is separated from unclassified information in accordance with 10 CFR 50.33(j) [10 CFR 54.17(f)]	☐	☐
	8. If the application contains restricted data, written agreement on the control of accessibility to such information is provided [10 CFR 54.17(g)]	☐	☐
	9. Information specified in 10 CFR 50.33(a) through (e), (h), and (i) is provided or referenced [10 CFR 54.19(a)]:	☐	☐
	A. Name of applicant	☐	☐
	B. Address of applicant	☐	☐
	C. Business description	☐	☐
	D. Citizenship and ownership details	☐	☐
	E. License information	☐	☐
	F. Construction or alteration dates	☐	☐
	G. Regulatory agencies and local publications	☐	☐
	10. Conforming changes, as needed, to the standard indemnity agreement have been submitted (10 CFR 140.92, Appendix B) to account for the proposed change in the expiration date [10 CFR 54.19(b)]	☐	☐

Table 1.1-1 Acceptance Review Checklist for Subsequent License Renewal Application Acceptability for Docketing (Continued)

	Yes	No
II. Technical Information		
1. An integrated plant assessment [10 CFR 54.21(a)] is provided, and consists of:		
A. For those systems, structures, and components (SSCs) within the scope of license renewal (10 CFR 54.4), identification and listing of those structures and components (SCs) that are subject to an aging management review (AMR) in accordance with 10 CFR 54.21(a)(1)(i) and (ii)		
a. Description of the boundary of the system or structure considered (if applicant initially scoped at the system or structure level). Within this boundary, identification of SCs subject to an AMR. For commodity groups, description of basis for the grouping	☐	☐
b. Lists of SCs subject to an AMR	☐	☐
B. Description and justification of methods used to identify SCs subject to an AMR [10 CFR 54.21(a)(2)]	☐	☐
C. Demonstration that the effects of aging will be adequately managed for each structure and component identified, so that their intended function(s) will be maintained consistent with the current licensing basis (CLB) for the period of extended operation [10 CFR 54.21(a)(3)]		
a. Description of the intended function(s) of the SCs	☐	☐
b. Identification of applicable aging effects based on materials, environment, operating experience, etc.	☐	☐
c. Identification and description of aging management programs (AMPs)	☐	☐
d. Demonstration of aging management provided	☐	☐
2. An evaluation of time-limited aging analysis (TLAAs) is provided, and consists of:		
A. Listing and description of plant-specific TLAAs in accordance with the six criteria specified in 10 CFR 54.3 [10 CFR 54.21(c)(1)]	☐	☐
B. An evaluation of each identified TLAA using one of the three approaches specified in 10 CFR 54.21(c)(1)(i) to (iii)	☐	☐
3. All plant-specific exemptions granted pursuant to 10 CFR 50.12 and in effect that are based on a TLAA are listed, and evaluations justifying the continuation of these exemptions for the subsequent period of extended operation are provided [10 CFR 54.21(c)(2)]	☐	☐
A. Listing of plant-specific exemptions that are based on TLAAs as defined in 10 CFR 54.3 [10 CFR 54.21(c)(2)]	☐	☐
B. An evaluation of each identified exemption justifying the continuation of these exemptions for the subsequent period of extended operation [10 CFR 54.21(c)(2)]	☐	☐

Table 1.1-1 Acceptance Review Checklist for Subsequent License Renewal Application Acceptability for Docketing (Continued)

		Yes	No
III	**An Final Safety Analysis Report Supplement [10 CFR 54.21(d)] is provided and contains the following information**:		
	1. Summary description of the AMPs and activities for managing the effects of aging	☐	☐
	2. Summary description of the evaluation of TLAAs	☐	☐
IV.	**Technical Specification Changes**		
	Any technical specification changes necessary to manage the aging effects during the period of extended operation and their justifications are included in the application (10 CFR 54.22)	☐	☐
V.	**Environmental Information**		
	Application includes a supplement to the environmental report that is in accordance with the requirements of Subpart A of 10 CFR Part 51 (10 CFR 54.23)	☐	☐
VI.	**Timeliness Provision**		
	The application is sufficient and submitted at least 5 years before expiration of current license [10 CFR 2.109(b)]. If not, application can be accepted for docketing, but the timely renewal provision in 10 CFR 2.109(b) does not apply	☐	☐
VII.	**Conclusions Regarding Acceptance of Application for Docketing**		
	The application is reasonably complete and meets the Acceptance Review Checklist criteria I through V and is recommended for docketing	☐	☐

1.2 <u>Integrated Plant Assessments and Aging Management Reviews</u>

The NRC Project Manager (PM) responsible for the safety review of the SLRA is responsible for assigning to appropriate NRC Office of Nuclear Reactor Regulation divisions the review or audit of aging management reviews (AMRs) of systems, structures and components (SSCs) or aging management programs (AMPs) identified in the applicant's SLRA. The PM documents to which organization each AMR or AMP is assigned. The assigned AMRs and AMPs are reviewed per the criteria described in Sections 3.1 through 3.6 of this SRP-SLR, for review of SLRAs, as directed by the scope of each of these sections. Chapter 4.0 of this standard review plan provides guidelines for using TLAAs as the basis for evaluating and managing aging effects by analysis. Specifically, Section 4.1 of this SRP-SLR provides the NRC staff's guidance for identifying TLAAs in accordance with the requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(c)(1) (TN4878) and the definitions of TLAAs in 10 CFR 54.3. TLAAs are reviewed in accordance with the acceptance criteria and guidance described in Sections 4.2 through 4.7 of this SRP-SLR.

Review of the AMPs requires assessment of 10 program elements as defined in this SRP-SLR. The NRC division assigned the AMP reviews of the 10 program elements to verify their technical adequacy. For three of the 10 program elements (corrective actions, confirmation process, and administrative controls), the NRC division responsible for review of the quality assurance (QA) aspects of the application verifies that the applicant has documented a commitment in the Final Safety Analysis Report (FSAR) Supplement to expand the scope of its 10 CFR Part 50 (TN249), with Appendix B program to address the associated program elements for each AMP. If the applicant chooses alternate means of addressing these three program elements, (i.e., use of a process other than the applicant's 10 CFR Part 50, Appendix B program) the NRC division assigned to review the AMP should request that the division responsible for QA review the applicant's proposal on a case-specific basis.

1.2.1 Background on the Types of Reviews

Section 54.21(a)(3) to 10 CFR Part 54 (TN4878) requires the application to demonstrate, for SSCs within the scope of license renewal and subject to an AMR pursuant to 10 CFR 54.21(a)(1), that the effects of aging are adequately managed so that the intended function(s) are maintained consistent with the current licensing basis (CLB) for the subsequent period of extended operation. This AMR consists of identifying the material, environment, aging effects, and the AMP(s) credited for managing the aging effects.

Sections 3.1 through 3.6 of this SRP-SLR describe how the AMRs and AMPs are reviewed. In this SRP-SLR, Section 3.X.2 (where X denotes number 1–6) presents the acceptance criteria describing methods to determine whether the applicant has met the requirements of the NRC's regulations in 10 CFR 54.21. Section 3.X.3 presents the review procedures to be followed.

The AMR line items in the 3.X-1 tables provide a generic list of AMRs for groups of components that may be included in the reactor coolant system, emergency safety feature systems, auxiliary systems, steam and power conversion systems, structures and structural components, and electrical systems of an applicant's pressurized water reactor (PWR) or boiling water reactor (BWR) plant design. The AMR items are provided in a column-based format that accomplishes the following objectives:

- New (N), Modified (M), Deleted (D), Edited (E) Item: The description of this column identifies whether the AMR line item is new, was modified, deleted, or edited. The NRC will publish the technical bases for these new, modified, and deleted AMR items in a NUREG containing the disposition of public comments and the technical bases for changes in the guidance documents after the final SLR guidance documents are published.
- "ID" column: The description for this column provides an identification number for the AMR item of a given commodity grouping of components that have common materials of fabrication, environmental conditions, and aging effects.
- "Type" column: The description for this column identifies whether the specific AMR item in the table is applicable to BWR, PWR, or both plant designs.
- "Component" column: The description for this column identifies the specific components that are within the scope of the commodity grouping in the AMR item and the materials of fabrication and environmental conditions that are applicable to the components in the AMR item.
- "Aging Effect/Mechanism" column: The description for this column identifies the aging effects and mechanisms that are applicable to the material-environmental combinations for the components in the commodity grouping of the AMR item.
- "Aging Management Program/TLAA" column: The description for this column provides AMPs or TLAAs that may be used to manage the aging effects that apply to the components in the commodity grouping of the AMR item and to demonstrate compliance with the aging management requirement in 10 CFR 54.21(a)(3) (TN4878).
- "Further Evaluation" column: The description for this column identifies whether the AMP or TLAA recommended in the "Aging Management Program/TLAA" column of the AMR item requires additional evaluation (further evaluation) by an applicant adopting the AMR item. This column also references the specific subsection(s) in SRP-SLR Chapter 3.0 applicable to the evaluation of the components in the commodity grouping of the AMR item.
- "GALL-SLR Item" column: The description for this column identifies the component-specific AMR items in the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report that derives from the commodity-group-based item in the SRP-SLR AMR table.

Edited (E) items, in contrast to modified (M) items, are those for which no technical aspects were changed. Examples of editorial changes include:

- Line item citations that were missed in the SRP-SLR Table 3.X 1.
- Deleting whether the environment is internal or external from the description of the environment because based on the material, environment, aging effect, and AMP combination, it is obvious that the environment could only be on either the inside or outside of the component.
- Deletion of the term "piping element" from aging management review items that do not cite glass as a material. Piping elements are defined in the GALL-SLR Report as components constructed of glass.
- Line item changes that only involved removing detail related to a Further Evaluation Recommended column were removed after it was verified that the identical information was included in the SRP-SLR further evaluation section.
- Line item changes that only involved renumbering further evaluation sections.

- Aging effects changed from “and” to “or.” This could appear to be a technical change; however, this is not the case because the staff confirmed that was never the intent that both aging effects were occurring. For example, the “and” in “cracking due to stress corrosion cracking and cyclic loading” was replaced with “or.”
- Deleting the term “environment” from the description of the environment in the “Environment” column when the phrase “any environment” was used because it was obvious and redundant.
- Descriptors for the AMPs in the “Aging Management Program/TLAA” column were simplified if the information was provided elsewhere.
- Minor edits to component descriptions, examples: (i) deleting “elastomer” from “elastomer, elastomer seals;” and (ii) adding “piping” or “ducting” in front of the term “component.”
- Adding the term “electrical” to Structure and/or Component and Aging Effect/Mechanism description.

The GALL-SLR Report is a technical basis document to the SRP-SLR and provides generic AMR and AMP guidance that may be used as part of the bases for developing an SLRA. As such, the GALL-SLR Report contains an acceptable method that may be used to assist an applicant in: (i) developing the integrated plant assessment for an SLRA, as required by 10 CFR 54.21(a); (ii) identifying those components and structures that are required to be within the scope of an AMR, as required by 10 CFR 54.21(a)(1); and (iii) managing those aging effects that are applicable to these SSCs, as required by 10 CFR 54.21(a)(3) (TN4878). An applicant may propose an alternative method for performing the integrated plant assessment. Therefore, the use of the GALL-SLR Report is not required; however, its use should facilitate both preparation of an SLRA by an applicant and timely, uniform review by the NRC staff. If the GALL-SLR Report is used for the development of an SLRA, the GALL-SLR Report should be treated as an NRC-approved topical report (TR).

The GALL-SLR Report contains an AMR evaluation of a large number of structures and components (SCs) that may be in the scope of a typical SLRA and may need to be the subject of an AMR in accordance with requirements in 10 CFR 54.21(a)(1). The AMR results documented in the GALL-SLR Report indicate that many existing, typical generic AMPs are adequate for manageing the aging effects for particular SCs without change. The GALL-SLR Report also contains recommendations on specific areas in the generic existing programs that should be augmented for SLRAs and documents the technical basis for each such determination. In addition, the GALL-SLR Report identifies certain SCs that may or may not be subject to particular aging effects, and for which industry groups are developing generic AMPs or investigating whether aging management is warranted. The ultimate generic resolution of such an issue may need NRC review and approval for plant-specific implementation, as indicated in a plant-specific FSAR Supplement, and reflected in the safety evaluation report (SER) associated with a particular SLRA.

The GALL-SLR Report does not address scoping of SSCs for SLR. The determination of SSCs that need to be within the scope of SLR is plant-specific aspect of the application and is required to be performed in accordance with the requirements in 10 CFR 54.4. Consistent with the scoping guidelines in Chapter 2.0 of this SRP-SLR, the scoping results for an SLRA are dependent on the plant design and CLB. Therefore, the inclusion of a certain SCs in a given AMR line item of the GALL-SLR Report does not mean that the particular SC is within the scope of the SLR for all plants.

Conversely, the omission of a certain SC in the GALL-SLR Report does not mean that a particular SC in the plant design is not within the scope of the SLRA or does not need to be the subject of an AMR in accordance with the requirements in 10 CFR 54.21(a)(1) (TN4878). The AMR line items in the SRP-SLR and GALL-SLR Report may not provide a comprehensive list of all SCs that need to be within the subject of an AMR or a comprehensive list of all potential aging effects that may be applicable to those SC as being the subject of an AMR. Therefore, as has been the practice for initial license renewal applications, plant-specific AMRs should be performed if additional aging effects (not referenced in the SRP-SLR and GALL-SLR Report) are applicable to the design of a specific SC subject to an AMR.

As indicated in the bulleted list above, the specific AMR line items in Chapters II–VIII of the GALL-SLR Report derive from and are identified in the AMR line items of the 3.X-2 tables of the SRP-SLR. The AMR line items in GALL-SLR Report are formatted in a manner that is analogous (but not identical) to the format of the AMR line items in the SRP-SLR. In addition, as indicated above, the “Further Evaluation” column in the AMR line items of the 3.X-1 tables of this report and the AMR tables (Chapters II through VIII of the GALL-SLR Report) establish whether the aging management bases in those AMR line items need to be the subject of further assessment by the applicant (i.e., the subject of “Further Evaluations”). The “Further Evaluation” topics and the acceptance criteria for satisfying these “Further Evaluations” are described in the 3.X.2.2 sections of this report. The related review procedures for these “Further Evaluation” topics are provided in the 3.X.3.2 sections of this report.

Therefore, for SCs in the plant design that are required to be scoped into the SLRA and subject to an AMR, the applicant may use the AMR line items in the 3.X-1 tables of the SRP-SLR, and the AMR line items in the GALL-SLR Report referenced in these SRP-SLR tables, as a basis for comparison to the design of the SCs in the plant design. If this method is used for development of the AMR, the applicant may adopt those AMR items in the SRP-SLR and GALL-SLR Reports that are applicable to the design of the SCs in the plant in order to aid the applicant in identifying those aging effects that are applicable to the SC. For those AMR items in the SLRA that are designated as being consistent with the SRP-SLR and GALL-SLR Report and are the subject of “Further Evaluation” aging management topics, the AMR should include the applicant’s bases on how those “Further Evaluation” criteria have been addressed and met, as applicable to the licensing basis and design basis for the plant’s design.

As part of the development of the SLRA, the applicant should assess the AMPs in the GALL-SLR Report. The applicant may choose to use an AMP that is consistent with the GALL-SLR Report AMP, or may choose a plant-specific AMP. An applicant may reference the GALL-SLR Report in an SLRA to designate which programs at the applicant’s facility will be used to manage the effects of aging for specific SC, and how those programs correspond to the AMPs reviewed and approved in the GALL-SLR Report. If an applicant does take credit for a program in the GALL-SLR Report, it is incumbent on the applicant to ensure that the conditions and operating experience (OE) at the plant is bounded by the conditions and OE for which the GALL-SLR Report program was evaluated. If these bounding conditions are not met it is incumbent on the applicant to address the additional effects of aging and augment the AMP(s) in the GALL-SLR Report in the SLRA, as appropriate.

If a GALL-SLR Report AMP is selected to manage aging, the applicant may take one or more exceptions to specific GALL-SLR Report AMP elements. Exceptions include portions of the GALL-SLR Report AMP that the applicant does not intend to implement, which the staff will review on a case-by-case basis. Any deviation or exception to the GALL-SLR Report AMP should be described and justified. The applicant may identify that the exception was previously approved for the plant under review. The applicant may also use precedence from another plant to justify their exception. In both these cases, the reviewer is to confirm that the justifications for the previously approved exceptions are acceptable for the subsequent period of extended operation. For example, a previously approved exception may have been acceptable for operation up to 60 years, but not past 60 years.

In some cases, an applicant may choose an existing plant program that does not currently meet all the program elements defined in the GALL-SLR Report AMP. If this is the situation, the applicant makes a commitment to augment the existing program to satisfy the GALL-SLR Report AMP elements prior to the subsequent period of extended operation.

Enhancements are revisions or additions to existing AMPs that the applicant commits to implement prior to the subsequent period of extended operation. Enhancements include, but are not limited to, those activities needed to ensure consistency with the GALL-SLR Report recommendations. Enhancements may expand, but not reduce the scope of an AMP.

For the programs submitted in the SLRA that the applicant claims are consistent with the GALL-SLR Report, the NRC staff will verify that the applicant's programs are consistent with those described in the GALL-SLR Report and/or with plant conditions and OE during the performance of an AMP audit and review. The focus of the balance of the NRC staff review of an SLRA is on those programs that an applicant has enhanced to be consistent with the GALL-SLR Report, those programs for which the applicant has taken an exception to the program described in the GALL-SLR Report, and plant-specific programs not described in the GALL-SLR Report.

An audit and review is conducted at the applicant's facility to evaluate AMPs that the applicant claims to be consistent with the GALL-SLR Report. The applicant may use a plant-specific AMP or plant-specific aging management activities as the basis for aging management of a specific structure or component. If plant-specific AMPs or aging management activities are used as the basis for aging management, the NRC staff reviews the AMPs or activities in accordance with the program element criteria that are defined in the SRP-SLR Appendix A.1, Section A.1.2.3.

Reviews are also performed to address those AMRs or AMPs related to emergent issues, stated to be not consistent with the GALL-SLR Report, or based on an NRC-approved precedent (e.g., AMRs and AMPs addressed in an NRC SER of a previous SLRA) or TR. SRP-SLR Section 1.2.3 provides additional guidance on reviewing those GALL-based or plant-specific AMPs that are based on NRC-endorsed TRs. As a result of the criteria established in 10 CFR Part 54 (TN4878), the guidance provided in SRP-SLR, GALL-SLR Report, and the applicant's exceptions and/or enhancements to a GALL-SLR Report AMP, the following aspects of the SLRA are audited or reviewed by the NRC staff.

<u>AMRs</u>

- AMR results consistent with the GALL-SLR Report.
- AMR results for which further evaluation is recommended.
- AMR results not consistent with or not addressed in the GALL-SLR Report.

<u>AMPs</u>

- Consistent with the GALL-SLR Report AMPs
- Plant-specific AMPs

TLAAs

FSAR Supplement

- The regulation in 10 CFR 54.21(d) (TN4878) requires the SLRA to include a FSAR Supplement summary description for each AMP or aging management activity and each TLAA that is included in the SLRA.
- The renewed license will include a license condition that will specifies the time for incorporating the contents of its FSAR Supplement into the FSAR as specified in 10 CFR 50.71(e) (TN249). This includes incorporation of all FSAR Supplement summary descriptions that were included in the FSAR Supplement for AMPs, aging management activities, and TLAAs included in the SLRA, and any programmatic or TLAA-related enhancements or commitments that may have been included in the FSAR Supplement, including those for implementing the AMPs, aging management activities and TLAAs during the subsequent period of extended operation.

1.2.2 Applications With Approved Extended Power Uprates

Extended power uprates (EPUs) are licensing actions that some licensees have recently requested the NRC staff to approve, which can affect aging management. In an NRC staff letter to the Advisory Committee on Reactor Safeguards, dated October 26, 2004, (Agencywide Documents Access and Management System [ADAMS] Accession No. ML042790085), the NRC Executive Director for Operation states that “All license renewal applications with an approved EPU will be required to perform an OE review and its impact on AMPs for SCs before entering the subsequent period of extended operation.” One way for an applicant with an approved EPU to satisfy this criterion is to document its commitment to perform an OE review and its impact on AMPs for SSCs before entering the subsequent period of extended operation as part of its SLRA. Such licensee commitments should be documented in the NRC staff’s SER, written in support of issuing a renewed license. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant completes these activities no later than the committed date. EPU impact on SSCs should be part of the SLR review. If necessary, the PM assigns a responsible group to address EPU.

1.2.3 Aging Management Programs That Rely on Implementation of Nuclear Regulatory Commission Approved Technical or Topical Reports

The NRC Office Instruction LIC-500, Revision 5, establishes the NRC’s current process expectations for applying the methodology in an NRC-endorsed or NRC-approved technical or TR to the CLB or current design basis of a licensed U.S. light-water reactor facility. The LIC-500 office instruction identifies that the use of such reports may be subject to specific limitations or actions, which are identified and issued in the NRC’s safety evaluations (SEs) that evaluate the TR methodologies. The LIC-500 office instruction states that it is the NRC’s expectation that licensees or applicants applying these types of reports to their CLBs or design bases will address or respond to those action items or limitations that were issued in the NRC staff’s SEs regarding the TR methodologies.

The GALL-SLR Report AMPs that rely on the recommended activities in NRC-endorsed TRs identifies those TRs that are within the scope of the AMPs. Examples of GALL-SLR Report AMPs that rely on NRC-approved industry reports include, but are not limited to: (1) GALL-SLR Report AMP XI.M4, “BWR Vessel ID Attachment Welds,” (2) GALL-SLR Report AMP XI.M8, "BWR Penetrations," and (3) GALL-SLR Report AMP XI.M9, "BWR Vessel Internals." Plant-specific AMPs may also be based on NRC-approved TRs.

For AMPs that rely on one or more NRC-endorsed TRs, the use of TR methodologies that are relied upon for aging management are subject to the applicant's bases for resolving any limitations or action items that are placed on implementation of the applicable TR methodologies. Therefore, an applicant's bases for resolving any limitations or actions items on the TRs is especially relevant to the applicant's determination on whether the scope of the program, or other program elements in the AMP, will need to be augmented or enhanced beyond conformance with the recommended criteria, evaluations, and activities in the applicable TRs. Therefore, the AMPs should include the applicant's bases for resolving any limitation or action items on the applicable TR methodologies, as documented in the NRC SE regarding the methodologies. If it is determined that the basis for resolving a specific TR limitation or applicant action item would result in the need for augmentation of the AMP beyond the criteria, evaluations, or activities recommended in the TRs, the applicant should enhance its AMPs accordingly to identify the TR guidance protocols or activities that will be impacted and the specific AMP program elements that will need to be enhanced or adjusted (as necessary and applicable to the CLB and design basis for the facility) as a result of the applicant's basis for resolving the specific limitation or action item. Consistent with the recommendations in Nuclear Energy Institute 95-10, as referenced by Regulatory Guide 1.188 Vanguard Can Help with Total Financial Wellness (NRC 2005-TN7997), applicants may provide their bases for resolving the specific limitations or action items in Appendix C of their SLRAs.

In addition, for AMPs that rely on these types of TRs, the recommended activities in these TRs may go beyond activities within the scope of the applicable NRC requirements specified in the GALL-SLR (e.g., those requirements specified in any of the applicable Federal Acts, NRC regulations, plant operating license or technical specification requirements, or NRC-issued orders). Implementation of the TRs referenced in the AMPs does not relieve the applicant from complying with the applicable requirements, unless applicable Code reliefs, regulatory exemptions, or notices of enforcement discretion are requested and granted by the NRC for the specific type of requirement that applies to the CLB. This is in addition to those aspects of the 10 CFR Part 50 (TN249), Appendix B program that may apply to the AMPs.

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

2.1 Scoping and Screening Methodology

Review Responsibilities

Primary — Assigned branch(es)

Secondary — None

2.1.1 Areas of Review

This section addresses the scoping and screening methodology for subsequent license renewal (SLR). As required by Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(a)(2) (TN4878), the applicant in its integrated plant assessment is required to describe and justify methods used to identify systems, structures, and components (SSCs) subject to an aging management review (AMR). The SSCs subject to AMR are those that perform an intended function, as described in 10 CFR 54.4, and meet two criteria in 10 CFR 54.21(a)(1)(i) and (ii). The two criteria include structures and components (SCs):

1 That perform an intended function, as described in § 54.4, without moving parts or without a change in configuration or properties.

2 That are not subject to replacement based on a qualified life or specified time period.

Such SCs are denoted as “passive” and “long-lived” in this standard review plan (SRP).

The identification of the SSCs within the scope of SLR is called “scoping.” For those SSCs within the scope of SLR, the identification of “passive” and “long-lived” SCs that are subject to an AMR are called “screening.”

To verify that the applicant has properly implemented its methodology, the U.S. Nuclear Regulatory Commission (NRC) staff reviews the implementation results separately, following the guidance outlined in Sections 2.2 through 2.5.

The following areas relating to the applicant’s scoping and screening methodology have been reviewed and presented below.

2.1.1.1 Scoping

The methodology used by the applicant to implement the scoping requirements of 10 CFR 54.4, “Scope,” is reviewed.

2.1.1.2 Screening

The methodology used by the applicant to implement the screening requirements of 10 CFR 54.21(a)(1) is reviewed.

2.1.2 Acceptance Criteria

The acceptance criteria for the areas of review are based on the following regulations:

- 10 CFR 54.4(a) (TN4878) as it relates to the identification of plant SSCs within the scope of the Rule.
- 10 CFR 54.4(b) as it relates to the identification of the intended functions of plant SSCs determined to be within the scope of the Rule.
- 10 CFR 54.21(a)(1) and (a)(2) as they relate to the methods utilized by the applicant to identify plant SCs subject to an AMR.

Specific criteria necessary to determine whether the applicant has met the relevant requirements of 10 CFR 54.4(a), 54.4(b), 54.21(a)(1), and 54.21(a)(2) are as follows.

2.1.2.1 Scoping

The scoping methodology used by the applicant should be consistent with the process described in Section 3.0, “Identify the SSCs within the Scope of License Renewal and Their Intended Functions,” of Nuclear Energy Institute (NEI) 95-10, “Industry Guideline for Implementing the Requirements of 10 CFR Part 54—The License Renewal Rule” (Ref. 1), as referenced by Regulatory Guide (RG) 1.188, or the justification provided by the applicant for any exceptions should provide a reasonable basis for the exception.

2.1.2.2 Screening

The screening methodology used by the applicant should be consistent with the process described in Section 4.1, “Identification of Structures and Components Subject to an Aging Management Review and Intended Functions,” of NEI 95-10 (Ref. 1), as referenced by RG 1.188.

2.1.3 Review Procedures

Preparation for the review of the scoping and screening methodology employed by the applicant should include review of the following sources of information:

- The safety evaluation report (SER) that was issued on the facility’s license renewal. This review is conducted for the purpose of familiarization with the principal design criteria for the facility and its current licensing basis (CLB), as defined in 10 CFR 54.3(a) (TN4878).
- Chapters 1 through 12 of the updated Final Safety Analysis Report (UFSAR) and the facility’s technical specifications for the purposes of familiarization with the facility design and the nomenclature that is applied to SSCs within the facility (including the bases for such nomenclature). During this review, the SSCs should be identified that are relied upon to remain functional during and after design basis events (DBEs), as defined in 10 CFR 50.49(b)(1)(ii) (TN249), for which the facility was designed, to ensure that the functions described in 10 CFR 54.4(a)(1) are successfully accomplished. This review should also yield information regarding seismic Category I SSCs as defined in RG 1.29, “Seismic Design Classification for Nuclear Power Plants” (NRC 2016-TN5879). For a newer plant, this information is typically contained in Section 3.2.1, “Seismic Classification,” of the UFSAR consistent with the SRP (NUREG–0800) (NRC 2021-TN8013).

- Chapter 15 (or equivalent) of the UFSAR to identify the anticipated operational occurrences and postulated accidents that are explicitly evaluated in the accident analyses for the facility. During this review, the SSCs that are relied upon to remain functional during and following DBEs [as defined in 10 CFR 50.49(b)(1) (TN249)] to ensure the functions described in 10 CFR 54.4(a)(1) (TN4878) should be identified.
- The set of DBEs as defined in the Rule are not limited to Chapter 15 (or equivalent) of the UFSAR. Examples of DBEs that may not be described in this chapter include external events, such as floods, storms, earthquakes, tornadoes, or hurricanes, and internal events, such as a high-energy line break. Information regarding DBEs as defined in 10 CFR 50.49(b)(1) may be found in any chapter of the facility UFSAR, the Commission's regulations, NRC orders, exemptions, or license conditions within the CLB. These sources should also be reviewed to identify SSCs that are relied upon to remain functional during and following DBEs [as defined in 10 CFR 50.49(b)(1)] to ensure the functions described in 10 CFR 54.4(a)(1).
- The facility's Probabilistic Risk Analysis Summary Report that was prepared by the licensee in response to Generic Letter (GL) 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities–10 CFR 50.54(f)," dated November 23, 1988 (NRC 1988-TN8014). This review should yield additional information regarding the impact of the individual plant examination (IPE) on the CLB for the facility. While the License Renewal (LR) Rule is "deterministic," the NRC in the Statements of Consideration (SOC) accompanying the Rule also states that "In license renewal, probabilistic methods may be most useful, on a plant-specific basis, in helping to assess the relative importance of structures and components that are subject to an AMR by helping to draw attention to specific vulnerabilities [e.g., results of an IPE or individual plant examination of external events (IPEEE)" (60 FR 22468). For example, the reviewer should focus on IPE information pertaining to plant changes or modifications that are initiated by the licensee in accordance with the requirements of 10 CFR 50.59 or 10 CFR 50.90.
- The results of the facility's IPEEE study conducted as a follow-up to the IPE performed as a result of GL 88-20 to identify any changes or modifications made to the facility in accordance with the requirements of 10 CFR 50.59 or 10 CFR 50.90.
- The applicant's docketed correspondence related to the following regulations:
  (i) 10 CFR 50.48, "Fire Protection;"
  (ii) 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants;"
  (iii) 10 CFR 50.61, "Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events" or 10 CFR 50.61a, "Alternate Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events," in accordance with the applicant's CLB (applicable only to pressurized water reactor [PWR] plants);
  (iv) 10 CFR 50.62, "Requirements for Reduction of Risk from Anticipated Transients without Scram Events for Light-Water-Cooled Nuclear Power Plants;" and
  (v) 10 CFR 50.63, "Loss of All Alternating Current Power" (applicable to PWR plants).

Other NRC staff members may be reviewing the applicant's scoping and screening results separately following the guidance in Sections 2.2 through 2.5. The reviewer should keep these other NRC staff members informed of findings that may affect their review of the applicant's scoping and screening results. The reviewer should coordinate this sharing of information through the SLR Project Manager (PM).

2.1.3.1 Scoping

Once the information described above has been gathered, the NRC staff reviews the applicant's methodology to determine whether its depth and breadth are sufficiently comprehensive to identify the SSCs within the scope of SLR, and the SCs requiring an AMR. Because "[t]he CLB represents the evolving set of requirements and commitments for a specific plant that are modified as necessary over the life of a plant to ensure continuation of an adequate level of safety" (60 FR 22465, May 8, 1995), the regulations, orders, license conditions, exemptions, and technical specifications (TS) defining functional requirements for facility SSCs that make up an applicant's CLB should be considered as the initial input for the scoping process. The DBEs are defined in 10 CFR 50.49 (TN249) as conditions of normal operation, including anticipated operational occurrences and DBAs. External events, DBAs, and natural phenomena for the plant must be designed to ensure: (1) the integrity of the reactor pressure boundary, (2) the capability to shut down the reactor and maintain it in safe shutdown condition, or (3) the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to those referred to in 10 CFR 50.34(a)(1), 50.67(b)(2), or 100.11 (TN282), as applicable. Therefore, to determine the safety-related SSCs that are within the scope of the Rule under 10 CFR 54.4(a)(1) (TN4878), the applicant must identify those SSCs that are relied upon to remain functional during and following these DBEs, consistent with the CLB of the facility. Most licensees have developed lists or databases that identify the SSCs relied upon for compliance with other regulations in a manner consistent with the CLB of their facilities. Consistent with the licensing process and regulatory criteria used to develop such lists or databases, licensees should build upon these information sources to satisfy 10 CFR Part 54 requirements.

With respect to TS, the NRC has stated (60 *Federal Register* [FR] 22467):

> The Commission believes that there is sufficient experience with its policy on technical specifications to apply that policy generically in revising the license renewal rule consistent with the Commission's desire to credit existing regulatory programs. Therefore, the Commission concludes that the technical specification limiting conditions for operation scoping category is unwarranted and has deleted the requirement that identifies systems, structures, and components with operability requirements in technical specifications as being within the scope of the license renewal review.

Therefore, the applicant is not required to consider its TS and applicable limiting conditions of operation when scoping for SLR. Needless to say that the events and functions addressed within the applicant's TS can be excluded when determining the SSCs within the scope of SLR solely on the basis of inclusion of such an event's in the TS. Rather, those SSCs governed by an applicant's TS that are relied upon to remain functional during a DBE, as identified within the applicant's UFSAR, applicable NRC regulations, license conditions, NRC orders, and exemptions, need to be included within the scope of SLR.

For licensee commitments, such as licensee responses to NRC bulletins, GLs, or enforcement actions, and those documented in NRC staff safety evaluations or licensee event reports, and others that make up the remainder of an applicant's CLB, and associated SSCs need not be considered under SLR. Generic communications, safety evaluations, and other similar documents found on the docket do not reflect regulatory requirements, and commitments made by a licensee to address any associated safety concerns and are not typically considered to be design requirements. However, any generic communication, safety evaluation, or licensee commitment that specifically identify or describe a function associated with a SSC necessary to fulfill the requirement of a particular regulation, order, license condition, and/or exemption may need to be considered when scoping for SLR. For example, NRC Bulletin 88-11 (NRC 1988-TN7998), “Pressurizer Surge Line Thermal Stratification,” (Agencywide Documents Access and Management System [ADAMS] Accession No. ML031220290) states:

> The licensing basis according to 10 CFR 50.55a for all PWRs requires that the licensee meet the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Sections III and XI and to reconcile the pipe stresses and fatigue evaluation when any significant differences are observed between measured data and the analytical results for the hypothesized conditions. Staff evaluation indicates that the thermal stratification phenomenon could occur in all PWR surge lines and may invalidate the analyses supporting the integrity of the surge line. The staff’s concerns include unexpected bending and thermal striping (rapid oscillation of the thermal boundary interface along the piping inside surface) as they affect the overall integrity of the surge line for its design life (e.g., the increase of fatigue).

Therefore, this bulletin specifically describes conditions that may affect compliance with the requirements associated with 10 CFR 50.55a (TN249) and functions specifically related to this regulation that must be considered in the scoping process for SLR.

An applicant may take an approach in scoping and screening that combines similar components from various systems. For example, containment isolation valves from various systems may be identified as a single system for the purposes of the SLR.

NRC staff from branches responsible for systems may be requested to assist in reviewing the plant design basis and intended function(s), as necessary.

The reviewer should verify that the applicant’s scoping methods document the actual information sources used (for example, those identified in Table 2.1-1).

2.1.3.1.1 Safety-Related

The applicant’s methodology is reviewed to ensure that the safety-related SSCs are identified to satisfactorily accomplish any of the intended functions identified in 10 CFR 54.4(a)(1) (TN4878). The reviewer must ascertain how, and to what extent, the applicant incorporated the information in the CLB for the facility in its methodology. Specifically, the reviewer should review the application, as well as all other relevant sources of information outlined above, to identify the set of plant-specific conditions for normal operation, DBAs, external events, and natural phenomena for which the plant must be designed to ensure the following functions:

- the integrity of the reactor coolant pressure 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 that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1) (TN249), 50.67(b)(2), or 100.11 (TN282), as applicable.

2.1.3.1.2 Nonsafety-related

The applicant's methodology is reviewed to ensure that nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1) (TN4878) are identified as being within the scope of SLR.

The scoping criterion under 10 CFR 54.4(a)(2), in general, is intended to identify those nonsafety-related SSCs that support safety-related functions. More specifically, this scoping criterion requires an applicant to identify all nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified under 10 CFR 54.4(a)(1). Section III.c(iii) of the SOC (60 FR 22467) clarifies the NRC's intent for this requirement in the following statement:

> The inclusion of nonsafety-related systems, structures, and components whose failure could prevent other systems, structures, and components from accomplishing a safety function is intended to provide protection against safety function failure in cases where the safety-related structure or component is not itself impaired by age-related degradation but is vulnerable to failure from the failure of another structure or component that may be so impaired.

In addition, Section III.c(iii) of the SOC provides the following guidance to assist an applicant in determining the extent to which failures must be considered when applying this scoping criterion:

> [C]onsideration of hypothetical failures that could result from system interdependencies that *are not part of the CLB* and that have not been previously experienced is not required. However, for some license renewal applicants, the Commission cannot exclude the possibility that hypothetical failures that *are part of the CLB* may require consideration of second-, third-, or fourth-level support systems.

Therefore, to satisfy the scoping criterion under 10 CFR 54.4(a)(2), the applicant must identify those nonsafety-related SSCs (including certain second-, third-, or fourth-level support systems) whose failures are considered in the CLB and could prevent the satisfactory accomplishment of a safety-related function identified under 10 CFR 54.4(a)(1). In order to identify such systems, the applicant should consider the failures identified in: (i) the documentation that supports and consitutes its CLB, (ii) plant-specific operating experience (OE), and (iii) industrywide OE that is specifically applicable to its facility. The applicant need not consider hypothetical failures that are not part of the CLB, have not been previously reported or experienced, or are not applicable to its facility.

In part, 10 CFR 54.4(a)(2) requires that the applicant consider all nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), 10 CFR 54.4(a)(1)(ii), and 10 CFR 54.4(a)(1)(iii) to be within the scope of the SLR. In letters dated December 3, 2001 and March 15, 2002, the NRC-issued a staff position to NEI that provided NRC staff guidance for determining which SSCs meet the 10 CFR 54.4(a)(2) criterion. The letter dated December 3, 2001, "License Renewal Issue: Scoping of Seismic II/I Piping Systems," provided specific examples of OE that identified pipe failure events (summarized in Information Notice 2001-09, "Main Feedwater System Degradation in Safety Related ASME Code Class 2 Piping Inside the Containment of a Pressurized Water Reactor" [ADAMS Accession No. ML011490408]) and the approaches the NRC considers acceptable to determine which piping systems should be included in the scope based on the 10 CFR 54.4(a)(2) (TN4878) criterion.

The March 15, 2002, letter, “License Renewal Issue: Guidance on the Identification and Treatment of Structures, Systems, and Components which meet 10 CFR 54.4(a)(2),” (ADAMS Accession No. ML020770026) further described the NRC staff’s recommendations for the evaluation of nonpiping SSCs to determine which additional nonsafety-related SSCs are within the scope of SLR. The position states that the applicants should not consider hypothetical failures, but rather should base their evaluation on the plant’s CLB, engineering judgment and analyses, and relevant OE. The paper further describes OE as all documented plant-specific and industrywide experiences that can be used to determine the plausibility of a failure. Documentation would include NRC generic communications and event reports, plant-specific condition reports, industry reports such as significant OE Reports or Institute of Nuclear Power Operations Event Reports, and engineering evaluations.

For example, the safety classification of a pipe at certain locations, such as valves, may change throughout its length in the plant. In these instances, the applicant should identify the safety-related portion of the pipe as being within the scope of SLR under 10 CFR 54.4(a)(1). However, for entire pipe runs which includes associated piping anchors, their analysis may be included as part of the CLB to establish that it could withstand DBE loads. If this is the case, a failure in the pipe run or in the associated piping anchors could render the safety-related portion of the piping unable to perform its intended function under CLB design conditions. Therefore, the reviewer must verify that the applicant’s methodology includes: (1) the remaining nonsafety-related piping up to its anchors and (2) the associated piping anchors as being within the scope of SLR under 10 CFR 54.4(a)(2).

In order to comply, in part, with the requirements of 10 CFR 54.4(a)(2), all applicants must include in the scope all nonsafety-related piping attached directly to safety-related piping (within the scope of SLR) up to a defined anchor point consistent with the plant CLB. This anchor point may be served by a true anchor (a device or structure that restrains forces and moments in three orthogonal directions) or an equivalent anchor, such as a large piece of plant equipment (e.g., a heat exchanger), determined by an evaluation of the plant-specific piping design (i.e., design documentation, such as piping stress analysis for the facility). Applicants should be able to define an equivalent anchor consistent with their CLB (e.g., description in the UFSAR or other CLB documentation), which is being credited for the 10 CFR 54.4(a)(2) evaluation, and should be able to describe the SCs that are part of the nonsafety-related piping segment boundary up to and including the anchor point or equivalent anchor point within the scope of SLR.

There may be isolated cases where an equivalent anchor point for a particular piping segment is not clearly described within the existing CLB information. In those instances, the applicant may use a combination of restraints or supports such that the nonsafety-related piping and associated SCs attached to safety-related piping is included in the scope up to a boundary point that encompasses at least two supports in each of three orthogonal directions.

It is important to note that the scoping criterion under 10 CFR 54.4(a)(2) specifically applies to those functions “identified in paragraphs (a)(1)(i), (ii), and (iii)” of 10 CFR 54.4 and does not apply to functions identified in 10 CFR 54.4(a)(3), as discussed below.

2.1.3.1.3 “Regulated Events”

The applicant’s methodology is reviewed to ensure that all SSCs relied upon in safety analyses or plant evaluations are appropriately identified to perform functions in compliance with the requirements of the fire protection, environmental qualification (EQ), pressurized thermal shock (PTS) (applicable only to PWRs), anticipated transients without scram (ATWS), and station blackout (SBO) regulations. The reviewer should review the applicant’s docketed correspondence associated with compliance of the facility with these regulations.

The scoping criteria in 10 CFR 54.4(a)(3) (TN4878) require an applicant to consider “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, EQ, PTS, ATWS and SBO].” In addition, Section III.c(iii) (60 FR 22467) of the SOC states that the NRC intended to limit the potential for unnecessary expansion of the review for SSCs that meet the scoping criteria under 10 CFR 54.4(a)(3) and provides additional guidance that qualifies what is meant by “those SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission regulations” in the following statement:

> [T]he Commission intends this nonsafety-related category [§ 54.4(a)(2)] to apply to systems, structures, and components whose failure would prevent the accomplishment of an intended function of a safety-related system, structure, and component. An applicant for license renewal should rely on the plant’s CLB, actual plant-specific experience, industry-wide operating experience, as appropriate, and existing engineering evaluations to determine those nonsafety-related systems, structures, and components that are the initial focus of the license renewal review.

Therefore, all SSCs that are being relied upon in the plant’s CLB (as defined in 10 CFR 54.3), plant-specific experience, industrywide experience (as appropriate), and safety analyses or plant evaluations to perform a function that demonstrates compliance with NRC regulations identified under 10 CFR 54.4(a)(3) are required to be included within the scope of the Rule. For example, if a nonsafety-related diesel generator is required for safe shutdown under the fire protection plan, the diesel generator and all SSCs specifically relied upon for that generator to comply with NRC regulations shall be included within the scope of SLR under 10 CFR 54.4(a)(3). Such SSCs may include, but should not be limited to, the cooling water system or systems relied upon for operability, the diesel support pedestal, and any applicable power supply cable specifically being relied upon for safe shutdown in the event of a fire.

In addition, the last sentence of the second paragraph in Section III.c(iii) of the SOC provides the following guidance for limiting the application of the scoping criterion under 10 CFR 54.4(a)(3) as it applies to the use of hypothetical failures: Consideration of hypothetical failures that could result from system interdependencies, that are not part of the current licensing bases and that have not been previously reported or experienced is not required (60 FR 22461-TN8012).

The SOC does not provide any additional guidance relating to the use of hypothetical failures or the need to consider second-, third-, or fourth-level support systems for scoping under 10 CFR 54.4(a)(3) (TN4878). Therefore, in the absence of any guidance, an applicant need not consider hypothetical failures or second-, third-, or fourth-level support systems in determining the SSCs within the scope of the Rule under 10 CFR 54.4(a)(3). For example, if a nonsafety-related diesel generator is relied upon only to remain functional to demonstrate compliance with the NRC SBO regulation, the applicant need not consider the following SSCs: (1) an alternate/backup cooling water system, (2) nonseismically-qualified building walls, or (3) an overhead segment of nonseismically-qualified piping (in a Seismic II/I configuration). This guidance is not intended to exclude any support system (whether identified by an applicant's CLB, or as indicated from actual plant-specific experience, industrywide experience [as applicable], safety analyses, or plant evaluations) that is specifically relied upon for compliance with the applicable NRC regulation. For example, if analysis of a nonsafety-related diesel generator (relied upon to demonstrate compliance with an applicable NRC regulation) specifically relies upon a second cooling system to cool the diesel generator jacket water cooling system for the generator to be operable, then both cooling systems must be included within the scope of the Rule under 10 CFR 54.4(a)(3).

The applicant is required to identify the SSCs whose functions are relied upon to demonstrate compliance with the regulations identified in 10 CFR 54.4(a)(3) (that is, whose functions were credited in the analysis or evaluation). Mere mention of an SSC in the analysis or evaluation does not necessarily constitute support of an intended function as required by the regulation.

For EQ, the reviewer verifies that the applicant has indicated that the EQ equipment is the equipment already identified by the licensee under 10 CFR 50.49(b) (TN249), i.e., equipment relied upon in safety analyses or plant evaluations to demonstrate compliance with NRC regulations for EQ (10 CFR 50.49).

For SBO, the reviewer verifies that the applicant's methodology would include those SSCs relied upon during the "coping duration" and "recovery" phase of an SBO event. In addition, because 10 CFR 50.63(c)(1)(ii) and its associated guidance in RG 1.155 include procedures to recover from an offsite and onsite power SBO, the offsite power system that is used to connect the plant to the offsite power source should also be included within the scope of the Rule. However, the NRC staff's review is based on the plant-specific CLB, regulatory requirements, and offsite power design configurations.

Table 2.2-1 contains examples of system and structure scoping results and the basis for the disposition.

2.1.3.2 Screening

Once the SSCs within the scope of SLR have been identified, the next step is determining which SCs are subject to an AMR (i.e., "screening"). Table 2.1-3 contains specific NRC staff guidance on certain subjects of screening.

2.1.3.2.1 "Passive"

The reviewer reviews the applicant's methodology to ensure that "passive" SCs are identified as those that perform their intended functions without moving parts or a change in configuration or properties in accordance with 10 CFR 54.21(a)(1)(i) (TN4878). The description of "passive" may also be interpreted to include SCs that do not display "a change in state." 10 CFR 54.21(a)(1)(i) provides specific examples of SCs that do or do not meet the criterion. The reviewer verifies that the applicant's screening methodology includes consideration of the intended functions of the SCs consistent with the plant's CLB, as typified in Table 2.1-4 and Table 2.1-5, respectively.

The License Renewal Rule focuses on "passive" SCs because SCs that have passive functions generally do not have performance and condition characteristics that are as readily observable as those performing active functions. “Passive” SCs, for the purpose of the License Renewal Rule, are those that perform an intended function, as described in 10 CFR 54.4, without moving parts or without a change in configuration or properties. The description of “passive” may also be interpreted to include SCs that do not display “a change of state.”

Table 2.1-6 provides a list of typical SCs identifying whether they meet 10 CFR 54.21(a)(1)(i). 10 CFR 54.21(a)(1)(i) explicitly excludes instrumentation, such as pressure transmitters, pressure indicators, and water level indicators, from an AMR. The applicant does not have to identify pressure retaining boundaries of these above-mentioned instruments because 10 CFR 54.21(a)(1)(i) excludes them without exception, unlike pumps and valves. Further, instrumentation is sensitive equipment and degradation of its pressure retaining boundary would be readily determined by surveillance and testing. If an applicant determines that certain SCs listed in Table 2.1-6 for meeting 10 CFR 54.21(a)(1)(i) do not meet the requirements for its plant, the reviewer evaluates the applicant’s basis for that determination.

2.1.3.2.2 “Long-Lived”

The applicant’s methodology is reviewed to ensure that “long-lived” SCs are identified as those that are not subject to periodic replacement based on a qualified life or specified time period. Passive SCs that are not replaced on the basis of a qualified life or specified time period require an AMR.

Replacement programs may be based on vendor recommendations, plant experience, or any means that establishes a specific replacement frequency under a controlled program. Section f(i)(b) of the SOC provides the following guidance for identifying “long-lived” SCs:

> In sum, a structure or component that is not replaced either (i) on a specified interval based upon the qualified life of the structure or component or (ii) periodically in accordance with a specified time period, is deemed by § 54.21(a)(1)(ii) of this rule to be “long-lived,” and therefore subject to the § 54.21(a)(3) aging management review [60 FR 22478].

A qualified life does not necessarily have to be based on calendar time. A qualified life based on run time or cycles is an example of qualified life reference that are not based on calendar time.

The SCs that are replaced on the basis of performance or condition are not generically excluded from an AMR. Rather, performance or condition monitoring may be evaluated later in the integrated plant assessment as programs to ensure functionality during the subsequent period of extended operation. Section f(i)(b) of the SOC provides the following guidance on this topic:

> It is important to note, however, that the Commission has decided not to generically exclude passive structures and components that are replaced based on performance or condition from an aging management review. Absent the specific nature of the performance or condition replacement criteria and the fact that the Commission has determined that the components with “passive” functions are not as readily monitorable as components with active functions, such generic exclusion is not appropriate. However, the Commission does not intend to preclude a license renewal applicant from providing site-specific justification in a license renewal application that a replacement program on the basis of performance or condition for a passive structure or component provides reasonable assurance that the

intended function of the passive structure or component will be maintained in the period of extended operation. (60 FR 22478)

2.1.4 Evaluation Findings

When the review of the information in the SLR application is complete, and the reviewer has determined that it is satisfactory and in accordance with the acceptance criteria in Section 2.1.2, a statement of the following type should be included in the NRC staff's SER:

> On the basis of its review, as discussed above, the NRC staff concludes that there is reasonable assurance that the applicant's methodology for identifying the systems, structures, and components within the scope of subsequent license renewal and the SCs requiring an AMR is consistent with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1) (TN4878).

2.1.5 Implementation

Except for cases in which the applicant proposes an alternative method for complying with specified portions of NRC regulations, the NRC staff members follow the methods described herein in their evaluation of conformance with NRC regulations. The staff evaluate these alternatives and reports them as acceptable if the alternatives provide reasonable assurance that the component's intended functions will be maintained.

2.1.6 References

1. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54–The License Renewal Rule." Revision 6. Agencywide Documents Access and Management System (ADAMS) Accession No. ML051860406. Washington, DC: Nuclear Energy Institute. June 2005.

1. NRC. Regulatory Guide 1.29, "Seismic Design Classification for Nuclear Power Plants." Revision 5. ADAMS Accession No. ML16118A148. Washington, DC: U.S. Nuclear Regulatory Commission. July 2016. NRC 2016-TN5879

2. NRC. NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." ADAMS Accession No. ML070630046. Washington, DC: U.S. Nuclear Regulatory Commission. March 2007. NRC 2021-TN8013

3. NRC. Generic Letter (GL) 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities-10 CFR 50.54(f)." ADAMS Accession No. ML031150465. Washington, DC: U.S. Nuclear Regulatory Commission. November 1988. NRC 1988-TN8014

4. NRC. Regulatory Guide 1.188, "Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses." Revision 1. ADAMS Accession No. ML051920430. Washington, DC: U.S. Nuclear Regulatory Commission. September 2005. NRC 2005-TN7997

5. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54–The License Renewal Rule." Revision 0. ADAMS Accession No. ML031600708. Washington, DC: Nuclear Energy Institute. March 1996. NEI 1996-TN7996

Table 2.1-1 Sample Listing of Potential Information Sources

Verified databases (databases that are subject to administrative controls to assure and maintain the integrity of the stored data or information)
Master equipment lists (including Nuclear Steam Supply System vendor listings)
Quality Assurance List (Q-lists)
Updated Final Safety Analysis Reports
Piping and instrument diagrams
U.S. Nuclear Regulatory Commission Orders, exemptions, or license conditions for the facility
Design basis documents
General arrangement or structural outline drawings
Probabilistic risk assessment summary report
Maintenance rule compliance documentation
Design basis event evaluations (including plant-specific 10 *Code of Federal Regulations* 50.59 evaluation procedures)
Emergency operating procedures
Docketed correspondence
System interaction commitments
Technical specifications
Environmental qualification program documents
Regulatory compliance reports (including Safety Evaluation Reports)
Severe Accident Management Guidelines

Table 2.1-2 Specific Staff Guidance on Scoping

Issue	Guidance
Commodity groups	The applicant may also group like structures and components (SCs) into commodity groups. Examples of commodity groups include pipe supports and cable trays. Similarity in characteristics such as function, design, materials of construction, aging management practices, or environments can be the basis for grouping SCs. If the applicant uses commodity groups, the reviewer verifies that the applicant has described the basis of the grouping.
Complex assemblies	Some SCs, when combined, are considered a complex assembly (for example, diesel generator starting air skids or heating, ventilating, and air conditioning refrigerant units). For purposes of performing an aging management review (AMR), it is important to clearly establish the boundaries of review. An applicant should establish the boundaries for such assemblies by identifying each SC that makes up the complex assembly and determining whether or not each SC is subject to an AMR (Ref. 1). The evaluation of a complex assembly should indicate whether the assembly performs only active intended functions or whether it also performs passive intended functions (such as providing a pressure retaining boundary). • A complex assembly that performs only active intended functions does not require an AMR for the SCs comprising the complex assembly. • A complex assembly that performs a passive intended function, either solely or in addition to an active function, should be evaluated to identify the passive and long-lived SCs ’subject to an AMR (i.e., SCs that support the passive function or whose failure could impact an intended function). See the guidance in this table on “Hypothetical failures” to support this determination. The Nuclear Energy Institute 95-10, Revision 0, Appendix C, Example 5 (Ref. 6), illustrates how the evaluation boundary for a control room chiller complex assembly might be determined. The control room chillers were purchased as a skid-mounted equipment. These chillers are part of the control room chilled water system. There are two control room chillers each representing a 100% capacity refrigeration unit. The function of the control room chillers is to provide a reliable source of chilled water at a maximum temperature of 7 °C (44 °F), to maintain a pressure boundary for the control room chilled water system, service water system, and refrigerant, respectively. All of these functions are considered intended functions. Typically, control room chillers are considered as one functional unit; however, for purposes of evaluating the effects of aging, it is necessary to consider the individual components. Therefore, the boundary of each control room chiller is established as follows: 1. At the inlet and outlet flanges of the service water system connections on the control room chiller condenser the connected piping is considered a part of the service water system. 2. For electrical power supply, the boundary is the output terminals on the circuit breakers supplying power to the skid. This includes the cables from the circuit breaker to the skid and applies for both 480 volts (V) alternating current (AC) and 120 VAC.

Table 2.1-2 Specific Staff Guidance on Scoping (Continued)

Issue	Guidance
	3. The interface for instrument air supplies extends from the instrument air tubing connection to the pressure control regulators, temperature controllers and transmitters, and solenoid valves located on the skid. The tubing from the instrument air header to the device on the skid is part of the instrument air system. 4. The interface with the annunciator system is at the external connection of the contacts of the device on the skid (limit switch, pressure switch, level switch, etc., that indicates the alarm condition. The cables are part of the annunciator system. Based on the boundaries established, the following components would be subject to an AMR: condenser, evaporator, economizer, chiller refrigerant piping, refrigerant expansion orifice, foundations and bolting, electrical cabinets, cables, conduit, trays and supports, and valves.
Hypothetical failures	For *Code of Federal Regulations* 10 CFR 54.4(a)(2), an applicant should consider those failures identified in: (1) the documentation that makes up its current licensing basis (CLB), (2) plant-specific operating experience (OE), and (3) industrywide OE, that are specifically applicable to its facility. The applicant need not consider hypothetical failures that are not part of CLB and that have not been previously reported or experienced. For example, an applicant should consider including: (1) the portion of a fire protection system identified in the updated Final Safety Analysis Report that supplies water to the refueling floor that is relied upon in a design basis accident analysis as an alternate source of cooling water that can be used to mitigate the consequences from the loss of spent fuel pool cooling, (2) a nonsafety-related, non-seismically-qualified building whose intended function as described in the plant's CLB is to protect a tank that is relied upon as an alternate source of cooling water needed to mitigate the consequences of a design basis event, and (3) a segment of nonsafety-related piping identified as a Seismic II/I component in the applicant's CLB.
Cascading	For 10 CFR 54.4(a)(3), an applicant need not consider hypothetical failures or second-, third-, or fourth-level support systems. For example, if a nonsafety-related diesel generator is only relied upon to remain functional to demonstrate compliance with the U.S. Nuclear Regulation Commission's (NRC's) station blackout regulations, an applicant may not need to consider: (1) an alternate/backup cooling water system, (2) the diesel generator non-seismically-qualified building walls, or (3) an overhead segment of non-seismically-qualified piping (in a Seismic II/I configuration). An applicant may not exclude any support system (identified by its CLB, actual plant-specific experience, industrywide experience, or existing engineering evaluations, as applicable) that is specifically relied upon for compliance with, or operation within, applicable NRC regulation. For example, if the analysis of a nonsafety-related diesel generator (relied upon to demonstrate compliance with an applicable NRC regulation) specifically relies upon a second cooling system to cool the diesel generator jacket water cooling system for the diesel to be operable, then both cooling systems must be included within the scope of the Rule.

AC = alternating current; AMR = aging management review; CFR = *Code of Federal Regulations*; CLB = current licensing basis; NRC = U.S. Nuclear Regulatory Commission; OE = operating experience; SC = structures and components; VAC = volts alternating current.

Table 2.1-3 Specific Staff Guidance on Screening

Issue	Guidance
Consumables	Consumables may be divided into the following four categories for the purpose of license renewal: (1) packing, gaskets, component seals, and O-rings; (2) structural sealants; (3) oil, grease, and component filters; and (4) system filters, fire extinguishers, fire hoses, and air packs. The consumables in both categories (1) and (2) are considered as subcomponents and are not explicitly called out in the scoping and screening procedures. Rather, they are implicitly included at the component-level (e.g., if a valve is identified as being in scope, a seal in that valve would also be in scope as a subcomponent of that valve). For category (1), the applicant would generally be able to exclude these subcomponents using a clear basis. For category (2), these subcomponents may perform functions without moving parts or a change in configuration, and they are not typically replaced. The applicant's structural aging management programs should address these items with respect to an aging management review (AMR) program on a plant-specific basis. The consumables in category (3) are usually short-lived and periodically replaced, and can normally be excluded from an AMR on that basis. Likewise, the consumables that fall within category (4) are typically replaced based on performance or condition monitoring that identifies whether these components are at the end of their qualified lives and may be excluded, on a plant-specific basis, from AMR under *Code of Federal Regulations* (10 CFR) 54.21(a)(1)(ii). The applicant should identify the standards that are relied upon for the replacement as part of the methodology description (for example, National Fire Protection Association standards for fire protection equipment).
Heat exchanger intended functions	Both the pressure boundary and heat transfer functions for heat exchangers should be considered because heat transfer may be a primary safety function of these components. There may be a unique aging effect associated with different materials in the heat exchanger parts that are associated with the heat transfer function and not the pressure boundary function. Normally the programs that effectively manage aging effects of the pressure boundary function can be implemented in conjunction with the procedures for monitoring heat exchanger performance to effectively manage aging effects applicable to the heat transfer function.
Multiple functions	The structures and components may have multiple functions. The intended functions as delineated in 10 CFR 54.4(b) are to be reviewed for subsequent license renewal. For example, a flow orifice that is credited in a plant's accident analysis to limit flow would have two intended functions. One intended function is pressure boundary. The other intended function is to limit flow. The reviewer verifies that the applicant has considered multiple functions in identifying structure- and component-intended functions.

AMR = aging management review; CFR = *Code of Federal Regulations.*

Table 2.1-4 Typical "Passive" Structure-Intended Functions

Structures	
Intended Function	**Description**
Direct flow	Provide spray shield or curbs for directing flow (e.g., safety injection flow to containment sump)
Expansion/separation	Provide for thermal expansion and/or seismic separation
Fire barrier	Provide rated fire barrier to confine or retard a fire from spreading to or from adjacent areas of the plant
Flood barrier	Provide flood protection barrier (internal and external flooding event)
Gaseous release path	Provide path for release of filtered and unfiltered gaseous discharge
Heat sink	Provide heat sink during station blackout or design basis accidents
High energy line break) shielding	Provide shielding against high energy line break
Missile barrier	Provide missile barrier (internally or externally generated)
Pipe whip restraint	Provide pipe whip restraint
Pressure relief	Provide overpressure protection
Shelter, protection	Provide shelter/protection to safety-related components
Shielding	Provide shielding against radiation
Shutdown cooling water	Provide source of cooling water for plant shutdown
Structural pressure barrier	Provide pressure boundary or essentially leak-tight barrier to protect public health and safety in the event of any postulated design basis events.

Table 2.1-5 Typical “Passive” Component-Intended Functions

Components	
Intended Function	**Description**
Absorb neutrons	Absorb neutrons
Electrical continuity	Provide electrical connections to specified sections of an electrical circuit to deliver voltage, current, or signals
Filter	Provide filtration
Heat transfer	Provide heat transfer
Insulate (electrical)	Insulate and support an electrical conductor
Insulate (thermal)	Inhibit/prevent heat transfer across a thermal gradient
Leakage boundary (spatial)	Nonsafety-related component that maintains mechanical and structural integrity to prevent spatial interactions that could cause failure of safety-related systems, structures, and components
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
Spray	Convert fluid into spray
Structural integrity (attached)	Nonsafety-related component that maintains mechanical and structural integrity to provide structural support to attached safety-related piping and components
Structural support	Provide structural and/or functional support to safety-related and/or nonsafety-related components
Throttle	Provide flow restriction

Table 2.1-6 Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 *Code of Federal Regulations* 54.21(a)(1)(i) (Yes/No)
1	Structures	Category I structures	Yes
2	Structures	Primary containment structure	Yes
3	Structures	Intake structures	Yes
4	Structures	Intake canal	Yes
5	Structures	Other non-category I structures within the scope of subsequent license	Yes
6	Structures	Equipment supports and foundations	Yes
7	Structures	Structural bellows	Yes
8	Structures	Controlled leakage doors	Yes
9	Structures	Penetration seals	Yes
10	Structures	compressible joints and seals	Yes
11	Structures	fuel pool and sump liners	Yes
12	Structures	Concrete curbs	Yes
13	Structures	Offgas stack and flue	Yes
14	Structures	Fire barriers	Yes
15	Structures	Pipe whip restraints and jet impingement shields	Yes
16	Structures	Electrical and instrumentation and control penetration assemblies	Yes
17	Structures	Instrumentation racks, frames, panels, and enclosures	Yes
18	Structures	Electrical panels, racks, cabinets, and other enclosures	Yes
19	Structures	Cable trays and supports	Yes
20	Structures	Conduit	Yes
21	Structures	TubeTrack®	Yes
22	Structures	Reactor vessel internals	Yes
23	Structures	American Society of Mechanical Engineers (ASME) Class 1 hangers and supports	Yes
24	Structures	Non-ASME Class 1 hangers and supports	Yes
25	Structures	Snubbers	No

Table 2.1-6 Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment (Continued)

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 *Code of Federal Regulations* 54.21(a)(1)(i) (Yes/No)
26	Reactor coolant pressure boundary components (Note: The components of the RCPB are defined by each plant''s current licensing basis [CLB] and site-specific documentation)	ASME Class 1 piping	Yes
27	RCPB	Reactor vessel	Yes
28	RCPB	Reactor coolant pumps	Yes (casing)
29	RCPB	Control rod drives	No
30	RCPB	Control rod drive (CRD) housing	Yes
31	RCPB	Steam generators	Yes
32	RCPB	Pressurizer	Yes
33	Non-Class 1 piping components	Underground piping	Yes
34	Non-Class 1 piping components	Piping in low temperature demineralized water service	Yes
35	Non-Class 1 piping components	Piping in high-temperature single-phase service	Yes
36	Non-Class 1 piping components	Piping in multiple phase service	Yes
37	Non-Class 1 piping components	Service water piping	Yes
38	Non-Class 1 piping components	Low temperature gas transport piping	Yes
39	Non-Class 1 piping components	Stainless steel tubing	Yes
40	Non-Class 1 piping components	Instrument tubing	Yes
41	Non-Class 1 piping components	Expansion joints	Yes
42	Non-Class 1 piping components	Ductwork	Yes
43	Non-Class 1 piping components	Sprinkler heads	Yes

Table 2.1-6 Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment (Continued)

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 *Code of Federal Regulations* 54.21(a)(1)(i) (Yes/No)
44	Non-Class 1 piping components	Miscellaneous appurtenances (includes fittings, couplings, reducers, elbows, thermowells, flanges, fasteners, welded attachments, etc.)	Yes
45	Pumps	Emergency core cooling system pumps	Yes (casing)
46	Pumps	Service water and fire pumps	Yes (casing)
47	Pumps	Lube oil and closed cooling water pumps	Yes (casing)
48	Pumps	Condensate pumps	Yes (casing)
49	Pumps	Borated water pumps	Yes (casing)
50	Pumps	Emergency service water pumps	Yes (casing)
51	Pumps	Submersible pumps	Yes (casing)
52	Turbines	Turbine pump drives (excluding pumps)	Yes (casing)
53	Turbines	Gas turbines	Yes (casing)
54	Turbines	Controls (actuator and overspeed trip)	No
55	Engines	Fire pump diesel engines	No
56	Emergency Diesel Generators	Emergency diesel generators	No
57	Heat Exchangers	Condensers	Yes
58	Heat Exchangers	Heating, ventilation, and air conditioning (HVAC) coolers (including housings)	Yes
59	Heat Exchangers	Primary water system heat exchangers	Yes
60	Heat Exchangers	Treated water system heat exchangers	Yes
61	Heat Exchangers	Closed cooling water system heat exchangers	Yes
62	Heat Exchangers	Lubricating oil system heat exchangers	Yes
63	Heat Exchangers	Raw water system heat exchangers	Yes
64	Heat Exchangers	Containment atmospheric system heat exchangers	Yes
65	Miscellaneous Process Components	Gland seal blower	No
66	Miscellaneous Process Components	Recombiners	The applicant shall identify the intended function and apply the integrated plant assessment process to determine if the grouping is active or passive.

Table 2.1-6 Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment (Continued)

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 *Code of Federal Regulations* 54.21(a)(1)(i) (Yes/No)
67	Miscellaneous Process Components	Flexible connectors	Yes
68	Miscellaneous Process Components	Strainers	Yes
69	Miscellaneous Process Components	Rupture disks	Yes
70	Miscellaneous Process Components	Steam traps	Yes
71	Miscellaneous Process Components	Restricting orifices	Yes
72	Miscellaneous Process Components	Air compressor	No
73	Electrical and instrumentation and control (I&C)	Alarm unit (e.g., fire detection devices)	No
74	Electrical and I&C	Analyzers (e.g., gas analyzers, conductivity analyzers)	No
75	Electrical and I&C	Annunciators (e.g., lights, buzzers, alarms)	No
76	Electrical and I&C	Batteries	No
77	Electrical and I&C	Cables and connections, bus, electrical portions of electrical and I&C penetration assemblies, includes fuse holders outside of cabinets of active electrical structure and component (e.g., electrical penetration assembly cables and connections, connectors, electrical splices, fuse holders, terminal blocks, power cables, control cables, instrument cables, insulated cables, communication cables, uninsulated ground conductors, transmission conductors, isolated-phase bus, non-segregated-phase bus, segregated-phase bus, switchyard bus)	Yes

Table 2.1-6 Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment (Continued)

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 *Code of Federal Regulations* 54.21(a)(1)(i) (Yes/No)
78	Electrical and I&C	Chargers, converters, inverters (e.g., converters-voltage/current, converters-voltage/pneumatic, battery chargers/inverters, motor-generator sets)	No
79	Electrical and I&C	Circuit breakers (e.g., air circuit breakers, molded case circuit breakers, oil-filled circuit breakers)	No
80	Electrical and I&C	Communication equipment (e.g., telephones, video or audio recording or playback equipment, intercoms, computer terminals, electronic messaging, radios, transmission line traps, and other power-line carrier equipment)	No
81	Electrical and I&C	Electric heaters	No Yes, for pressure boundary, if applicable
82	Electrical and I&C	Heat tracing	No
83	Electrical and I&C	Electrical controls and panel internal component assemblies (may include internal devices such as, but not limited to, switches, breakers, indicating lights, etc.) (e.g., main control board, HVAC control board)	No
84	Electrical and I&C	Elements, resistance temperature detectors (RTDs), sensors, thermocouples, transducers (e.g., conductivity elements, flow elements, temperature sensors, radiation sensors, watt transducers, thermocouples, RTDs, vibration probes, amp transducers, frequency transducers, power factor transducers, speed transducers, reactive power (var) transducers, vibration transducers, voltage transducers)	No Yes for pressure boundary, if applicable
85	Electrical and I&C	Fuses	No
86	Electrical and I&C	Generators, motors (e.g., emergency diesel generators, emergency core cooling system, and emergency service water pump motors, small motors, motor-generator sets, steam turbine generators, combustion turbine generators, fan motors, pump motors, valve motors, air compressor motors)	No

Table 2.1-6 **Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment (Continued)**

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 *Code of Federal Regulations* 54.21(a)(1)(i) (Yes/No)
87	Electrical and I&C	High-voltage insulators (e.g., porcelain switchyard insulators, transmission line insulators)	Yes
88	Electrical and I&C	Surge arresters (e.g., switchyard surge arresters, lightning arresters, surge suppressers, surge capacitors, protective capacitors)	No
89	Electrical and I&C	Indicators (e.g., differential pressure indicators, pressure indicators, flow indicators, level indicators, speed indicators, temperature indicators, analog indicators, digital indicators, light-emitting diode, bar graph indicators, liquid-crystal display indicators)	No
90	Electrical and I&C	Isolators (e.g., transformer isolators, optical isolators, isolation relays, isolating transfer diodes)	No
91	Electrical and I&C	Light Bulbs (e.g., indicating lights, emergency lighting, incandescent light bulbs, fluorescent light bulbs)	No
92	Electrical and I&C	Loop Controllers (e.g., differential pressure indicating controllers, flow indicating controllers, temperature controllers, controllers, speed controllers, programmable logic controller, single loop digital controller, process controllers, manual loader, selector station, hand/auto station, auto/manual station)	No
93	Electrical and I&C	Meters (e.g., ammeters, volt meters, frequency meters, var meters, watt meters, power factor meters, watt-hour meters)	No
94	Electrical and I&C	Power supplies	No
95	Electrical and I&C	Radiation Monitors (e.g., area radiation monitors, process radiation monitors)	No
96	Electrical and I&C	Recorders (e.g., chart recorders, digital recorders, events recorders)	No
97	Electrical and I&C	Regulators (e.g., voltage regulators)	No
98	Electrical and I&C	Relays (e.g., protective relays, control/logic relays, auxiliary relays)	No
99	Electrical and I&C	Signal conditioners	No

Table 2.1-6 Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment (Continued)

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 *Code of Federal Regulations* 54.21(a)(1)(i) (Yes/No)
100	Electrical and I&C	Solenoid operators	No
101	Electrical and I&C	Solid-State Devices (e.g., transistors, circuit boards, computers)	No
102	Electrical and I&C	Switches (e.g., differential pressure indicating switches, differential pressure switches, pressure indicator switches, pressure switches, flow switches, conductivity switches, level-indicating switches, temperature-indicating switches, temperature switches, moisture switches, position switches, vibration switches, level switches, control switches, automatic transfer switches, manual transfer switches, manual disconnect switches, current switches, limit switches, knife switches)	No
103	Electrical and I&C	Switchgear, load centers, motor control centers, distribution panel internal component assemblies (may include internal devices such as, but not limited to, switches, breakers, indicating lights, etc.) (e.g., 4.16 kV switchgear, 480 V load centers, 480 V motor control centers, 250 V direct current motor control centers, 6.9 kv switchgear units, 240/125 V power distribution panels)	No
104	Electrical and I&C	Transformers (e.g., instrument transformers, load center transformers, small distribution transformers, large power transformers, isolation transformers, coupling capacitor voltage transformers)	No
105	Electrical and I&C	Transmitters (e.g., differential pressure transmitters, pressure transmitters, flow transmitters, level transmitters, radiation transmitters, static pressure transmitters)	No
106	Valves	Hydraulic-operated valves	Yes (bodies)
107	Valves	Explosive valves	Yes (bodies)
108	Valves	Manual valves	Yes (bodies)
109	Valves	Small valves	Yes (bodies)
110	Valves	Motor-operated valves	Yes (bodies)
111	Valves	Air-operated valves	Yes (bodies)
112	Valves	Main steam isolation valves	Yes (bodies)

Table 2.1-6 Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment (Continued)

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 *Code of Federal Regulations* 54.21(a)(1)(i) (Yes/No)
113	Valves	Small relief valves	Yes (bodies)
114	Valves	Check valves	Yes (bodies)
115	Valves	Safety relief valves	Yes (bodies)
116	Valves	Dampers, louvers, and gravity dampers	Yes (housings)
117	Tanks	Air accumulators	Yes
118	Tanks	Discharge accumulators (dampers)	Yes
119	Tanks	Boron acid storage tanks	Yes
120	Tanks	Above ground oil tanks	Yes
121	Tanks	Underground oil tanks	Yes
122	Tanks	Demineralized water tanks	Yes
123	Tanks	Neutron shield tank	Yes
124	Fans	Ventilation Fans (includes intake fans, exhaust fans, and purge fans)	Yes (housings)
125	Fans	Other fans	Yes (housings)
126	Miscellaneous	Emergency lighting	No
127	Miscellaneous	Hose stations	Yes
128	Miscellaneous	Fire damper	Yes (housings)

ASME = American Society of Mechanical Engineers; CLB = current licensing basis; HVAC = heating, ventilation, and air conditioning; I&C = instrumentation and control; RCPB = reactor coolant pressure boundary; RTD = resistance temperature detectors.

2.2 Plant-Level Scoping Results

Review Responsibilities

Primary — Assigned branch(es)

Secondary — None

2.2.1 Areas of Review

This section addresses the plant-level scoping results for SLR. 10 CFR) 54.21(a)(1) requires the applicant to identify and list SCs subject to an AMR. These are "passive," "long-lived" SCs that are within the scope of SLR. In addition, 10 CFR 54.21(a)(2) (TN4878) requires the applicant to describe and justify the methods used to identify these SCs. The NRC staff reviews the applicant's methodology separately, following the guidance in Section 2.0.

The applicant should provide a list of all the plant systems and structures, identifying those that are within the scope of SLR. If the list exists elsewhere, such as in the UFSAR, it is acceptable to merely identify the reference. The License Renewal Rule does not require the identification of all plant systems and structures within the scope of SLR. However, providing such a list may make the review more efficient.

On the basis of the DBEs considered in the plant's CLB and other CLB information relating to nonsafety-related systems and structures and certain regulated events, the applicant would identify those plant-level systems and structures within the scope of SLR, as defined in 10 CFR 54.4(a). This is "scoping" of the plant-level systems and structures for SLR. To verify that the applicant has properly implemented its methodology, the NRC staff focuses its review on the implementation results to confirm that there is no omission of plant-level systems and structures within the scope of SLR.

Examples of plant systems are the reactor coolant, containment spray, standby gas treatment (boiling water reactor [BWR], emergency core cooling, open and closed-cycle cooling water, compressed air, chemical and volume control [PWR], standby liquid control [BWR], main steam, feedwater, condensate, steam generator blowdown [PWR], and auxiliary feedwater systems [PWR]).

Examples of plant structures are the primary containment, secondary containment (BWR), control room, auxiliary building, fuel storage building, radioactive waste building, and ultimate heat sink cooling tower.

Examples of components are the reactor vessel (RV), reactor vessel internals, steam generator (PWR), and light and heavy load handling cranes. Some applicants may have categorized such components as plant "systems" for their convenience.

After plant-level scoping, the applicant should identify the portions of the system or structure that perform an intended function, as defined in 10 CFR 54.4(b). Then the applicant should identify those SCs that are "passive" and "long-lived," in accordance with 10 CFR 54.21(a)(1)(i) and (ii). The "passive," "long-lived" SCs identified are subject to an AMR. The NRC staff reviews these results separately following the guidance outlined in Sections 2.3 through 2.5.

The applicant has the flexibility to determine the set of systems and structures it considers as within the scope of SLR, provided that this set includes the systems and structures that the NRC has determined are within the scope of SLR. Therefore, the reviewer need not review all systems and structures that the applicant has identified to be within the scope of SLR because the applicant has the option to include more SCs than those defined to be within the scope of SLR by 10 CFR 54.4.

The areas relating to the methodology implementation for the plant-level systems and structures described below are evaluated by the reviewer/s.

2.2.1.1 Systems and Structures Within the Scope of Subsequent License Renewal

The reviewer verifies the applicant's identification of plant-level systems and structures that are within the scope of SLR.

2.2.2 Acceptance Criteria

The acceptance criteria for the area of review define methods for determining whether the applicant has identified the systems and structures within the scope of SLR in accordance with NRC regulations in 10 CFR 54.4 (TN4878). For the applicant's implementation of its methodology to be acceptable, the NRC staff should have reasonable assurance that there has been no omission of plant-level systems and structures within the scope of SLR.

2.2.2.1 Systems and Structures Within the Scope of Subsequent License Renewal

Systems and structures are within the scope of SLR as delineated in 10 CFR 54.4(a) if they are:

- Safety-related systems and structures that are relied upon to remain functional during and following DBEs (as defined in 10 CFR 50.49(b)(1) [TN249]) to ensure the following functions:
    - the integrity of the reactor coolant pressure 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 that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1), 50.67(b)(2), or 100.11, as applicable.
- All nonsafety-related systems and structures whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1) above.
- All systems and structures relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with NRC regulations for fire protection (10 CFR 50.48), EQ (10 CFR 50.49), pressurized thermal shock (10 CFR 50.61), ATWS (10 CFR 50.62), and SBO (10 CFR 50.63).

2.2.3 Review Procedures

The reviewer verifies the results of the applicant's scoping and screening. If the reviewer requests additional information from the applicant regarding why a certain system or structure was not identified by the applicant as being within the scope of SLR for the applicant's plant, the reviewer should provide a focused question, clearly explaining what information is needed, explaining why it is needed, and how it will allow the NRC staff to make its safety evaluation. In addition, other NRC staff members review the applicant's scoping and screening methodology separately following the guidance in Section 2.0. The reviewer should keep the other NRC staff members informed of findings that may affect their review of the applicant's methodology. The reviewer should coordinate this sharing of information through the SLR PM.

For the area of review, the following review procedures are to be followed.

2.2.3.1 Systems and Structures within the Scope of Subsequent License Renewal

The reviewer determines whether the applicant has properly identified the plant-level systems and structures within the scope of SLR by reviewing selected systems and structures that the applicant did not identify as being within the scope of SLR to verify that they do not have any intended functions.

The reviewer should use the plant UFSAR, orders, applicable regulations, exemptions, and license conditions to determine the design basis for the SSCs (if components are identified as "systems" by the applicant). The design basis determines the intended function(s) of an SSC. Such functions determine whether the SSC is within the scope of SLR under 10 CFR 54.4 (TN4878).

This section addresses scoping at a system or structural level. Thus, if any portion of a system or structure performs an intended function as defined in 10 CFR 54.4(b), the system or structure is within the scope of SLR. The reviews of individual portions of systems and structures that are within the scope of SLR are addressed separately in Sections 2.3 through 2.5.

The applicant should submit a list of all plant-level systems and structures, identifying those that are within the scope of SLR (10 CFR 54.4) and subject to AMR (10 CFR 54.21(a)(1). The reviewer should sample selected systems and structures that the applicant did not identify as within the scope of SLR to determine if they perform any intended functions. The following are examples:

- The applicant does not identify the radiation monitoring system as being within the scope of SLR. The reviewer may review the UFSAR to verify that this particular system does not perform any intended functions at the applicant's plant.
- The applicant does not identify the polar crane as being within the scope of SLR. The reviewer may review the UFSAR to verify that this particular structure is not "Seismic II over I," denoting a structure that is not seismic Category I interacting with a seismic Category I structure as described in Position C.2 of Regulatory Guide 1.29, "Seismic Design Classification for Nuclear Power Plants" (NRC 2016-TN5879).
- The applicant does not identify the fire protection pump house as being within the scope of SLR. The reviewer may review the plant's commitments to the fire protection regulation (10 CFR 50.48) (TN249) to verify that this particular structure does not perform any intended functions at the plant.
- The applicant uses the "spaces" approach for scoping electrical equipment and elects to include all electrical equipment onsite to be within the scope of SLR except for the 525 kV switchyard and the 230 kV transmission lines. The reviewer may review the UFSAR and commitments to the SBO regulation (10 CFR 50.63) (TN249) to verify that the 525 kV switchyard and the 230 kV transmission lines do not perform any intended functions at the applicant's plant.

The applicant may choose to group similar SCs together in commodity groups for separate analyses. If only a portion of a system or structure has an intended function and is addressed separately in a specific commodity group, it is acceptable for an applicant to identify that system or structure as not being within the scope of SLR. However, for completeness, the applicant should include some reference indicating that a portion of the system or structure with an intended function is evaluated within the commodity group.

Section 2.0 contains additional guidance on the following:

- commodity groups,
- complex assemblies,
- hypothetical failure, and
- cascading.

If the reviewer has evaluated systems and structures in sufficient detail and does not identify any omissions of systems and structures from those within the scope of SLR, the NRC staff would have reasonable assurance that the applicant has identified all the systems and structures within the scope of SLR accurately.

If the reviewer determines that the applicant has satisfied the criteria described in this review section, the NRC staff would have reasonable assurance that the applicant has identified the all the systems and structures within the scope of SLR accurately.

2.2.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR), then the NRC staff's evaluation supports conclusions of the following type, to be included in the SER:

> On the basis of its review, as discussed above, the NRC staff concludes that there is reasonable assurance that the applicant has appropriately identified the systems and structures within the scope of SLR in accordance with 10 CFR 54.4 (TN4878).

2.2.5 Implementation

Except for cases in which the applicant proposes an alternative method for complying with specified portions of NRC regulations, the NRC staff members follow the methods described herein in their evaluation of conformance with NRC regulations. For a proposed alternative, the staff evaluates the alternative on a case-by-case basis and finds it acceptable if the staff determines that the alternative provides reasonable assurance that the component's intended functions will be maintained.

Table 2.2-1 contains examples of system and structure scoping results and the basis for the disposition.

2.2.6 References

1. NRC. Regulatory Guide 1.29, "Seismic Design Classification for Nuclear Power Plants." Revision 5. Agencywide Documents Access and Management System (ADAMS) Accession No. ML16118A148. Washington, DC: U.S. Nuclear Regulatory Commission. July 2016. NRC 2016-TN5879

Table 2.2-1 Examples of System and Structure Scoping and Basis for Disposition

Example	Disposition
Recirculation cooling water system	One function of the recirculation cooling water system is to remove decay heat from the stored fuel in the spent fuel pool via the spent fuel pool cooling system. However, the spent fuel pool cooling system at the subject facility is not safety-related, and following a seismic event, the safety-related spent fuel pool structure and spent fuel pool makeup water supplies make sure that there is adequate removal of decay heat to prevent potential offsite exposures comparable to those described in 10 *Code of Federal Regulations* Part 100. Therefore, the recirculation cooling water system is not within the scope of subsequent license renewal (SLR) based on the spent fuel decay heat removal function.
Station blackout (SBO) diesel generator building	The plant's updated Final Safety Analysis Report (UFSAR) indicates that certain structural components of the SBO diesel generator building for the plant are designed to preclude seismic failure and subsequent impact of the structure on the adjacent safety-related emergency diesel generator building. In addition, the UFSAR indicates that certain equipment attached to the roof of the building have been anchored to resist tornado wind loads. Thus, the SBO diesel generator building is within the scope of SLR.

SBO = station blackout; SLR = subsequent license renewal; UFSAR = updated Final Safety Analysis Report.

2.3 Scoping and Screening Results: Mechanical Systems

Review Responsibilities

Primary — Assigned branch(es)

Secondary — None

2.3.1 Areas of Review

This section addresses the mechanical systems scoping and screening results for SLR. Typical mechanical systems consist of the following:

- reactor coolant system (such as RV and internals, components forming part of coolant pressure boundary, coolant piping system and connected lines, and steam generators);
- engineered safety features (such as containment spray and isolation systems, standby gas treatment system, emergency core cooling system, and fan cooler system);
- auxiliary systems (such as new and spent fuel storage, spent fuel cooling and cleanup systems, suppression pool cleanup system, load handling system, open and closed-cycle cooling water systems, ultimate heat sink, compressed air system, chemical and volume control system, standby liquid control system, coolant storage/refueling water systems, ventilation systems, diesel generator system, and fire protection system); and
- steam and power conversion systems (such as turbines, main and extraction steam, feedwater, condensate, steam generator blowdown, and auxiliary feedwater).

The 10 CFR) 54.21(a)(1) requires an applicant to identify and list SCs subject to an AMR. These are “passive,” “long-lived” SCs that are within the scope of SLR. In addition, 10 CFR 54.21(a)(2) (TN4878) requires an applicant to describe and justify the methods used to identify these SCs. The NRC staff reviews the applicant’s methodology separately following the guidance in Section 2.0. To verify that the applicant has properly implemented its methodology, the NRC staff focuses its review on the implementation results. Such a focus allows the NRC staff to confirm that there is no omission of mechanical system components that are subject to an AMR by the applicant. If the review identifies no omission, the NRC staff has the basis to find that there is reasonable assurance that the applicant has identified the mechanical system components that are subject to an AMR.

An applicant should list all plant-level systems and structures. On the basis of the DBEs considered in the plant’s CLB) and other CLB information relating to nonsafety-related systems and structures and certain regulated events, the applicant should identify those plant-level systems and structures within the scope of SLR, as defined in 10 CFR 54.4(a). This is “scoping” of the plant-level systems and structures for SLR. The NRC staff reviews the applicant’s plant-level “scoping” results separately following the guidance in Section 2.2.

For a mechanical system that is within the scope of SLR, the applicant should identify the portions of the system that perform an intended function, as defined in 10 CFR 54.4(b). The applicant may identify these particular portions of the system in marked-up piping and instrument diagrams or in other media. This is “scoping” of mechanical components in a system to identify those that are within the scope of SLR for a system.

For those identified mechanical components that are within the scope of SLR, the applicant must identify those that are “passive” and “long-lived,” as required by 10 CFR 54.21(a)(1)(i) and (ii). These “passive,” “long-lived” mechanical components are those that are subject to an AMR. This process is “screening” of mechanical components in a system to identify those that are “passive” and “long-lived.”

The applicant has the flexibility to determine the set of SCs for which an AMR is performed, provided that this set includes the SCs for which the NRC has determined that an AMR is required. This is based on the SOC for the License Renewal Rule (60 FR 22478). Therefore, the reviewer need not review all components that the applicant has identified as subject to an AMR because the applicant has the option to include more components than those required to be subject to an AMR pursuant to 10 CFR 54.21(a)(1).

2.3.2 Acceptance Criteria

The acceptance criteria for the areas of review define methods for determining whether the applicant has met the requirements of NRC regulations in 10 CFR 54.21(a)(1) (TN4878). For the applicant’s implementation of its methodology to be acceptable, the NRC staff should have reasonable assurance that there has been no omission of mechanical system components that are subject to an AMR.

2.3.2.1 Components Within the Scope of Subsequent License Renewal

Mechanical components are within the scope of SLR as delineated in 10 CFR 54.4(a) if they are:

- Safety-related SSCs that are relied upon to remain functional during and following DBEs (as defined in 10 CFR 50.49(b)(1) [TN249]) to ensure the following functions:
  - the integrity of the reactor coolant pressure boundary;
  - the capability to shut down the reactor and maintain it in a safe shut down condition; or
  - the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2), or 10 CFR 100.11, as applicable.
- All nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii), or (iii).
- All SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with NRC regulations for fire protection (10 CFR 50.48), EQ (10 CFR 50.49), pressurized thermal shock (10 CFR 50.61), ATWS (10 CFR 50.62), and station blackout (10 CFR 50.63).

2.3.2.2 Components Subject to an Aging Management Review

Mechanical components are subject to an AMR if they are within the scope of SLR and perform an intended function as defined in 10 CFR 54.4(b) (TN4878) without moving parts or a change in configuration or properties (“passive”), and are not subject to replacement based on a qualified life or specified time period (“long-lived”) (10 CFR 54.21(a)(1)(i) and (ii)).

2.3.3 Review Procedures

The reviewer verifies the results of the applicant's scoping and screening. If the reviewer requests additional information from the applicant regarding why a certain component was not identified by the applicant as being within the scope of SLR or subject to an AMR for the applicant's plant, the reviewer should provide a focused question that clearly explains what information is needed, why the information is needed, and how the information will allow the NRC staff to make its safety evaluation. In addition, other NRC staff members review the applicant's scoping and screening methodology separately, following the guidance in Section 2.0. The reviewer should keep the other NRC staff members informed of findings that may affect their review of the applicant's methodology. The reviewer should coordinate this sharing of information through the SLR PM.

For each area of review, the following review procedures are to be followed.

2.3.3.1 Components Within the Scope of Subsequent License Renewal

In this step, the NRC staff determine whether the applicant has properly identified the components that are within the scope of SLR. The Rule requires applicants to identify components that are within the scope of SLR and subject to an AMR. In the past, license renewal applications (LRAs) have included a table of components that are within the scope of SLR which generally need not be submitted with the subsequent license renewal application (SLRA) itself. Although a list of components within the scope of SLR will be available at plant sites for inspection, the reviewer should determine through sampling of piping and instrument diagrams, and review of the (UFSAR and other plant documents, which components are within the scope of SLR. The reviewer should check to see if any components exist that the NRC staff believes are within the scope of SLR but are not identified by the applicant as being subject to an AMR (and request that the applicant provide justification for omitting those components that are "passive" and "long-lived").

The reviewer should use the UFSAR, orders, applicable regulations, exemptions, and license conditions to determine the design basis for the SSCs. The design basis specifies the intended function(s) of the system(s). That intended function is used to determine the components within that system that are relied upon for the system to perform its intended functions.

The reviewer should focus the review on those components that are not identified as being within the scope of SLR, especially the SLR boundary points and major flow paths. The reviewer should verify that the components do not have intended functions. Portions of the system identified as being within the scope of SLR by the applicant do not have to be reviewed because the applicant has the option to include more components within the scope than the Rule requires.

Further, the reviewer should select system functions described in the UFSAR that are required by 10 CFR 54.4 (TN4878) to verify that components having intended functions were not omitted from the scope of the Rule.

For example, if a reviewer verifies that a portion of a system does not perform an intended function, is not identified as being subject to an AMR by the applicant, and is isolated from the portion of the system that is identified as being subject to an AMR by a boundary valve, the reviewer should verify that the boundary valve is subject to an AMR, or that the valve is not necessary for the within-scope part of the system to perform its intended function. Likewise, the reviewer should identify the extended practicality of the system functions of the piping runs and components that are identified as not being within the scope of SLR to make sure that they do not have intended functions that meet the requirements of 10 CFR 54.4.

Section 2.0 contains additional guidance on the following:

- commodity groups;
- complex assemblies;
- hypothetical failure; and
- cascading

If the reviewer has reviewed the components in sufficient detail and does not identify any omissions of components within the scope of SLR, the reviewer would have reasonable assurance that the applicant has identified the components within the scope of SLR for the mechanical systems accurately.

Table 2.3-1 provides examples of mechanical components scoping lessons learned from the review of the initial LRAs and the basis for their disposition.

2.3.3.2 Components Subject to an Aging Management Review

In this step, the reviewer determines whether the applicant has accurately identified the components subject to an AMR from among those that are within the scope of SLR renewal (i.e., those identified in Section 2.3.3.1). The reviewer should review selected components that the applicant has identified as within the scope of SLR but as not subject to an AMR. The reviewer should verify that the applicant has not omitted from an AMR, components that perform intended functions without moving parts or without a change in configuration or properties and that are not subject to replacement on the basis of a qualified life or specified time period.

Starting with the boundary verified in Section 2.3.3.1, the reviewer should sample components that are within the scope of SLR for that system, but were not identified by the applicant as subject to an AMR. Only components that are “passive” and “long-lived” are subject to an AMR. Table 2.1-6 is provided to assist the reviewer in identifying the “passive” components.” The applicant should justify omitting a component from an AMR that is within the scope of SLR at their facility and listed as “passive” on Table 2.1-6. Although Table 2.1-6 is extensive, it may not be all-inclusive. Thus, the reviewer should use other available information sources, such as prior application reviews, to determine whether a component may be subject to an AMR.

For example, an applicant has marked a boundary of a certain system that is within the scope of SLR. The marked-up diagram shows that there are pipes, valves, and air compressors within this boundary. The applicant has identified piping and valve bodies as subject to an AMR. Because Table 2.1-6 indicates that air compressors are not subject to an AMR, the reviewer should find the applicant’s determination acceptable.

Section 2.0 contains additional guidance on screening the following:

- consumables;
- heat exchanger intended functions; and
- multiple functions.

If the reviewer does not identify any omissions of components from those that are subject to an AMR, the NRC staff would then have reasonable assurance that the applicant has identified the components subject to an AMR for the mechanical systems accurately.

Table 2.3-2 provides examples of mechanical components screening developed from lessons learned during the review of the initial LRAs and bases for their disposition.

If the applicant determines that a component is subject to an AMR, the applicant should also identify the component's intended function, as defined in 10 CFR 54.4 (TN4878). Such functions must be maintained by any necessary AMRs. Table 2.3-3 provides examples of mechanical component-intended functions.

2.3.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of the SRP-SLR, then the NRC staff's evaluation would support conclusions of the following type, to be included in the SER:

> On the basis of its review, as discussed above, the NRC staff concludes that there is reasonable assurance that the applicant has appropriately identified the mechanical system components within the scope of subsequent license renewal, as required by 10 CFR 54.4 (TN4878), and that the applicant has adequately identified the system components subject to an AMR in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.5 Implementation

Except for cases in which the applicant proposes an alternative method for complying with specified portions of NRC regulations, the NRC staff members follow the methods described herein in their evaluation of conformance with NRC regulations. For a proposed alternative, the staff evaluates the alternative on a case-by-case basis and finds it acceptable if the staff determines that the alternative provides reasonable assurance that the component's intended functions will be maintained.

2.3.6 References

None

Table 2.3-1 Examples of Mechanical Components Scoping and Basis for Disposition

Example	Disposition
Piping segment that provides structural support	The safety-related/nonsafety-related boundary along a pipe run may occur at a valve location. The nonsafety-related piping segment between this valve and the next seismic anchor provides structural support in a seismic event. This piping segment is within the scope of subsequent license renewal (SLR).
Containment heating and ventilation system ductwork downstream of the fusible links providing cooling to the steam generator compartment and reactor vessel annulus	This nonsafety-related ductwork provides cooling to support the applicant's environmental qualification program. However, the failure of the cavity cooling system ductwork will not prevent the satisfactory completion of any critical safety function during and following a design basis event (DBE). Thus, this ductwork is not within the scope of SLR.
Standpipe installed inside the fuel oil storage tank	The standpipe as described in the applicant's CLB ensures that there is sufficient fuel oil reserve for the emergency diesel generator to operate for the number of days specified in the plant technical specifications (TS) following DBEs. Therefore, this standpipe is within the scope of SLR.
Insulation on boron injection tank	The temperature is high enough that insulation is not necessary to prevent boron precipitation. The plant TS require periodic verification of the tank temperature. Thus, the insulation is not relied upon to ensure the function of the emergency system and is not within the scope of SLR.
Pressurizer spray head	The spray head is not credited for the mitigation of any accidents addressed in the updated Final Safety Analysis Report accident analyses for many plants. The function of the pressurizer spray is to reduce reactor coolant system pressure during normal operating conditions. However, some plants rely on this component for pressure control to achieve cold shutdown during certain fire events. Failure of the spray head should be evaluated in terms of any possible damage to surrounding safety grade components, in addition to the need for spray. Therefore, this component should be evaluated on a plant-specific basis.

CLB = current licensing basis; DBE = design basis event; SLR = subsequent license renewal; TS = technical specifications.

Table 2.3-2 Examples of Mechanical Components Screening and Basis for Disposition

Example	Disposition
Diesel engine jacket water heat exchanger and portions of the diesel fuel oil system and starting air system supplied by a vendor on a diesel generator skid	These are “passive,” “long-lived” components having intended functions. They are subject to an aging management review (AMR) for subsequent license renewal even though the diesel generator is considered “active.”
Fuel assemblies	The fuel assemblies are replaced at regular intervals based on the fuel cycle of the plant. They are not subject to an AMR.
Valve internals (such as disk and seat)	10 CFR 54.21(a)(1)(i) excludes valves, other than the valve body, from AMR. The Statements of Consideration of the License Renewal Rule provide the basis for excluding structures and components that perform their intended functions with moving parts or with a change in configuration or properties. Although the valve body is subject to an AMR, valve internals are not.

AMR = aging management review.

Table 2.3-3 Examples of Mechanical Component-Intended Functions

Component	Intended Function*
Piping	Pressure boundary
Valve body	Pressure boundary
Pump casing	Pressure boundary
Orifice	Pressure boundary flow restriction
Heat exchanger	Pressure boundary heat transfer
Reactor vessel internals	Structural support of fuel assemblies, control rods, and incore instrumentation, to maintain core configuration and flow distribution

*The component-intended functions are those that support the system-intended functions. For example, a heat exchanger in the spent fuel cooling system has a pressure boundary-intended function, but may not have a heat transfer function. Similarly, not all orifices have flow restriction as an intended function.

2.4 Scoping and Screening Results: Structures

Review Responsibilities

Primary — Assigned branch(es)

Secondary — None

2.4.1 Areas of Review

This section addresses the scoping and screening results of structures and structural components for SLR. Typical structures include the following:

- the primary containment structure.
- building structures (such as the intake structure, diesel generator building, auxiliary building, and turbine building).
- component supports (such as cable trays, pipe hangers, elastomer vibration isolators, equipment frames and stanchions, and heating, ventilation, and air conditioning ducting supports).
- non-safety-related structures whose failure could prevent safety-related SSCs from performing their intended functions (e.g., seismic Category II structures over Category I structures).

Typical structural components include the following: (i) liner plates, (ii) walls, (iii) floors, (iv) roofs, (v) foundations, (vi) doors, (vii) beams, (viii) columns, and (ix) frames.

10 CFR) 54.21(a)(1) requires an applicant to identify and list SCs subject to AMR. These are "passive," "long-lived" SCs that are within the scope of SLR. In addition, 10 CFR 54.21(a)(2) (TN4878) requires an applicant to describe and justify the methods used to identify these SCs. The NRC staff reviews the applicant's methodology separately following the guidance in Section 2.0. To verify that the applicant has properly implemented its methodology, the NRC staff focuses its review on the implementation results. Such a focus allows the NRC staff to confirm that there is no omission of structures that are subject to an AMR by the applicant. If the review identifies no omission, the NRC staff has the basis to find that there is reasonable assurance that the applicant has identified the SCs that are subject to an AMR.

An applicant should list all plant-level systems and structures. On the basis of the DBEs considered in the plant's CLB and other CLB information relating to nonsafety-related systems and structures and certain regulated events, the applicant should identify those plant-level systems and structures within the scope of SLR, as defined in 10 CFR 54.4(a). This is "scoping" of the plant-level systems and structures for SLR. The NRC staff reviews the applicant's plant-level "scoping" results separately following the guidance in Section 2.2.

For structures that are within the scope of SLR, an applicant must identify the SCs that are "passive" and "long-lived" in accordance with 10 CFR 54.21(a)(1)(i) and (ii). These "passive," "long-lived" SCs are subject to an AMR ("screening"). The applicant's methodology implementation results for identifying SCs subject to an AMR is the area of review.

The applicant has the flexibility to determine the set of SCs for which an AMR is performed, provided that this set includes the SCs for which the NRC has determined that an AMR is required. This flexibility is described in the SOC for the License Renewal Rule (60 FR 22478). Therefore, the reviewer should not focus the review on structural components that the applicant has already identified as subject to an AMR because it is an applicant's option to include more SCs than those subject to an AMR, pursuant to 10 CFR 54.21(a)(1). Rather, the reviewer should focus on those SCs that are not included by the applicant as subject to an AMR to ensure that they do not perform an intended function as defined in 10 CFR 54.4(b) or are not "passive" and "long-lived."

2.4.2 Acceptance Criteria

The acceptance criteria for the areas of review define methods for determining whether the applicant has met the requirements of NRC regulations in 10 CFR 54.21(a)(1) (TN4878). For the applicant's implementation of its methodology to be acceptable, the NRC staff should have reasonable assurance that there has been no omission of SCs that are subject to an AMR.

2.4.2.1 Structural Components Subject to an Aging Management Review

Structural components are within the scope of SLR as delineated in 10 CFR 54.4(a) if they are:

- Safety-related SSCs that are relied upon to remain functional during and following DBEs [as defined in 10 CFR 50.49(b)(1) (TN249)] to ensure the following functions:
  - the integrity of the reactor coolant pressure 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 that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2), or 10 CFR 100.11, as applicable.
- All nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii), or (iii).
- All SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with NRC regulations for fire protection (10 CFR 50.48), EQ (10 CFR 50.49), pressurized thermal shock (10 CFR 50.61), ATWS (10 CFR 50.62), and SBO (10 CFR 50.63).

Structural components are subject to an AMR if they are within the scope of SLR and perform an intended function as defined in 10 CFR 54.4(b) without moving parts or a change in configuration or properties ("passive"), and are not subject to replacement based on a qualified life or specified time period ("long-lived") (10 CFR 54.21(a)(1)(i) and (ii)).

2.4.3 Review Procedures

The reviewer verifies the applicant's scoping and screening results. If the reviewer requests additional information from the applicant regarding why a certain structure was not identified by the applicant as being within the scope of SLR or subject to an AMR for the applicant's plant, the reviewer should provide a focused question that clearly explains what information is needed, why the information is needed, and how the information will allow the NRC staff to make its safety finding. In addition, other NRC staff members review the applicant's scoping and screening methodology separately following the guidance in Section 2.0. The reviewer should keep these other NRC staff members informed of findings that may affect their review of the applicant’s methodology. The reviewer should coordinate this sharing of information through the SLR PM.

For each area of review, the following review procedures are to be followed:

2.4.3.1 Structural Components Within the Scope of Subsequent License Renewal

In this step, the NRC staff determines which structures and structural components are within the scope of SLR. The Rule requires applicants to identify structures that are subject to an AMR, but not structures that are within the scope of SLR. While in the past, LRAs have included a table of structures that are within the scope of SLR, that information need not be submitted with future SLR applications. Although that information will be available at plant sites for inspection, the reviewer should determine through sampling of piping and instrumentation diagram piping and instrumentation diagram and through review of the UFSAR and other plant documents which portion of the components are within the scope of SLR. The reviewer should check to see if any structures exist that the NRC staff believes are within the scope of SLR but are not identified by the applicant as being subject to an AMR (and request that the applicant provide justification for omitting those structures that are “passive” and “long lived”).

2.4.3.2 Structural Components Subject to an Aging Management Review

In general, structural components are “passive” and “long-lived.” Thus, they are subject to an AMR if they are within the scope of SLR. For each of the plant-level structures within the scope of SLR, an applicant should identify those structural components that have intended functions. For example, the applicant may identify that its auxiliary building is within the scope of SLR. For this auxiliary building, the applicant may identify the structural components of beams, concrete walls, blowout panels, etc., that are subject to an AMR. The applicant should justify omitting a component from an AMR that is within the scope of SLR at its facility and is listed as “passive” on Table 2.1-6. Although Table 2.1-6 is extensive, it may not be all-inclusive. Thus, the reviewer should use other available information, such as prior application reviews, to determine whether a component may be subject to an AMR.

As set forth below, the reviewer should focus on individual structures not subject to an AMR, one at a time, to confirm that the structural components that have intended functions have been identified by the applicant. In a few instances, only portions of a particular building are within the scope of SLR. For example, a portion of a particular turbine building provides shelter for some safety-related equipment, which is an intended function, and the remainder of this particular building does not have any intended functions. In this case, the reviewer should verify that the applicant has identified the relevant particular portion of the turbine building as being within the scope of SLR and subject to an AMR.

The reviewer should use the UFSAR, orders, applicable regulations, exemptions, and license conditions to determine the design basis for the SSCs. The design basis specifies the intended function(s) of the system(s). That intended function is used to determine the components within that system that are relied upon for the system to perform its intended functions.

The reviewer should focus the review on those structural components that have not been identified as being within the scope of SLR. For example, for a building within the scope of SLR, if an applicant did not identify the building roof as subject to an AMR, the reviewer should verify that the roof has no intended functions, such as a “Seismic Category II structures over

Category I structures" concern in accordance with the plant's CLB. The reviewer need not verify all structural components that have been identified as subject to an AMR by the applicant because the applicant has the option to include more structural components than the Rule requires.

Further, the reviewer should select functions described in the UFSAR to verify that structural components having intended functions were not omitted from the scope of the review. For example, if the UFSAR indicates that a dike within the fire pump house prevents a fuel oil fire from spreading to the electrically driven fire pump, the reviewer should verify that this dike has been identified as being within the scope of SLR. Similarly, if a nonsafety-related structure or component is included in the plant's CLB as a part of the safe shutdown path resulting from the resolution of unresolved safety issue A-46 (NRC 1987-TN8015), the reviewer should verify that the structure or component has been included within the scope of SLR.

The applicant should also identify the intended functions of structural components. Table 2.1-4 provides typical "passive" structural component-intended functions.

The NRC staff has developed additional scoping/screening guidance (Ref. 2). For example, some structural components may be grouped together as a commodity, such as pipe hangers, and some structural components are considered consumable materials, such as sealants. Additional guidance on these and other components are contained in Section 2.0 for the following:

- commodity groups;
- hypothetical failure;
- cascading;
- consumables; and
- multiple functions

If the reviewer does not identify any omissions of components from those that are subject to an AMR, the NRC staff would have reasonable assurance that the applicant has identified the components subject to an AMR for the structural systems.

Table 2.4-1 provides examples of structural components scoping/screening lessons learned from the review of initial LRAs and the basis for disposition.

If the applicant determines that a structural component may be subject to an AMR, the applicant should also identify the component's intended functions, as defined in 10 CFR 54.4 (TN4878). Such functions must be maintained by any necessary AMPs.

If the reviewer determines that the applicant has satisfied the criteria described in this review section, the NRC staff would have reasonable assurance that the applicant has identified the components that are within the scope of SLR and subject to an AMR.

2.4.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of the SRP-SLR, then the NRC staff's evaluation would support conclusions of the following type, to be included in the SER:

On the basis of its review, as discussed above, the NRC staff concludes that there is reasonable assurance that the applicant has appropriately identified the structural components subject to an AMR in accordance with the requirements stated in 10 CFR 54.21(a)(1) (TN4878).

2.4.5 Implementation

Except for cases in which the applicant proposes an alternative method for complying with specified portions of NRC regulations, the NRC staff members follow the methods described herein in their evaluation of conformance with NRC regulations. For a proposed alternative, the staff evaluates the alternative on a case-by-case basis and finds it acceptable if the staff determines that the alternative provides reasonable assurance that the component's intended functions will be maintained.

2.4.6 References

1. NRC. NUREG–1211, "Regulatory Analysis for Resolution of Unresolved Safety Issue A 46, Seismic Qualification of Equipment in Operating Plants." Agencywide Documents Access and Management System (ADAMS) Accession No. ML20212N054~~ML0311503~~. Washington, DC: U.S. Nuclear Regulatory Commission. February 1987. NRC 1987-TN8015

2. NRC. NUREG–0933, "Resolution of Generic Safety Issues." Supplement 34. ADAMS Accession No. ML11353A382. Washington, DC: U.S. Nuclear Regulatory Commission. December 2011.

Table 2.4-1 Examples of Structural Components Scoping/Screening and Basis for Disposition

Example	Disposition
Roof of turbine building	An applicant indicates that degradation or loss of its turbine building roof will not result in the loss of any intended functions. The turbine building contains safety-related systems, structures, and components in the basement, which would remain sheltered and protected by several reinforced concrete floors if the turbine building roof were to degrade. Because this roof does not perform an intended function, it is not within the scope of subsequent license renewal.
Post-tensioned containment tendon gallery	The intended function of the post-tensioning system is to impose compressive forces on the concrete containment structure to resist the internal pressure resulting from a design basis accident with no loss of structural integrity. Although the tendon gallery is not relied upon to maintain containment integrity during design basis events, operating experience indicates that water infiltration and high humidity in the tendon gallery can contribute to a significant aging effect on the vertical tendon anchorages that could potentially result in loss of the ability of the post-tensioning system to perform its intended function. However, containment inspections provide reasonable assurance that the tendon anchorages, including those in the gallery, will continue to perform their intended functions. Because the tendon gallery itself does not perform an intended function, it is not within the scope of subsequent license renewal.
Water-stops	Groundwater leakage into the auxiliary building could occur as a result of degradation to the water-stops. This leakage may cause flooding of equipment within the scope of subsequent license renewal. (The plant's updated Final Safety Analysis Report discusses the effects of flooding.) The water stops perform their functions without moving parts or a change in configuration, and they are not typically replaced. Thus, the water-stops are subject to an aging management review (AMR). However, they need not be called out explicitly in the scoping/screening results if they are included as parts of structural components that are subject to an AMR.

AMR = aging management review.

2.5 Scoping and Screening Results: Electrical and Instrumentation and Controls Systems

Review Responsibilities

Primary — Assigned branch(es)

Secondary — None

2.5.1 Areas of Review

This review plan section addresses the electrical and instrumentation and control (I&C) scoping and screening results for SLR. Typical electrical and I&C components that are subject to an AMR for SLR include electrical cables and connections.

10 CFR 54.21(a)(1) requires an applicant to identify and list SCs subject to an AMR. These are “passive,” “long-lived” SCs that are within the scope of SLR. In addition, 10 CFR 54.21(a)(2) (TN4878) requires an applicant to describe and justify the methods used to identify these SCs. The NRC staff reviews the applicant’s methodology separately following the guidance in Section 2.0. To verify that the applicant has properly implemented its methodology, the NRC staff focuses its review on the implementation results. Such a focus allows the NRC staff to confirm that there is no omission of electrical and I&C components that are subject to an AMR by the applicant. If the review identifies no omission, the NRC staff has the basis to find that there is reasonable assurance that the applicant has identified the electrical and I&C components that are subject to an AMR.

An applicant should list all plant-level systems and structures. On the basis of the DBEs considered in the plant’s CLB and other CLB information relating to nonsafety-related systems and structures and certain regulated events, the applicant would identify those plant-level systems and structures that are within the scope of SLR, as defined in 10 CFR 54.4(a). This is “scoping” of the plant-level systems and structures for SLR. The NRC staff reviews the applicant’s plant-level “scoping” results separately following the guidance in Section 2.2.

For an electrical and I&C system that is within the scope of SLR, an applicant may not identify the specific electrical and I&C components that are subject to an AMR. For example, an applicant may not “tag” each specific length of cable that is “passive” and “long-lived,” and performs an intended function as defined in 10 CFR 54.4(b). Instead, an applicant may use the so-called “plant spaces” approach (Ref. 1), which is explained below. The “plant spaces” approach provides efficiencies in the AMR of electrical equipment located within the same plant space environment.

Under the “plant spaces” approach, an applicant would identify all “passive,” “long-lived” electrical equipment within a specified plant space as subject to an AMR, regardless of whether these components perform any intended functions. For example, an applicant could identify all “passive,” “long-lived” electrical equipment located within the turbine building (“plant space”) as subject to an AMR for SLR. In the subsequent AMR, the applicant would evaluate the environment of the turbine building to determine the appropriate aging management activities for the tubine it houses. The applicant has options to further refine this encompassing scope on an as needed basis. For this example, if the applicant identified elevated temperatures in a particular area within the turbine building, the applicant may elect to further refine the scope in this particular area by: (1) identifying electrical equipment that is not subject to an AMR and (2) excluding this equipment from the AMR. In this case, the excluded electrical equipment would be reported in the application as not being subject to an AMR.

Many examples of electrical and I&C components that are not considered to be “passive” and are not subject to an AMR for SLR are provided in 10 CFR 54.21(a)(1)(i). Therefore, the applicant is expected to identify only a few electrical and I&C components, such as electrical penetrations, cables, and connections that are “passive” and subject to an AMR. However, the time-limited aging analysis (TLAA) evaluation requirements in 10 CFR 54.21(c) apply to EQ of electrical equipment, which is not limited to “passive” components.

An applicant has the flexibility to determine the set of electrical and I&C components for which an AMR is performed, provided that this set includes the electrical and I&C components for which the NRC has determined an AMR is required. This is based on the SOC for the License Renewal Rule (60 FR 22478). Therefore, the reviewer need not review all components that the applicant has identified as subject to an AMR because the applicant has the option to include more components than those required by 10 CFR 54.21(a)(1).

2.5.2 Acceptance Criteria

The acceptance criteria for the areas of review define methods for determining whether the applicant has met the requirements of NRC regulations in 10 CFR 54.21(a)(1) (TN4878). For the applicant’s implementation of its methodology to be acceptable, the NRC staff should have reasonable assurance that there has been no omission of electrical and I&C system components that are subject to an AMR.

2.5.2.1 Components Within the Scope of Subsequent License Renewal

Electrical and I&C components are within the scope of SLR as delineated in 10 CFR 54.4(a) if they are:

- Safety-related SSCs that are relied upon to remain functional during and following DBEs [as defined in 10 CFR 50.49(b)(1) (TN249)] to ensure the following functions:
    - maintaining the integrity of the reactor coolant pressure 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 that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2) or 10 CFR 100.11, as applicable.
- All nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii) or (iii).
- All SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with NRC regulations for fire protection (10 CFR 50.48), EQ (10 CFR 50.49), pressurized thermal shock (10 CFR 50.61), ATWS (10 CFR 50.62), and SBO (10 CFR 50.63).

2.5.2.1.1 Components Within the Scope of Station Blackout (10 CFR 50.63)

Both the offsite and onsite power systems are relied upon to meet the requirements of the SBO Rule. This includes the following:

- The onsite power system meeting the requirements under 10 CFR 54.4(a)(1) (TN4878) (safety-related systems).
- Equipment that is required to cope with an SBO (e.g., ac power sources and any cross-ties that may be stipulated to recovery from SBO) meeting the requirements under 10 CFR 54.4(a)(3).
- The plant system portion of the offsite power system that is used to connect the plant to the offsite power source meeting the requirements under 10 CFR 54.4(a)(3). The electrical distribution equipment out to the first circuit breaker with the offsite distribution system (i.e., equipment in the switchyard). This path typically includes the circuit breakers that connect to the offsite system power transformers (startup transformers), the transformers themselves, the intervening overhead or underground circuits between circuit breaker and transformer and transformer and onsite electrical distribution system, and the associated control circuits and structures. However, the NRC staff's review is based on the plant-specific CLB, regulatory requirements, and offsite power design configurations.

2.5.2.2 Components Subject to an Aging Management Review

Electrical and I&C components are subject to an AMR if they are within the scope of SLR and perform an intended function as defined in 10 CFR 54.4(b) (TN4878) without moving parts or without a change in configuration or properties ("passive"), and are not subject to replacement based on a qualified life or specified time period ("long-lived") [10 CFR 54.21(a)(1)(i) and (ii)].

2.5.3 Review Procedures

The reviewer verifies the results of the applicant's scoping and screening. If the reviewer requests additional information from the applicant regarding why a certain component was not identified by the applicant as being within the scope of SLR or subject to an AMR for the applicant's plant, the reviewer should provide a focused question that clearly explains what information is needed, why the information is needed, and how the information will allow the NRC staff to make its safety evaluation. In addition, other NRC staff members review the applicant's scoping and screening methodology separately following the guidance in Section 2.0. The reviewer should keep the other NRC staff members informed of findings that may affect their review of the applicant's methodology. The reviewer should coordinate this sharing of information through the SLR PM.

The reviewer should verify that an applicant has identified in the SLR application the electrical and I&C components that are subject to an AMR for its plant. The review procedures are presented below and assume that the applicant has performed "scoping" and "screening" of electrical and I&C system components in that sequence. However, the applicant may elect to perform "screening" before "scoping," which is acceptable because, regardless of the sequence, the end result should encompass the electrical and I&C components that are subject to an AMR.

Some of the electrical equipment that is in the scope of 10 CFR 50.49 (TN249) that have a qualified life of 40 years or greater are also within the scope of SLR under 10 CFR 54.4(a)(3) (TN4878). They have already been identified by licenses under 10 CFR 50.49(b). Licensees may rely upon their listing of EQ equipment, as required by 10 CFR 50.49(d), for the purposes of identifying electrical equipment satisfying 10 CFR 54.4(a)(3) that is also within the scope of 10 CFR 50.49 (60 FR 22466). However, the License Renewal Rule has a requirement [10 CFR 54.21(c)] on the evaluation of TLAAs, including EQ (10 CFR 50.49). EQ equipment is not limited to “passive” equipment. The applicant may identify EQ equipment separately for TLAA evaluation and not include such equipment as subject to an AMR under 10 CFR 54.21(a)(1). The EQ equipment identified for TLAA evaluation would include the “passive” EQ equipment subject to an AMR. The TLAA evaluation would ensure that the EQ equipment would be functional for the subsequent period of extended operation. The NRC staff reviews the applicant’s EQ TLAA evaluation separately following the guidance in Section 0.

For each area of review, the following review procedures are to be followed.

2.5.3.1 Components Within the Scope of Subsequent License Renewal

In this step, the NRC staff determine whether the applicant has properly identified the components that are within the scope of SLR. The Rule requires that the SLRA identify and list components that are within the scope of SLR and are subject to an AMR. Whereas, in the past, LRAs have included a table of components that are within the scope of SLR, generally that information need not be submitted with SLRAs. Although that information will be available at plant sites for inspection, the reviewer must determine, through sampling of one-line diagrams and through review of the UFSAR and other plant documents, which components are within the scope of SLR. The reviewer must check to see if any components exist that the NRC staff believes are within the scope but are not identified by the applicant as being subject to AMR (any request that the applicant provide justification for omitting those components that are “passive” and “long-lived”).

The reviewer should use the UFSAR, orders, applicable regulations, exemptions, and license conditions to determine the design basis for the SSCs. The design basis specifies the intended function(s) of the system(s). That intended function is used to determine the components within that system that are required for the system to perform its intended functions.

The applicant may use the “plant spaces” approach in scoping electrical and I&C components for SLR. In the “plant spaces” approach, an applicant may indicate that all electrical and I&C components located within a particular plant area (“plant space“), such as the containment and auxiliary building, are within the scope of SLR. The applicant may also indicate that all electrical and I&C components located within another plant area (“plant space”), such as the warehouse, are not within the scope of SLR. Table 2.5-1 contains examples of this “plant spaces” approach and the corresponding review procedures.

The applicant would use the “plant spaces” approach for the subsequent AMR of the electrical and I&C components. The applicant would evaluate the environment of the “plant spaces” to determine the appropriate aging management activities for the equipment housed there. The applicant has the option to further refine this encompassing scope on an as needed basis. For example, if the applicant identified elevated temperatures in a particular area within a building (“plant space”), the applicant may elect to identify only those “passive,” “long-lived” electrical and I&C components that perform an intended function in this particular area as subject to an AMR. This approach of limiting the “plant spaces” is consistent with the “plant spaces” approach. In this case, the reviewer verifies that the applicant has specifically identified the electrical and I&C components that may be within the scope of SLR in these limited “plant spaces.” The reviewer should verify that the electrical and I&C components that the applicant has elected to exclusively have the intended functions defined in 10 CFR 54.4(b) (TN4878).

Section 2.0 contains additional guidance on scoping the following:

- commodity groups;

- complex assemblies;
- scoping events;
- hypothetical failure; and
- cascading.

If the reviewer does not identify any omissions of components from those that are within the scope of SLR, the NRC staff would have reasonable assurance that the applicant has identified the components within the scope of SLR for the electrical and I&C systems accurately.

2.5.3.2 Components Subject to an Aging Management Review

In this step, the reviewer determines whether the applicant has properly identified the components subject to an AMR from among those which are within the scope of SLR (i.e., those identified in Section 2.5.3.1). The reviewer should review selected components that the applicant has identified as being within the scope of SLR to verify that the applicant has identified these components as being subject to an AMR if they perform intended functions without moving parts or without a change in configuration or properties and are not subject to replacement on the basis of a qualified life or specified time period. The description of “passive” may also be interpreted to include SCs that do not display “a change in state.”

Only components that are “passive” and “long-lived” are subject to an AMR. Table 2.1-6 lists many typical components and structures, and their associated intended functions, and identifies whether they are “passive.” The reviewer should use Table 2.1-6 for identifying if certain components are “passive.” The reviewer should verify that electrical and I&C components identified as “passive” in Table 2.1-6 have been included by the applicant as being subject to an AMR. Although Table 2.1-6 is extensive, it may not be all-inclusive. Thus, the reviewer should use other available information sources, such as prior application reviews, to determine whether a component may be subject to AMR.

Section 2.0 contains additional guidance on screening the following:

- consumables; and
- multiple intended functions.

If the reviewer does not identify any omissions of components from those that are subject to an AMR, the NRC staff would have reasonable assurance that the applicant has identified the components subject to an AMR for the electrical and I&C systems.

2.5.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of the SRP-SLR, then the NRC staff’s evaluation would support conclusions of the following type, to be included in the SER:

> On the basis of its review, as discussed above, the NRC staff concludes that there is reasonable assurance that the applicant has appropriately identified the electrical and instrumentation and controls system components subject to an AMR in accordance with the requirements stated in 10 CFR 54.21(a)(1) (TN4878).

2.5.5 Implementation

Except for cases in which the applicant proposes an alternative method for complying with specified portions of NRC regulations, the NRC staff members follow the methods described herein in their evaluation of conformance with NRC regulations. For a proposed alternative, the staff evaluates the alternative on a case-by-case basis and finds it acceptable if the staff determines that the alternative provides reasonable assurance that the component's intended functions will be maintained.

2.5.6 References

1. SNL. SAND96-0344, "Aging Management Guideline for Commercial Nuclear Power Plants-Electrical Cable and Terminations." Agencywide Documents Access and Management System (ADAMS) Accession No. ML031140264. Albuquerque, New Mexico: Sandia National Laboratories. September 1996.

Table 2.5-1 Examples of "Plant Spaces" Approach for Electrical and Instrumentation and Control Scoping and Corresponding Review Procedures

Example	Review Procedures
An applicant indicates that all electrical and instrumentation and control (I&C) components on site are within the scope of subsequent license renewal (SLR).	This is acceptable, and a review is not necessary because all electrical and I&C components are included without exception and would include those required by the Rule.
An applicant indicates that all electrical and I&C components located in seven specific buildings (containment, auxiliary building, turbine building, etc.) are within the scope of SLR.	The reviewer should review electrical systems and components in areas outside of these seven buildings ("plant spaces"). The reviewer should verify that the applicant has included any direct buried cables in trenches between these buildings as within the scope of SLR if they perform an intended function. The reviewer should also select buildings other than the seven indicated (for example, the radioactive waste facility) to verify that they do not contain any electrical and I&C components that perform any intended functions.
An applicant indicates that all electrical and I&C components located onsite, except for the 525 kV switchyard, 230 kV transmission lines, radioactive waste facility, and 44 kV substation, are within the scope of SLR.	The reviewer should select the specifically excluded "plant spaces" (that is, the 525 kV switchyard, 230 kV transmission lines, radioactive waste facility, and 44 kV substation) to verify that they do not contain any electrical and I&C components that perform any intended functions.

I&C = instrumentation and control; SLR = subsequent license renewal.

3.0 AGING MANAGEMENT REVIEW

3.1 Aging Management of Reactor Vessel, Internals, and Reactor Coolant System

Review Responsibilities

Primary — The branch(es) assigned responsibility by the Project Manager (PM) for the safety review of the subsequent license renewal application (SLRA).

Secondary — None

3.1.1 Areas of Review

This section addresses the aging management review (AMR) and the associated aging management programs (AMPs) of the reactor vessel, internals (RVI), and reactor coolant system. For a recent vintage plant, the information related to the reactor vessel (RV), internals, and reactor coolant system is contained in Chapter 5, “Reactor Coolant System and Connected Systems,” of the plant’s Final Safety Analysis Report (FSAR), consistent with the “Standard Review Plan (SRP) for the Review of Safety Analysis Reports for Nuclear Power Plants” (NUREG–0800). For older plants, the location of applicable information is plant-specific because an older plant’s FSAR may have predated NUREG–0800.

The reactor vessel, internals, and reactor coolant system includes the reactor vessel and internals. For boiling water reactors (BWRs), this system also includes the reactor coolant recirculation system and portions of other systems connected to the pressure vessel extending to the first isolation valve outside of containment or to the first anchor point. These connected systems include residual heat removal, low pressure core spray, high pressure core spray, low pressure coolant injection, high pressure coolant injection, reactor core isolation cooling, isolation condenser, reactor coolant cleanup, feedwater, and main steam. For pressurized water reactors (PWRs), the reactor coolant system includes the primary coolant loop, the pressurizer, and the steam generators (SGs). For PWRs the reactor coolant system also includes the pressurizer relief tank, which is not an American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Class 1 component. The connected systems for PWRs include the residual heat removal or low pressure injection system, core flood spray or safety injection tank, chemical and volume control system or high pressure injection system, and sampling system.

The responsible review organization is to review the following SLRA AMR and AMP items assigned to it, per Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Section 1.2:

AMRs

- AMR results consistent with the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report
- AMR results for which further evaluation is recommended
- AMR results not consistent with or not addressed in the GALL-SLR Report

AMPs

- Consistent with GALL-SLR Report AMPs (including those with enhancements and/or exceptions)
- Plant-specific AMPs

FSAR Supplement

- The responsible review organization is to review the FSAR Supplement associated with each assigned AMP.

3.1.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the U.S. Nuclear Regulatory Commission (NRC) regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21.

3.1.2.1 Aging Management Review Results Consistent With the Generic Aging Lessons Learned for Subsequent License Renewal Report

The AMR and the AMPs applicable to the reactor vessel, internals, and reactor coolant system are described and evaluated in Chapter IV of the GALL-SLR Report.

The applicant’s SLRA should provide sufficient information so that the reviewer is able to confirm that the specific SLRA AMR item and the associated SLRA AMP are consistent with the cited GALL-SLR Report AMR item. The reviewer should then confirm that the SLRA AMR item is consistent with the GALL-SLR Report AMR item to which it is compared. When an applicant credits a different AMP than recommended in the GALL-SLR Report, the reviewer should confirm that the alternate AMP is valid to use for aging management and will be sufficient and capable of managing the effects of aging as adequately as the AMP recommended by the GALL-SLR Report.

3.1.2.2 Aging Management Review Results for Which Further Evaluation Is Recommended by the Generic Aging Lessons Learned for Subsequent License Renewal Report

The basic acceptance criteria defined in Section 3.1.2.1 need to be applied first for all of the AMRs and AMPs reviewed as part of this section. In addition, if further evaluation is recommended, then additional criteria apply for each of the following aging effect aging mechanism combinations. Refer to Table 3.1-1, comparing the “Further Evaluation Recommended” and the “GALL-SLR” column, for the AMR items that reference the following sections.

3.1.2.2.1 Cumulative Fatigue Damage

Evaluations involving time-dependent fatigue or cyclical loading parameters may be time-limited aging analyses (TLAAs), as defined in 10 CFR 54.3 (TN4878). TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The TLAAs which involve time-dependent fatigue or cyclical loading parameters are addressed separately in Section 4.3, “Metal Fatigue,” of this SRP-SLR. For plant-specific cumulative usage factor calculations that are based on stress-based input methods, the methods are to be appropriately defined and discussed in the applicable TLAAs.

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 SG 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 SG inspections are designed to make sure that flaws cannot attain a depth sufficient to threaten the integrity of the welds. However, according to NRC Information Notice 90-04, "Cracking of the Upper Shell-to-Transition Cone Girth Welds in Steam Generators," the program may not be sufficient to detect pitting and crevice corrosion if general and pitting corrosion of the shell is known to exist. Augmented inspection is recommended to manage this aging effect. Furthermore, 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 (BTP) License Renewal and Standardization Branch (RLSB-1) (Appendix A.1 of this SRP-SLR).

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 SGs, generating a cut in the middle of the transition cone, and, consequently, a new transition cone closure weld. It is recommended that volumetric examinations be performed in accordance with the requirements of ASME Code Section XI for upper shell 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 SGs, 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 Code Section XI requirements. In addition, ASME Code Section XI does not require licensees to remove insulation when performing visual examination on nonborated treated water systems. Therefore, the effectiveness of the chemistry control program should be verified to make sure that loss of material due to general, pitting, and crevice corrosion is not occurring.

   For the new continuous circumferential weld, further evaluation is recommended 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 subsequent period of extended operation. Furthermore, this issue is limited to replacement of recirculating SGs with a new transition cone closure weld.

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 subsequent period of extended operation for all ferritic materials that have a neutron fluence greater than 10^{17} Newton per square centimeter [N/cm^2] (E >1 mega electron-volt [MeV]) at the end of the subsequent period of extended operation. Certain aspects of neutron irradiation embrittlement are TLAAs as defined in 10 CFR 54.3 (TN4878). The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The TLAA which covers aspects of neutron irradiation embrittlement is addressed separately in Section 4.2, “Reactor Pressure Vessel Neutron Embrittlement Analysis,” of this SRP-SLR.

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 RV material surveillance program monitors neutron irradiation embrittlement of the reactor vessel. The reactor vessel material surveillance program is either a plant-specific surveillance program or an integrated surveillance program, depending on matters such as the composition of limiting materials and the availability of surveillance capsules.

   In accordance with 10 CFR Part 50 (TN249), 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 NRC staff evaluation is required for a subsequent license renewal (SLR). Specific recommendations for an acceptable AMP are provided in GALL-SLR Report AMP XI.M31, “Reactor Vessel Material Surveillance.”

   A neutron fluence monitoring program may be used to monitor the neutron fluence levels that are used as time-dependent inputs for the plant’s RV neutron irradiation embrittlement TLAAs. These TLAAs are the subjects of the topics discussed in SRP-SLR Section 3.1.2.2.3.1 and “Acceptance Criteria” and “Review Procedure” guidance in SRP-SLR Section 4.2. For those applicants that determine it is appropriate to include a neutron fluence monitoring AMP in their SLRAs, the program is to be implemented in conjunction with the applicant’s implementation of an AMP that corresponds to GALL-SLR Report AMP XI.M31, “Reactor Vessel Material Surveillance.” Specific recommendations for an acceptable neutron fluence monitoring AMP are provided in GALL-SLR Report AMP X.M2, “Neutron Fluence Monitoring.”

3. Reduction in Fracture Toughness is a plant-specific TLAA for Babcock & Wilcox (B&W) reactor internals to be evaluated for the subsequent period of extended operation in accordance with the NRC staff’s safety evaluation concerning “Demonstration of the Management of Aging Effects for the Reactor Vessel Internals,” B&W 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-SLR.

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 stainless steel (SS) and nickel-alloy RV flange leak detection lines of BWR light-water reactor facilities. The plant-specific operating experience (OE) and condition of the RV flange leak detection lines are evaluated to determine if SCC or IGSCC has occurred. The aging effects involving cracking of SS and nickel-alloy RV flange leak detection lines are not applicable and do not require management if: (i) the plant-specific OE

does not reveal a history of SCC or IGSCC and (ii) a one-time inspection demonstrates that the effect of aging is not evident. The applicant documents the results of the plant-specific OE review in the SLRA. GALL-SLR Report AMP XI.M32, “One-Time Inspection,” describes an acceptable program to demonstrate that cracking is not occurring. If cracking has occurred, GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” describes an acceptable program to manage cracking in RV flange leak detection lines.

2. Cracking due to SCC and IGSCC could occur in SS BWR isolation condenser components exposed to reactor coolant. The existing program relies on control of reactor water chemistry to mitigate SCC and on ASME Code Section XI ISI to detect cracking. However, the existing program should be augmented to detect cracking due to SCC and IGSCC. An augmented program is recommended to include temperature and radioactivity monitoring of the shell-side water and eddy current testing of tubes to make sure that the component’s intended function will be maintained during the subsequent period of extended operation. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

3.1.2.2.5 Crack Growth Due to Cyclic Loading

Crack growth due to cyclic loading could occur in reactor pressure vessel (RPV) shell forgings clad with SS using a high-heat-input welding process. Therefore, the current licensing basis (CLB) may include flaw growth evaluations of intergranular separations (i.e., underclad cracks) that have been identified in the RPV to cladding welds for the vessel. The evaluations apply to SA 508 Class 2 RPV forging components where the cladding was deposited and welded to the vessel using a high-heat-input welding process. The CLBs that include these types of evaluations may need to be identified as TLAAs if they are determined to conform to the six criteria for defining TLAAs in 10 CFR 54.3(a) (TN4878). The methodology for evaluating the underclad flaw should be consistent with the flaw evaluation procedure and criterion in the ASME Code Section XI.[1] See SRP-SLR, Section 4.7, “Other Plant-Specific Time-Limited Aging Analyses,” for generic guidance for meeting the requirements of 10 CFR 54.21(c).

3.1.2.2.6 Cracking Due to Stress Corrosion Cracking

1. Deleted.

2. ~~“”~~Deleted.

3. Cracking due to SCC could occur in SS or nickel-alloy RV flange leak detection lines of PWR light-water reactor facilities. The plant-specific OE and condition of the RV flange leak detection lines are evaluated to determine if SCC has occurred. The aging effect involving cracking in SS and nickel-alloy RV flange leak detection lines is not applicable and does not require management if: (i) the plant-specific OE does not reveal a history of SCC and (ii) a one-time inspection demonstrates that effect of aging is not evident. The applicant documents the results of the plant-specific OE review in the SLRA. GALL-SLR Report AMP XI.M32, “One-Time Inspection,” describes an acceptable program to demonstrate that cracking is not occurring. If cracking has occurred, GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” describes an acceptable program to manage cracking in RV flange leak detection lines.

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[1] Refer to the GALL-SLR Report, Chapter I, for applicability of other editions of the ASME Code, Section XI.

3.1.2.2.7 Cracking Due to Cyclic Loading

Cracking due to cyclic loading could occur in steel and SS BWR isolation condenser components exposed to reactor coolant. The existing program relies on ASME Code Section XI ISI. However, the existing program should be augmented to detect cracking due to cyclic loading. An augmented program is recommended to include temperature and radioactivity monitoring of the shell-side water and eddy current testing of tubes to make sure that the component's intended function will be maintained during the subsequent period of extended operation. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

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. Further evaluation of a plant-specific AMP is recommended to make sure that this aging effect is adequately managed. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

3.1.2.2.9 Aging Management of Pressurized Water Reactor Vessel Internals (Applicable to Subsequent License Renewal Periods Only)

Electric Power Research Institute (EPRI) Topical Report (TR)-1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP 227 A)" (Agencywide Documents Access and Management System [ADAMS)] Accession Nos. ML12017A191 through ML12017A197 and ML12017A199), provided the industry's initial set of aging management inspection and evaluation (I&E) recommendations for the RVI components that are included in the design of a PWR facility. Since the issuance of MRP-227-A on January 9, 2012, EPRI updated its I&E guidelines for the PWR RVI components in TR No. 3002017168, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227, Revision 1-A)" (ADAMS Accession No. ML20175A112). MRP-227, Revision 1-A, incorporated the industry's bases for resolving operating experience and industry lessons learned resulting from component-specific inspections performed since the issuance of MRP-227-A in January 2012. The staff found the guidelines in MRP-227, Revision 1-A acceptable, as documented in a staff-issued safety evaluation dated April 25, 2019 (ADAMS Accession No. ML19081A001) and approved the TR for use as documented in the staff's letters to the EPRI Materials Reliability Program (MRP) dated February 19, 2020 and July 7, 2020 (ADAMS Accession Nos. ML20006D152 and ML20175A149).

In MRP-227, Revision 1-A, the EPRI MRP identified that the following aging mechanisms may be applicable to the design of the RVI components in these types of facilities: (i) SCC, (ii) irradiation-assisted stress corrosion cracking (IASCC), (iii) fatigue, (iv) wear, (v) neutron irradiation embrittlement, (vi) thermal aging embrittlement, (vii) void swelling and irradiation growth or component distortion, and (viii) thermal or irradiation-enhanced stress relaxation or irradiation-enhanced creep.

The EPRI MRP's functionality analysis and failure modes, effects, and criticality analysis bases for grouping Westinghouse-designed, B&W designed and Combustion Engineering (CE)-designed RVI components into the applicable inspection categories (as evaluated in MRP-227, Revision 1-A) were based on an assessment of aging effects and relevant time-dependent aging parameters through a cumulative 60-year licensing period (i.e., 40 years for the initial operating license period plus an additional 20 years during the initial period of extended operation). The EPRI MRP's assessment in MRP-227, Revision 1-A, did not evaluate the potential impacts of operation of Westinghouse-designed, B&W designed and CE designed reactors during an SLR operating period (60 to 80 years) on the existing susceptibility rankings and inspection categorizations for the RVI components in these designs, as defined in MRP-227, Revision 1-A or the applicable MRP background documents (e.g., MRP-191, Revision 1, for Westinghouse-designed or CE designed RVI components or MRP-189, Revision 2, for B&W designed components). As described in GALL-SLR Report AMP XI.M16A, the applicant may use the MRP-227, Revision 1-A based AMP as an initial reference basis for developing and defining the AMP that will be applied to the RVI components for the subsequent period of extended operation. However, to use this alternative basis, GALL-SLR Report AMP XI.M16A recommends that the MRP-227, Revision 1-A based AMP be enhanced to include a gap analysis of the components that are within the scope of the AMP. The gap analysis is a basis for identifying and justifying changes to the MRP-227, Revision 1-A based program that are necessary to provide reasonable assurance that the effects of age-related degradation will be managed during the subsequent period of extended operation. The criteria for the gap analysis are described in GALL-SLR Report AMP XI.M16A. If a gap analysis is needed to establish the appropriate aging management criteria for the RVI components, the applicant has the option of including the gap analysis in the SLRA or making the gap analysis and any supporting gap analysis documents available in the in-office audit portal for the SLRA review.

The SLR applicants for units of a PWR design will no longer need to include separate SLRA Appendix C Section responses in resolution of the Applicant/Licensee Action Item (A/LAIs) previously issued on MRP-227-A because the A/LAIs were resolved and closed by the staff in the April 25, 2019, safety evaluation for MRP-227, Revision 1-A. The sole A/LAI issued by the staff in the safety evaluation dated April 25, 2019, relates to an applicant’s methods and timing of inspections that will be applied to the baffle to former bolts or core shroud bolts in the plant design. Since an applicant’s resolution of this A/LAI can be appropriately addressed in the “Operating Experience” program element discussion for the AMP and in the applicant’s basis document for the AMP, a separate SLRA Appendix C response for the A/LAI is not necessary.

Alternatively, the PWR SLRA may define a plant-specific AMP for the RVI components to demonstrate that the RVI components will be managed in accordance with the requirements of 10 CFR 54.21(a)(3) (TN4878) during the proposed subsequent period of extended operation. Components to be inspected, parameters monitored, monitoring methods, inspection sample size, frequencies, expansion criteria, and acceptance criteria are justified in the SLRA. If the AMP is a plant-specific program, the NRC staff will assess the adequacy of the plant-specific AMP against the criteria for the 10 AMP program elements that are defined in Section 0 of SRP-SLR Appendix A.1.

3.1.2.2.10 Loss of Material Due to Wear

1. Industrial OE indicates that loss of material due to wear can occur in PWR control rod drive (CRD) head penetration nozzles made of nickel-alloy due to the interactions between the nozzle and the thermal sleeve centering pads of the nozzle (see Ref. 29). The CRD head penetration nozzles are also called control rod drive mechanism (CRDM) nozzles or CRDM head adapter tubes. The applicant should perform a further evaluation to confirm the adequacy of a plant-specific AMP or analysis (with any necessary inspections) for management of the aging effect. The applicant may use the acceptance criteria, which are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR), to demonstrate the adequacy of a plant-specific AMP. Alternatively, the applicant may perform an analysis with necessary inspections to confirm that loss of material due to wear does not affect the intended function(s) of these CRD head penetration nozzles, consistent with the CLB.

2. Industry OE indicates that loss of material due to wear can occur in the SS thermal sleeves of PWR CRD head penetration nozzles due to the interaction of the thermal sleeve with the adjacent components (such as CRD head penetration nozzle, drive rod, and penetration housing). For example, loss of material can occur where the thermal sleeve exits from the head penetration nozzle inside the RV (Ref. 30, 38). This type of wear is called thermal sleeve outer diameter wear, which results from the interactions between the thermal sleeve outer surface and the head penetration nozzle. Loss of material can also occur near the bottom of the thermal sleeve due to the interactions between the thermal sleeve inner surface and the drive rod passing though the thermal sleeve (Ref. 38). This type of wear is called thermal sleeve inner-diameter wear. In addition, thermal sleeve flange wear can occur due to the interactions between the bottom side of the thermal sleeve flange and the CRD penetration housing near the top of the thermal sleeve (Ref. 38, 39, 40). Therefore, the applicant should perform a further evaluation to confirm the adequacy of a plant-specific AMP for management of the aging effect. The applicant may use the acceptance criteria, which are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR), to demonstrate the adequacy of a plant-specific AMP.

3. Industry OE indicates that significant loss of material due to wear can occur in ASME Code Class 1, small-bore piping. For example, loss of material can occur in the presence of reflective metal insulation (RMI) and flow-induced vibrations of ASME Code Class 1 small-bore piping. This type of wear is difficult to identify unless the insulation is removed and the outside diameter (OD) of the piping is visually examined for wear marks (Ref. 38 and 39). This type of wear, defined as OD pipe wear, can potentially occur nearly 360 º around the OD of the subject pipe and could significantly reduce the load-bearing capacity of the subject pipe. Therefore, the applicant should perform a further evaluation to confirm the absence of the specific aging effect. If it is determined that the insulation has the potential to cause wear, the licensee may choose to mitigate the loss of material due to wear or alternatively use an existing program for management of the aging effect. The applicant may use the acceptance criteria, which are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR), to demonstrate the adequacy of a plant-specific AMP. The reviewer should ascertain that the applicant has verified through inspections that OD pipe wear is not an applicable aging effect that needs to be monitored or provide for a periodic inspection program so that significant OD wear of ASME Code Class 1 and 2 small-bore piping is detected prior to the loss of intended function.

3.1.2.2.11 Cracking Due to Primary Water Stress Corrosion Cracking

1. Foreign OE in SGs with a design similar to that of Westinghouse SGs (particularly Model 51) has identified cracks due to primary water stress corrosion cracking (PWSCC) in SG divider plate assemblies fabricated of Alloy 600 and/or the associated Alloy 600 weld materials, even with proper primary water chemistry. Cracks have been detected in the stub runner with depths typically about 0.08 inches (in.) (EPRI 3002002850).

   All but one of these instances of cracking has been detected in divider plate assemblies that are approximately 1.3 in. in thickness. For the cracks in the 1.3-in. thick divider plate assemblies, the cracks tend to be parallel to the divider-plate-to-stub-runner weld (i.e., run horizontally in parallel to the lower surface of the tubesheet). For the one instance of cracking in a divider plate assembly with a thickness greater than 1.3 in., the cracking occurred in a divider plate assembly with a thickness of approximately 2.4 in. near manufacturing marks on the upper end of the stub runner used for locating tubesheet holes. These flaws were estimated to be approximately 0.08-in. deep.

Although these instances indicate that the Water Chemistry Program may not be sufficient to manage cracking due to PWSCC in SG divider plate assemblies, analyses by the industry indicate that PWSCC in the divider plate assembly does not pose a structural integrity concern for other steam generator components (e.g., tubesheet and tube-to-tubesheet welds) and does not adversely affect other safety analyses (e.g., analyses supporting tube plugging and repairs, tube repair criteria, and design basis accidents). In addition, the industry analyses indicate that flaws in the divider plate assembly should not adversely affect the heat transfer function (as a result of bypass flow) during normal forced flow operation, during natural circulation conditions (assessed in the analyses of various design basis accidents), or in the event of a loss of coolant accident (LOCA).

Furthermore, additional industry analyses indicate that PWSCC in the divider plate assembly is unlikely to adversely impact adjacent items, such as the tubesheet cladding, tube-to-tubesheet welds, and channel head. Therefore,

- For units with divider plate assemblies fabricated of Alloy 690 and Alloy 690 type weld materials, use of the One-Time inspection AMP is not necessary.
- For units with divider plate assemblies fabricated of Alloy 600 or Alloy 600 type weld materials, if the analyses performed by the industry (EPRI 3002002850) are applicable and bounding for the unit, use of the One-Time Inspection AMP is not necessary. Applicants may demonstrate that the industry analyses are applicable and bounding for a site by providing a comparison of plant-specific parameters (e.g., dimensional assumptions for the divider plate, channel head, tube sheet and stub runner; material assumptions for the bottom head and cladding, upper vessel wall, tubesheet, stub runner, divider plate and welds, design, and transient loads) to the values provided in the industry analyses. One such method to provide this comparison is to use the checklist provided in the EPRI letter SGMP-IL-16-02.
- For units with divider plate assemblies fabricated of Alloy 600 or Alloy 600 type weld materials, if the industry analyses (EPRI 3002002850) are not bounding for the applicant's unit, use of the One-Time Inspection AMP is necessary or a rationale should be provided for why such a program is not needed. The One-Time Inspection AMP (in addition to the Water Chemistry and the Steam Generators AMP) should include an inspection that is capable of detecting cracking to verify the effectiveness of the Water Chemistry and Steam Generator AMP and the absence of PWSCC in the divider plate assemblies.

The existing programs rely on control of reactor water chemistry to mitigate cracking due to PWSCC and general visual inspections of the channel head interior surfaces (included as part of the Steam Generators AMP). The GALL-SLR Report recommends further evaluation for the use of the One-Time Inspection AMP to confirm the effectiveness of the Water Chemistry and Steam Generator AMPs as described in this section. In place of the one-time inspection AMP, the applicant may provide a rationale to justify why the one-time inspection AMP is not necessary.

2. Cracking due to PWSCC could occur in SG nickel-alloy tube-to-tubesheet welds exposed to reactor coolant. The acceptance criteria for this review are as follows:
   - For units with Alloy 600 SG tubes with permanently approved alternate repair criterion such as C*, F*, H*, or W* for both the hot- and cold-leg side of the SG, the weld is no longer part of the reactor coolant pressure boundary and use of the One-Time Inspection AMP is not necessary.

- For units with Alloy 600 steam generator tubes, if there is no permanently approved alternate repair criteria such as C*, F*, H*, or W*, or if the permanent approval applies to only the hot- or cold-leg side of the SG, use of the One-Time Inspection AMP is necessary;
- For units with thermally treated Alloy 690 SG tubes and with tubesheet cladding using Alloy 690 type material, use of the One-Time Inspection AMP is not necessary.
- For units with thermally treated Alloy 690 SG tubes and with tubesheet cladding using Alloy 600 type material, use of the One-Time Inspection AMP is necessary unless the applicant confirms that the industry's analyses for tube-to-tubesheet weld cracking (e.g., chromium content for the tube-to-tubesheet welds is approximately 22 percent and the tubesheet primary face is in compression as discussed in EPRI 3002002850) are applicable and bounding for the unit, and the applicant will perform general visual inspections of the tubesheet region looking for evidence of cracking (e.g., rust stains on the tubesheet cladding) as part of the Steam Generator Program. In lieu of using the one-time Inspection AMP, the applicant may provide a rationale for why use of the one-time inspection AMP is not necessary.

The existing programs rely on control of reactor water chemistry to mitigate cracking due to PWSCC and visual inspections of the steam generator head interior surfaces. Along with the Water Chemistry and Steam Generator AMPs, the One-Time Inspection AMP should be evaluated to confirm the effectiveness of the Water Chemistry and Steam Generators AMPs in certain circumstances. The One-Time Inspection AMP should include an inspection that is capable of detecting cracking to confirm the absence of PWSCC in the tube-to-tubesheet welds. In place of the one-time inspection AMP, the applicant may provide a rationale to justify why the one-time inspection AMP is not necessary.

3.1.2.2.12 Cracking Due to Irradiation-Assisted Stress Corrosion Cracking

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3.1.2.2.13 Loss of Fracture Toughness Due to Neutron Irradiation or Thermal Aging Embrittlement

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3.1.2.2.14 Loss of Preload Due to Thermal or Irradiation-Enhanced Stress Relaxation

The GALL-SLR Report AMP XI.M9 manages loss of preload due to thermal or irradiation-enhanced stress relaxation in BWR core plate rim hold-down bolts. The issue is applicable to BWR designed light-water reactors that employ rim hold-down bolts as the means for protecting the reactor's core plate from the consequences of lateral movement. The potential for such movement, if left unmanaged, could impact the ability of the reactor to be brought to a safe shutdown condition during an anticipated transient occurrence or during a postulated design basis accident or seismic event. This issue is not applicable to BWR reactor designs that use wedges as the means of precluding lateral movement of the core plate because the wedges are fixed in place and are not subject to this type of aging effect and mechanism combination.

The GALL-SLR Report AMP XI.M9 indicates that the inspections in the BWRVIP TR, “BWR Vessel and Internals Project, BWR Core Plate Inspection and Flaw Evaluation Guidelines (BWRVIP-25),” are used to manage loss of preload due to thermal or irradiation-enhanced stress relaxation in BWR designs with core plate rim hold-down bolts. However, in previous license renewal applications (LRAs), some applicants have identified that the inspection bases for managing loss of preload in BWRVIP-25 may not be capable of gaining access to the rim hold-down bolts or are not sufficient to detect loss of preload on the components. For applicants that have identified this issue in their past LRAs, the applicants either committed to modifying the plant design to install wedges in the core plate designs or to submit an inspection plan, with a supporting core plate rim hold-down bolt preload analysis for NRC approval at least 2 years prior to entering into the initial period of extended operation for the facility.

If an existing NRC-approved analysis for the bolts exists in the CLB and conforms to the definition of a TLAA, the applicant should identify the analysis as a TLAA for the SLRA and demonstrate how the analysis is acceptable in accordance with either 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878). Otherwise, if a new analysis will be performed to support an updated augmented inspection basis for the bolts for the subsequent period of extended operation, the NRC staff recommends that a license renewal commitment be placed in the FSAR Supplement for the applicant to submit both the inspection plan and the supporting loss of preload analysis to the NRC staff for approval at least 2 years prior to entering into the subsequent period of extended operation for the facility. If loss of preload in the bolts is managed with an AMP that correlates to GALL-SLR Report AMP XI.M9, the inspection basis in the applicable BWRVIP report is reviewed for continued validity, or else augmented as appropriate.

3.1.2.2.15 Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to Stress Corrosion Cracking

Loss of material due to general (steel only), crevice, or pitting corrosion and cracking due to SCC (SS only) can occur in steel and SS piping and piping components exposed to concrete. Concrete provides a highly alkaline environment that can mitigate the effects of loss of material for steel piping, thereby significantly reducing the corrosion rate. However, if water intrudes through the concrete, the pH can be reduced and ions that promote loss of material such as chlorides, which can penetrate the protective oxide layer created in the high alkalinity environment, can reach the surface of the metal. Carbonation can reduce the pH within concrete. The rate of carbonation is reduced by using concrete with a low water-to-cement ratio and low permeability. Concrete with low permeability also reduces the potential for the penetration of water. Adequate air entrainment improves the ability of the concrete to resist freezing and thawing cycles and therefore reduces the potential for cracking and intrusion of water. Cracking due to SCC, as well as pitting and crevice corrosion can occur due to halides present in the water that penetrate the surface of the metal.

If the following conditions are met, loss of material is not considered to be an applicable aging effect for steel: (i) attributes of the concrete are consistent with American Concrete Institute (ACI) 318 or ACI 349 (low water to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG–1557; (ii) plant-specific OE indicates no degradation of the concrete that could lead to penetration of water to the metal surface; and (iii) the piping is not potentially exposed to groundwater. For SS components loss of material and cracking due to SCC are not considered to be applicable aging effects as long as the piping is not potentially exposed to groundwater. Where these conditions are not met, loss of material due to general (steel only), crevice or pitting corrosion and cracking due to SCC (SS only) are identified as applicable aging effects. GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” describes an acceptable program to manage these aging effects.

3.1.2.2.16 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and Nickel Alloys

Loss of material due to pitting and crevice corrosion could occur in indoor or outdoor SS and nickel-alloy piping, piping components, and tanks exposed to any air, condensation, or underground environment when the component is: (i) uninsulated; (ii) insulated; (iii) in the vicinity of insulated components; or (iv) in the vicinity of potentially transportable halogens. Loss of material due to pitting and crevice corrosion can occur on SS and nickel alloys in environments containing sufficient halides (e.g., chlorides) in the presence of moisture.

Insulated SS and nickel-alloy components exposed to air, condensation, or underground environments are susceptible to loss of material due to pitting or crevice corrosion if the insulation contains certain contaminants. Leakage of fluids through mechanical connections such as bolted flanges and valve packing can result in contaminants leaching onto the component surface or the surfaces of other components below the component. For outdoor insulated SS and nickel-alloy components, rain and changing weather conditions can result in moisture intrusion into the insulation.

Plant-specific OE and the condition of SS and nickel-alloy components are evaluated to determine if prolonged exposure to the plant-specific environments has resulted in pitting or crevice corrosion. Loss of material due to pitting and crevice corrosion is not an aging effect that requires management for SS and nickel-alloy components if: (i) plant-specific OE does not reveal a history of loss of material due to pitting or crevice corrosion and (ii) a one-time inspection demonstrates that the aging effect is not occurring or is occurring so slowly that it will not affect the intended function of the components during the subsequent period of extended operation. The applicant documents the results of the plant-specific OE review in the SLRA.

In the environment of air-indoor controlled, pitting and crevice corrosion is only expected to occur in the presence of a source of moisture and halides. Inspections focus on the most susceptible locations.

The GALL-SLR Report recommends further evaluation of SS and nickel-alloy piping and piping components exposed to an air, condensation, or underground environment to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion. GALL-SLR Report AMP XI.M32, “One-Time Inspection,” describes an acceptable program to demonstrate that loss of material due to pitting and crevice corrosion is not occurring at a rate that will affect the intended function of the components. If loss of material due to pitting or crevice corrosion has occurred and is sufficient to potentially affect the intended function of an systems, structures, and components (SSC), GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” describes an acceptable program to manage loss of material due to pitting or crevice corrosion. The timing of the one-time or periodic inspections is consistent with that recommended in the AMP selected by the applicant during the development of the SLRA. For example, one-time inspections would be conducted between the 50th and 60th year of operation, as recommended by the “Detection of Aging Effects” program element in AMP XI.M32.

The applicant may mitigate or prevent the loss of material due to pitting and crevice corrosion through the use of a barrier coating to isolate the component from aggressive environments. However, the applicant should identify loss of material as applicable for SLR and identify the AMP that will be used to manage the integrity of the coating. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and air that contain halides. GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” describes an acceptable program to manage the integrity of a barrier coating for internal or external coatings.

3.1.2.2.17 Cracking Due to Thermal Fatigue

As addressed in NRC Bulletin 88-08, non-isolable branch lines connected to the reactor coolant system may be subject to unacceptable thermal stress that can cause thermal fatigue cracking and leakage failure (Ref. 44). The NRC Bulletin 88-08 states that, when such piping is identified, actions should be taken to ensure that the piping will not be subject to unacceptable thermal stress.

Industry OE and evaluation indicate that in some branch lines, thermal stratification or mixing cycles can occur due to the interaction between the hot swirl penetration from the reactor coolant system and the cold water in-leakage from a leaking valve (Ref. 45 - 49). In other branch lines, thermal stratification or mixing cycles can result from the interaction of the hot swirl penetration and the cold water in the normally cool, stagnant branch lines without a leaking valve. In addition, cold or hot fluid injections can cause thermal fatigue in the reactor coolant system as indicated in ASME Code Case N-716-1 (Ref. 50). Therefore, cracking due to thermal fatigue can occur due to cyclic stresses from the thermal stratification, mixing or injection cycles.

The industry guidance to manage the thermal fatigue in the PWR branch lines is described in EPRI MRP-146, Revision 2 (Ref. 48). The guidance provides methods for screening and evaluating the susceptibility of non-isolable branch lines to thermal fatigue. The MRP-146, Revision 2 also provides general guidance for monitoring valve in-leakage and thermal stress as needed and performing volumetric examinations on the susceptible locations (e.g., examination areas, volumes, and frequencies). These guidelines continue to be enhanced based on the lessons learned from relevant OE and research activities. The BWRVIP-155, Revision 1 also describes the evaluation of thermal fatigue susceptibility in the branch lines of BWR reactor coolant pressure boundary (Ref. 49).

In addition, the existing aging management at plants may rely on the risk-informed ISI that includes examination of the reactor coolant pressure boundary locations susceptible to thermal fatigue.

As discussed above, cracking due to thermal fatigue can occur in the reactor coolant system. The applicant should perform further evaluation to confirm the adequacy of a plant-specific AMP for management of the aging effect (e.g., adequate selection of susceptible locations for inspections, timely detection of cracks, and preventive action for valve in-leakage as needed). The applicant may use the acceptance criteria, which are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR), to demonstrate the adequacy of a plant-specific AMP.

3.1.2.2.18 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in BTP Inspection Quality Materials Branch (IQMB)-1 (Appendix Section A.2 of this SRP-SLR).

3.1.2.2.19 Ongoing Review of Operating Experience

Acceptance criteria are described in Appendix Section A.4, “Operating Experience for Aging Management Programs.”

3.1.2.3 Aging Management Review Results Not Consistent With or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report

Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

3.1.2.4 Aging Management Programs

For those AMPs that will be used for aging management and are based on the program elements of an AMP in the GALL-SLR Report, the NRC reviewer performs an audit of AMPs credited in the SLRA to confirm consistency with the GALL-SLR Report AMPs identified in Sections X, “Aging Management Programs That May Be Used to Demonstrate Acceptability of Time-Limited Aging Analyses in Accordance With Under 10 CFR 54.21(c) (1)(iii) (TN4878)” and XI, “Aging Management Programs.”

If the applicant identifies an exception to any of the program elements of the cited GALL-SLR Report AMP, the SLRA AMP should include a basis demonstrating how the criteria of 10 CFR 54.21(a)(3) would still be met. The reviewer should then confirm that the SLRA AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the SLRA AMP, the reviewer identifies a difference between the SLRA AMP and the GALL-SLR Report AMP that should have been identified as an exception to the GALL-SLR Report AMP, the difference should be reviewed and dispositioned appropriately. The reviewer should document the disposition of all SLRA-defined exceptions and NRC staff-identified differences.

The SLRA should identify any enhancements that are needed to permit an existing licensee AMP to be declared consistent with the GALL-SLR Report AMP to which the licensee AMP is compared. The reviewer is to confirm that the enhancement, when implemented, would allow the existing licensee AMP to be consistent with the GALL-SLR Report AMP and that the applicant has a commitment in the FSAR Supplement to implement the enhancement prior to the subsequent period of extended operation. The reviewer should document the disposition of all enhancements.

If the applicant chooses to use a plant-specific program that is not a GALL-SLR Report AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

3.1.2.5 Final Safety Analysis Report Supplement

The programs and activities for managing the effects of aging for the subsequent period of extended operation described in the FSAR Supplement should be sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59 (TN249). The description should contain information associated with the bases for determining that aging effects will be managed during the subsequent period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the subsequent period of extended operation. Table X-01 and Table XI-01 of the GALL-SLR Report provide examples of the type of information to be included in the FSAR Supplement. Table 3.1-2 lists the programs that are applicable for this SRP-SLR section.

3.1.3 Review Procedures

For each area of review, the following review procedures are to be followed.

3.1.3.1 Aging Management Review Results Consistent With the Generic Aging Lessons Learned for Subsequent License Renewal Report

The applicant may reference the GALL-SLR Report in its SLRA, as appropriate, and demonstrate that the AMRs and AMPs at its facility are consistent with those reviewed and approved in the GALL-SLR Report. The reviewer should not conduct a re-review of the substance of the matters described in the GALL-SLR Report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL-SLR Report, the reviewer should find acceptable the applicant's reference to the GALL-SLR Report in its SLRA. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms that the applicable aging effects have been addressed based on the staff's review of industry and plant-specific OE.

Furthermore, the reviewer should confirm that the applicant has addressed OE identified after the issuance of the GALL-SLR Report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the reactor vessel, internals, and reactor coolant system components that are contained in the GALL-SLR Report as applicable to its plant.

3.1.3.2 Aging Management Review Results for which Further Evaluation is Recommended by the Generic Aging Lessons Learned for Subsequent License Renewal Report

The basic review procedures defined in Section 3.1.3.1 need to be applied first for all of the AMRs and AMPs provided in this section. In addition, if the GALL-SLR Report AMR item to which the SLRA AMR item is compared identifies that "Further Evaluation Recommended," then additional criteria apply for each of the following aging effect/aging mechanism combinations.

3.1.3.2.1 Cumulative Fatigue Damage

Evaluations involving time-dependent fatigue or cyclical loading parameters may be TLAAs, as defined in 10 CFR 54.3 (TN4878). The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1).

The staff reviews the information on a case-by-case basis consistent with the review procedures in SRP-SLR Section 4.3 to determine whether the applicant has provided a sufficient basis for dispositioning the TLAAs in accordance with the acceptance criteria in 10 CFR 54.21(c)(1)(i), (ii), or (iii). This includes staff's review of those cumulative usage factor analyses that qualify as TLAAs and are based on plant-specific, methods utilized for stress-based calculations.Loss of Material Due to General, Pitting, and Crevice Corrosion

1. An augmented program is recommended for the management of loss of material due to general, pitting, and crevice corrosion for steel PWR SG shell assembly exposed to secondary feedwater and steam. The existing program relies on control of water chemistry to mitigate corrosion and ISI to detect loss of material. The extent and schedule of the existing SG 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 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. Therefore, an augmented inspection is recommended to manage this aging effect. Furthermore, 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 BTP RLSB-1 (Appendix

Section A.1 of this SRP-SLR). Loss of material due to general, pitting, and crevice corrosion could also occur for the steel top head enclosure (without cladding) top head nozzles (vent, top head spray or reactor core isolation cooling, and spare) exposed to the reactor coolant. The existing program relies on control of reactor water chemistry to mitigate corrosion. However, control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the Water Chemistry Program should be verified to ensure that corrosion is not occurring. The reviewer verifies on a case-by-case basis that the applicant has proposed a program that will manage loss of material due to general, pitting and crevice corrosion by providing enhanced inspection and supplemental methods to detect loss of material to ascertain that the component-intended function will be maintained during the subsequent period of extended operation.

2. Further evaluation of programs is recommended to manage the loss of material due to general, pitting, and crevice corrosion for the new transition cone closure weld generated in the steel PWR replacement recirculating steam generator transition cone shell exposed to secondary feedwater and steam. The existing program relies on control of reactor water chemistry to mitigate corrosion and on ISI to detect loss of material. The reviewer verifies on a case-by-case basis that the applicant has proposed an augmented program that will manage loss of material due to general, pitting, and crevice corrosion and ascertain that the component-intended function will be maintained during the subsequent period of extended operation.

   The reviewer verifies that the applicant has described the surface condition and the resultant flow near the new transition cone closure weld (e.g., weld crown, ground flush, etc.) and how these parameters could affect the susceptibility of this weld to this aging effect, relative to that of the upper and lower transition welds. Based on this information, the reviewer verifies whether any additional aging management of the new transition weld is necessary. If additional aging management is necessary, the reviewer verifies whether the applicant has described an AMP of the new transition cone closure weld (including examination frequency and technique) that will be effective in managing an aging effect, such as the loss of material due to general, pitting, and crevice corrosion during the subsequent period of extended operation for the new transition cone closure weld.

3.1.3.2.2 Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement

1. Neutron irradiation embrittlement is a TLAA as defined in 10 CFR 54.3 (TN4878). The TLAAs are required to be evaluated in accordance with 10 CFR 54.21I(1). The NRC staff reviews the evaluation of this TLAA following the guidance in Section 4.2 of this SRP-SLR.

2. Neutron irradiation embrittlement is a TLAA as defined in 10 CFR 54.3. The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The NRC staff reviews the evaluation of this TLAA following the guidance in Section 4.2 of this SRP-SLR. Further evaluation for a RV materials surveillance program is recommended for the subsequent period of extended operation to monitor neutron embrittlement of the reactor vessel. The RV surveillance program is either a plant-specific surveillance program or an integrated surveillance program, depending on matters such as the composition of limiting materials, availability of surveillance. A neutron fluence monitoring program is used to monitor the neutron fluence levels that are used as the time-dependent inputs for those RV neutron irradiation embrittlement TLAAs that are the subject of the topics in SRP-SLR Section 3.1.2.2.3, Section 1, and SRP-SLR Section 4.2.

In accordance with 10 CFR Part 50 (TN249), Appendix H, an applicant must submit its proposed capsule withdrawal schedule for approval prior to implementation. Untested capsules placed in storage must be maintained for future insertion. Thus, further NRC staff evaluation is required for SLR. The reviewer verifies on a case-by-case basis that the applicant has proposed an adequate RV materials surveillance program for the subsequent period of extended operation. The reviewer also verifies on a case-by-case basis whether the applicant has proposed an acceptable neutron fluence monitoring AMP for the subsequent period of extended operation. Specific recommendations for acceptable AMPs are provided in GALL-SLR Report AMP XI.M31, "Reactor Vessel Surveillance," for RV material surveillance programs and GALL-SLR Report AMP X.M2, "Neutron Fluence Monitoring," for neutron fluence monitoring programs.

3. Reduction in Fracture Toughness for B&W reactor internals is a TLAA as defined in 10 CFR 54.3. The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The NRC staff reviews the evaluation of this TLAA following the guidance in Section 4.7 of this SRP-SLR, consistent with the action item documented in the NRC staff's safety evaluation for B&W Owners Group report number BAW-2248, which is included in BAW-2248A of March 2000.

3.1.3.2.3 Cracking Due to Stress Corrosion Cracking and Intergranular Stress Corrosion Cracking

1. Cracking due to SCC and IGSCC could occur in 3.1-17or3.1-17icSS and nickel-alloy RV flange leak detection lines of BWR light-water reactor facilities. The reviewer independently verifies the sufficiency of the applicant's evaluation of plant-specific OE. If the review of plant-specific OE reveals that SCC and IGSCC is not applicable, the reviewer verifies that GALL-SLR Report AMP XI.M32, "One-Time Inspection," is cited for all applicable AMR line items. If the review of plant-specific OE reveals that SCC or IGSCC is applicable, the reviewer verifies that GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," is cited for all applicable AMR line items. The reviewer should make sure that the inspection method proposed for the inspection of the components is capable of providing indications of cracking prior to a loss of intended function in the lines.

2. An augmented program is recommended to include temperature and radioactivity monitoring of the shell-side water and eddy current testing of tubes for the management of cracking due to SCC and IGSCC of the SS BWR isolation condenser components. The existing program relies on control of reactor water chemistry to mitigate SCC and IGSCC and on ASME Code Section XI ISI to detect leakage. However, the existing program should be augmented to detect cracking due to SCC and IGSCC. The reviewer reviews the applicant's proposed program on a case-by-case basis to make sure that an adequate program will be in place for the management of these aging effects.

3.1.3.2.4 Crack Growth Due to Cyclic Loading

Further assessment of evaluations or analyses in the CLB to manage crack growth due to cyclic loading in RPV shell forgings clad with SS using a high-heat-input welding process is recommended. Specifically, the CLB may include flaw growth evaluations of intergranular separations (i.e., underclad cracks) that have been identified in the RPV to cladding welds for the vessel. The evaluations apply to SA 508 Class 2 RPV forging components where the cladding was deposited and welded to the vessel using a high-heat-input welding process. The CLBs that include these types of evaluations may need to be identified as TLAAs if they are determined to conform to the six criteria for defining TLAAs in 10 CFR 54.3(a) (TN4878). The methodology for evaluating the underclad flaw should be consistent with the current well established flaw evaluation procedure and criterion in the ASME Code Section XI. The SRP-SLR, Section 4.7 provides generic guidance for meeting the requirements of 10 CFR 54.21(c). The NRC staff reviews the evaluation of this TLAA separately following the guidance in Section 4.7 of this SRP-SLR.

3.1.3.2.5 Cracking Due to Stress Corrosion Cracking

1. ’Reserved

2. ’Cracking due to SCC could occur in SS or nickel-alloy RV flange leak detection lines of PWR light-water reactor facilities. The reviewer independently verifies the sufficiency of the applicant’s evaluation of plant-specific OE. If the review of plant-specific OE reveals that SCC is not applicable, the reviewer verifies that GALL-SLR Report AMP XI.M32, “One-Time Inspection,” is cited for all applicable AMR line items. If the review of plant-specific OE reveals that SCC is applicable, the reviewer verifies that GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” is cited for all applicable AMR line items. The reviewer should make sure that the inspection method proposed for the inspection of the components is capable of providing indications of cracking prior to a loss of intended function in the lines.

3.1.3.2.6 Cracking Due to Cyclic Loading

An augmented program for the management of cracking due to cyclic loading in steel and SS BWR isolation condenser components is recommended. The existing program relies on ASME Code Section XI ISI for detection. However, the inspection requirements should be augmented to detect cracking due to cyclic loading. An augmented program to include temperature and radioactivity monitoring of the shell-side water and eddy current testing of tubes is recommended to make sure that the component’s intended function will be maintained during the subsequent period of extended operation. The reviewer verifies on a case-by-case basis that the applicant has proposed an augmented program that will detect cracking and make sure that the component-intended function will be maintained during the subsequent period of extended operation.

3.1.3.2.7 Loss of Material Due to Erosion

Further evaluation of a plant-specific AMP is recommended for the management of loss of material due to erosion of steel steam generator feedwater impingement plates and supports exposed to secondary feedwater. The reviewer reviews the applicant’s proposed program on a case-by-case basis to make sure that an adequate program will be in place for the management of these aging effects.

3.1.3.2.8 Aging Management of PWR Reactor Vessel Internals (Applicable to Subsequent License Renewal Periods Only)

The EPRI TR No. 3002017168, “Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227, Revision 1-A)” (ADAMS Accession No. ML20175A112), provides the industry’s updated aging management recommendations for the RVI components that are included in the design of a PWR facility, based on an analysis of plant operation for 60 years. The review procedures in this section are based on the staff’s assumption that a PWR SLR applicant’s PWR vessel internals AMP will be based on the I&E guidelines in MRP-227, Revision 1-A P for the AMP that will be applied and implemented during the subsequent period of extended operation. The rationale for this assumption is based on the MRP-defined “Needed Requirement” in Section 7.3 of MRP-227, Revision 1-A, which states that the update of an MRP-based program “shall be implemented by January 1, 2022.”

In MRP-227, Revision 1-A, the EPRI MRP identified that the following aging mechanisms may be applicable to the design of the RVI components in these types of facilities: (i) SCC, (ii) IASCC, (iii) fatigue, (iv) wear, (v) neutron irradiation embrittlement, (vi) thermal aging embrittlement, (vii) void swelling and irradiation growth or distortion, or (viii) thermal or irradiation-enhanced stress relaxation or irradiation-enhanced creep. The staff-approved MRP-227, Revision 1-A in a safety evaluation dated April 25, 2019 (ADAMS Accession No. ML19081A001). In that safety evaluation, the staff resolved and closed all A/LAIs that had been based on the previous version of the I&E guidelines (i.e., those in the MRP-227, Revision 1-A report), however the staff identified a new A/LAI.

The assessments of RVI components in MRP-227, Revision 1-A, and the MRP-defined background reports for MRP-227, Revision 1-A have not been updated based on an assessment of aging effects over an 80-year period of operation.

If a plant-specific AMP is proposed for the RVI components, the reviewer evaluates the adequacy of the applicant’s AMP on a case-by-case basis against the criteria for plant-specific AMP program elements defined in Sections A.1.2.3.1 through A.1.2.3.10 of SRP-SLR Appendix Section A.1. The reviewer verifies that the applicant has defined both the type of performance monitoring, condition monitoring, preventative monitoring, or mitigative monitoring activities that will be used for aging management of the RVI components and the specific program element criteria for the AMP that will be used to manage age-related effects in the RVI components during the subsequent period of extended operation.

If a PWR applicant for SLR proposes to use GALL-SLR Report AMP XI.M16A, “PWR Vessel Internals,” as the basis for aging management, the staff reviews the program elements of the AMP against the program element criteria defined in AMP XI.M16A. The staff verifies that the applicant has addressed the relevancy of the A/LAI for MRP-227, Revision 1-A in the “Operating Experience” program element of the AMP, or in the applicant’s technical basis document or procedure for the AMP. The staff also verifies that the proposed program includes a gap analysis that provides the identification and justification of:

- Components that screen in for additional aging effects or mechanisms when assessed for aging through the end of the subsequent period of extended operation.
- Components that previously screened in for an aging effect or mechanism and the severity of that aging effect or mechanism could significantly increase during the subsequent period of extended operation.
- Changes to the existing MRP-227, Revision 1-A program characteristics or criteria, including but not limited to changes in inspection categories, inspection criteria, or primary-to-expansion component criteria and relationships
- If a gap analysis is needed to establish the appropriate aging management criteria for the RVI components, the staff evaluates the adequacy and justification of the gap analysis in the safety evaluation report (SER) for the SLRA. Specifically, the staff’s review should focus on the following aspects of the gap analysiIhe gap analysis methodoI;
- the components that screened in for additional aging effects or mechanisms when assessed for aging through the end of the subsequent period of extended oItion;

- the components for which a previously screened in aging effect or mechanism has been identified as potentially more severe during the subsequent period of extended operation;
- the components whose AMP inspection categories have changed from those previously identified for the components in MRP-227, Revision 1-A; and
- proposed changes to the AMP characteristics or criteria as identified in the SLRA.

For those RVI components that screened in for additional aging effects or mechanisms, or that are subject to site-specific or component-specific changes in the EPRI MRP's I&E protocols for the components, the staff also confirms that the applicant has included and justified appropriate AMR line items for the components. The applicant may use the updated version of GALL-SLR Report Item IV.B2.R-423, IV.B3.R-423, or IV.B4.R-423, to address any RVI component for which the EPRI MRP I&E protocols for managing cracking or specific cracking mechanisms in the component are being updated or adjusted on a site-specific or component-specific basis. The applicant may use the updated revision of GALL-SLR Report Items IV.B2.R-424, IV.B3.R-424, or IV.B4.R-424 to address any RVI component for which the EPRI MRP I&E protocols for managing non-cracking effects or mechanisms in the component are being updated or adjusted on a site-specific or component-specific basis.

Otherwise, an applicant may use an NRC-approved generic report such as an approved revision of MRP-227 that considers a period of operation of 80 years. In this case, the staff reviews any responses to action items on the aging management methods that may be identified in the NRC approval of the generic report.

3.1.3.2.9 Loss of Material Due to Wear

1. Loss of material due to wear can occur in PWR CRD head penetration nozzles due to the interactions between the nozzle and the thermal sleeve centering pads of the nozzle. The applicant should perform a further evaluation to confirm the adequacy of a plant-specific AMP or analysis (with any necessary inspections) for management of the aging effect. The reviewer confirms that the applicant's plant-specific AMP for managing this aging effect meets the acceptance criteria that are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR). Alternatively, the reviewer confirms that loss of material due to wear does not affect the intended function(s) of CRD head penetration nozzles, consistent with the CLB, if the applicant relies on an analysis for aging management. The reviewer also confirms the necessity of inspections to ascertain the adequacy of the analysis.
2. Loss of material due to wear can occur in the thermal sleeves of PWR CRD head penetration nozzles due to the thermal sleeve interactions with the adjacent components (e.g., CRD head penetration nozzle, drive rod, and penetration housing). The applicant should perform a further evaluation to confirm the adequacy of a plant-specific AMP for management of the aging effect. The reviewer confirms that the applicant's plant-specific AMP for managing this aging effect meets the acceptance criteria that are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).
3. Industry OE indicates that significant loss of material due to wear can occur in ASME Code Class 1, small-bore piping. For example, loss of material can occur in the presence of reflective metals insulation, and flow-induced vibrations of ASME Code Class 1 small-bore piping. This type of wear is difficult to identify unless the insulation is removed and the OD of the piping is visually examined for wear marks (Ref. 38). This type of wear is called OD pipe wear, and in some instances can be potentially near 360 around the OD of the subject pipe and could significantly reduce the load bearing capacity of the subject pipe. Therefore, the

applicant should perform a further evaluation to confirm the absence of the specific aging effect. If moderate or no degradation is evident however, it is determined that the insulation has the potential to cause wear, the applicant may choose to mitigate the loss of material due to wear or alternatively use an existing program for management of the aging effect. The applicant may use the acceptance criteria, which are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR), to demonstrate the adequacy of a plant-specific AMP. The reviewer should make sure that the applicant has verified through inspections that OD pipe wear is not an applicable aging effect that needs to be monitored or provide a periodic inspection program so that significant OD loss of material is detected prior to loss of intended function.

3.1.3.2.10 Cracking Due to Primary Water Stress Corrosion Cracking

1. Use of the one-time inspection AMP should be evaluated, along with the primary Water Chemistry and Steam Generator AMPs, to manage cracking due to PWSCC in nickel-alloy divider plate assemblies. For divider plate assemblies fabricated of Alloy 690 and Alloy 690 type welding materials, the One-Time Inspection AMP is not necessary. For divider plate assemblies made of Alloy 600 or Alloy 600 type welding materials, the reviewer verifies that the applicant has an adequate basis for concluding that the analyses performed by the industry (EPRI 3002002850) assessing the significance of divider plate cracking are applicable and bounding for the conditions at its unit. If the industry's analyses are not bounding, the reviewer evaluates the applicant's use of the one-time inspection AMP on a case-by-case basis to make sure it is adequate for the management of this aging effect or the reviewer reviews the applicant's rationale (e.g., a more detailed plant-specific evaluation than performed by the industry) for why use of the one-time inspection AMP is not necessary.
2. Use of a One-Time Inspection AMP should be evaluated, along with the primary Water Chemistry and Steam Generator AMPs, to manage cracking due to PWSCC in nickel-alloy steam generator tube-to-tubesheet welds exposed to reactor coolant. The reviewer verifies the combination of materials of construction of the steam generator tubes and tubesheet cladding and the classification of the tube-to-tubesheet weld (i.e., whether it is part of the reactor coolant pressure boundary). If the combination and classification require use of the one-time inspection AMP, the reviewer reviews the applicant's proposed program on a case-by-case basis to ensure adequate management of this aging effect. Alternatively, the reviewer evaluates the applicant's rationale for why use of the one-time inspection AMP is not necessary.

3.1.3.2.11 Cracking Due to Irradiation-Assisted Stress Corrosion Cracking

AMP "" '' Deleted.

3.1.3.2.12 Loss of Fracture Toughness Due to Neutron Irradiation or Thermal Aging Embrittlement

AMP '' Deleted.

3.1.3.2.13 Loss of Preload Due to Thermal or Irradiation-Enhanced Stress Relaxation

The GALL-SLR Report AMP XI.M9 of the GALL-SLR Report, "BWR Vessel Internals," manages loss of preload due to thermal or irradiation-enhanced stress relaxation in BWR core plate rim hold-down bolts. The issue is applicable to BWR light-water reactors that employ rim hold-down bolts as the means for protecting the reactor’s core plate from the consequences of lateral movement. The potential for such movement, if left unmanaged, could impact the ability of the reactor to be brought into a safe shutdown condition during an anticipated transient occurrence or during a postulated design basis accident or seismic event. This issue is not applicable to BWR reactor designs that use wedges as the means of precluding lateral movement of the core plate because the wedges are fixed in place and are not subject to this type of aging effect and mechanism combination.

The GALL-SLR Report AMP XI.M9 indicates that the inspections in BWRVIP TR, “BWR Vessel and Internals Project, BWR Core Plate Inspection and Flaw Evaluation Guidelines (BWRVIP-25),” is used to manage loss of preload due to thermal or irradiation-enhanced stress relaxation in BWR designs with core plate rim hold-down bolts. However, in initial LRAs, some applicants have identified that the inspection bases for managing loss of preload in BWRVIP-25 may not be capable of gaining access to the rim hold-down bolts or are not sufficient to detect loss of preload on the components. For applicants that have identified this issue in their past LRAs, the applicants have committed to modifying the plant design to install wedges in the core plate designs or to submitting an inspection plan, with a supporting core plate rim hold-down bolt preload analysis for NRC approval at least 2 years prior to entering the subsequent period of extended operation for the facility.

For SLRAs that apply to BWRs with core plate rim hold-down bolts, the reviewer assesses whether the SLRA has included an enhanced augmented inspection basis for plants’ core plate rim hold-down bolts as applicable, and has justified the augmented inspection basis that will be applied to the components, as appropriate. If an existing NRC-approved analysis for the bolts exists in the CLB and conforms to the definition of a TLAA, the reviewer assesses whether the applicant has identified the analysis as a TLAA for the SLRA and has demonstrated why the analysis is acceptable in accordance with eitheI0 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878). Otherwise, if a new analysis will be performed to support an updated 80-year augmented inspection basis for the bolts for the subsequent period of extended operation, the NRC staff reviews the applicant’s augmented inspection and evaluation basis to determine whether the FSAR Supplement for the SLRA has included a license commitment to submit both the inspection plan and the supporting loss of preload analysis to the NRC staff at least 2 years prior to entering into the subsequent period of extended operation for the facility.

3.1.3.2.14 Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to Stress Corrosion Cracking

For steel piping and piping components exposed to concrete, if the following conditions are met, loss of material is not considered to be an applicable aging effect for steel: (i) 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; (ii) plant-specific OE indicates no degradation of the concrete that could lead to penetration of water to the metal surface; and (iii) the piping is not potentially exposed to groundwater. For SS piping and piping components, loss of material and cracking due to SCC are not considered to be applicable aging effects as long as the piping is not potentially exposed to groundwater. Where these conditions are not met, loss of material due to general (steel only), crevice, or pitting corrosion, and cracking due to SCC (SS only) are identified as applicable aging effects. The GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” describes an acceptable program to manage these aging effects.

The reviewer verifies that the concrete was specified to meet ACI 318 or ACI 349 (low water-to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG–1557. The reviewer should evaluate plant-specific OE to determine whether concrete degradation sufficient to allow water intrusion has occurred.

3.1.3.2.15 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and Nickel Alloys

The GALL-SLR Report recommends further evaluation to manage loss of material due to pitting and crevice corrosion of SS and nickel-alloy piping and piping components exposed to any air, condensation, or underground environment when the component is: (i) uninsulated; (ii) insulated; (iii) in the vicinity of insulated components where sufficient halides (e.g., chlorides) and moisture may be present; or (iv) in the vicinity of potentially transportable halogens.

The reviewer independently verifies the sufficiency of the applicant's evaluation of plant-specific OE. If the review of plant-specific OE reveals loss of material due to pitting or crevice corrosion in SS and nickel alloys, the reviewer determines whether an adequate program is credited to manage the aging effect. If there is no related plant-specific OE, the reviewer verifies that AMP XI.M32, "One-Time Inspection," is cited for all applicable AMR line items.

An applicant may refine its OE search, and subsequent one-time inspections, by binning plant-specific environments into subcategories. For example, the applicant could categorize the indoor air locations as those where leakage could impinge on the SS component's surface (e.g., leakage from mechanical connections) and those where there is no potential for leakage. When the applicant chooses to conduct its OE search in this manner, the reviewer is to also confirm that the applicant has adequately addressed the potential for the periodic introduction of either moisture or halides from secondary sources. Secondary sources of moisture or halides should be considered for all environments including indoor conditioned air. Typical secondary sources of moisture or halides include: (i) Wleakage from mechanical connections; (ii) leakage into vaults; and (iii) insulation containing halides. Grouping of environments consistent with that described in the detection of aging effects program element of GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," is appropriate.

If the applicant uses a barrier coating to mitigate or prevent the loss of material due to pitting and crevice corrosion, the reviewer verifies that the loss of coating integrity is being managed for the associated components with a program equivalent to the GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks."

3.1.3.2.16 Cracking Due to Thermal Fatigue

Cracking due to thermal fatigue can occur in the reactor coolant system. The applicant should perform further evaluation to confirm the adequacy of a plant-specific AMP for management of the aging effect. The reviewer confirms that the applicant's plant-specific AMP for managing this aging effect meets the acceptance criteria that are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR). The reviewer also confirms that the plant-specific OE supports the adequacy of the program (e.g., adequate selection of susceptible locations for inspections, timely detection of cracks, and preventive action for valve in-leakage as needed).

3.1.3.2.17 Quality Assurance for Aging Management of Nonsafety-Related Components

The applicant’s AMPs for SLR should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered in 10 CFR Part 50 (TN249), Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an AMR for SLR. Nevertheless, the applicant has the option to expand the scope of its 10 CFR Part 50, Appendix B program to include these components and address the associated program elements. If the applicant chooses this option, the reviewer verifies that the applicant has documented such a commitment in the FSAR Supplement. If the applicant chooses alternative means, the branch responsible for quality assurance (QA) should be requested to review the applicant’s proposal on a case-by-case basis.

3.1.3.2.18 Ongoing Review of Operating Experience

The applicant’s AMPs should contain the element of OE. The reviewer verifies that the applicant has appropriate programs or processes for the ongoing review of both plant-specific and industry OE concerning age-related degradation and aging management. Such reviews are used to make sure that the AMPs are effective in managing the aging effects for which they are created. The AMPs are either enhanced or new AMPs are developed, as appropriate, when it is determined through the evaluation of the OE that the effects of aging may not be adequately managed. Additional information is available in Appendix Section A.4, “Operating Experience for Aging Management Programs.”

In addition, the reviewer confirms that the applicant has provided an appropriate summary description of these activities in the FSAR Supplement.

3.1.3.3 Aging Managing Review Results Not C3.1-24 orstent with or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report

The reviewer should confirm that the applicant, in its SLRA, has identified applicable aging effects, listed the appropriate combination of materials and environments, and AMPs that will adequately manage the aging effects. The AMP credited by the applicant could be an AMP that is described and evaluated in the GALL-SLR Report or a plant-specific program. The review procedures are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.1.3.4 Aging Management Programs

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR Report AMP. If the applicant identifies in the SLRA AMP an exception to any of the program elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3) (TN4878). If the reviewer identifies a difference, between the SLRA AMP and the GALL-SLR Report AMP not identified by the SLRA, with which the SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions, or differences. The AMPs evaluated in the GALL-SLR Report pertinent to the RV, RVI, and reactor coolant system are summarized in Table 3.1-1 of this SRP-SLR. The “GALL-SLR Item” column identifies the AMR item numbers in the GALL-SLR Report, Chapter IV, presenting detailed information summarized by this row.

3.1.3.5 Final Safety Analysis Report Supplement

The reviewer confirms that the applicant has provided in its FSAR Supplement information equivalent to that provided in GALL-SLR Table X-01 and Table XI-01 for aging management of the reactor vessel, internals, and reactor coolant system. Table 3.1-2 lists the AMPs that are applicable for this SRP-SLR Section. The reviewer also confirms that the applicant has provided information equivalent to that in GALL-SLR Table X-01 and Ta3.1-25or3.1-25icant3.1-25 and Section 3.1.3.3 of this SRP-SLR, “Aging Management Review Results Not Consistent with or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report.”

The NRC staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursualto 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR Supplement before the license is renewed, no condition will be necessary.

An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to make sure that the applicant will complete these activities no later than the committed date.

3.1.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of this section, then an evaluation finding similar to the following text should be included in the NRC staff’s SER:

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has demonstrated that the aging effects associated with the reactor vessel, internals, and reactor coolant system components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the subsequent period of extended operation, as required by 10 CFR 54.21(a)(3) (TN4878).
>
> The NRC staff also reviewed the applicable FSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the reactor vessel, internals and reactor coolant system, as required by 10 CFR 54.21(d).

3.1.5 Implementation

Except for cases in which the applicant proposes an alternative method for complying with specified portions of NRC regulations, the NRC staff members follow the methods described herein in their evaluation of conformance with NRC regulations. The staff evaluates these alternatives and finds them acceptable if the staff determines that the alternatives provide reasonable assurance that the component’s intended functions will be maintained.

3.1.6 References

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Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	001	Boiling water reactor (BWR) / pressure water reactor (PWR)	Steel reactor vessel (RV) closure flange assembly components exposed to air-indoor uncontrolled	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, Standard Review Plan for Review of Subsequent License Renewal (SRP-SLR) Section 4.3 ""Metal Fatigue""	Yes (SRP-SLR Section 3.1.2.2.1)	IV.A1.RP-201 IV.A2.RP-54
	002	PWR	Nickel-alloy tubes and sleeves exposed to reactor coolant, secondary feedwater/steam	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 "Metal F"atigue"""	Yes (SRP-SLR Section 3.1.2.2.1)	IV.D1.R-46 IV.D2.R-46
	003	BWR/PWR	Stainless steel (SS), nickel alloy reactor vessel internal (RVI) components exposed to reactor coolant, neutron flux	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 "Metal F"atigue"""	Yes (SRP-SLR Section 3.1.2.2.1)	IV.B1.R-53 IV.B2.RP-303 IV.B3.RP-339 IV.B4.R-53
	004	BWR/PWR	Steel pressure vessel support skirt and attachment welds	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 "Metal F"atigue"""	Yes (SRP-SLR Section 3.1.2.2.1)	IV.A1.R-70 IV.A2.R-70

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
3.1-31 or 3.1-31ic BWR		SS, steel (with or without nickel 3.1-31 or 3.1-31ic or SS cladding), nickel alloy reactor coolant pressure boundary components: piping, piping components; other pressure retaining components exposed to reactor coolant	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 “Metal F”atigue”“”	Yes (SRP-SLR Section 3.1.2.2.1)	IV.C1.R-220	
3.1-31 or 3.1-31ic BWR		SS, steel (with or without nickel 3.1-31 o r3.1-31ic or SS cladding), nickel-alloy RV components: nozzles, penetrations, safe ends, thermal sleeves, vessel shells, heads and welds exposed to reactor coolant	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 “Metal Fatigue”“”“”	Yes (SRP-SLR Section 3.1.2.2.1)	IV.A1.R-04	

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
3.1-32 or 3.1-32ic PWR	SS, steel (with or without nickel 3.1-32 or 3.1-32ic or SS cladding), nickel-alloy steam generator components exposed to reactor coolant	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 “Metal Fatigue”“”“”	Yes (SRP-SLR Section 3.1.2.2.1)	IV.D1.R-221 IV.D2.R-222		
3.1-32 o r3.1-32ic PWR	SS, steel (with or without nickel 3.1-32or3.1-32ic or SS cladding), nickel-alloy reactor coolant pressure boundary piping, piping components, other pressure retaining components exposed to reactor coolant	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 “Metal Fatigue”“”“”	Yes (SRP-SLR Section 3.1.2.2.1)	IV.C2.R-223		
E	010	PWR	Steel (with or without nickel 3.1-32 or 3.1-32ic or SS 3.1-32or3.1-32icg), SS, or nickel-alloy	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 “Metal Fatigue”“”“”	Yes (SRP-SLR Section 3.1.2.2.1)	IV.A2.R-219

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			RV components: nozzles, penetrations, pressure housings, safe ends; thermal sleeves, vessel shells, heads and welds exposed to reactor coolant				
E	011	BWR/PWR3.1-33 or 3.1-33ic or SS pump and valve closure bolting exposed to high temperatures and thermal cycles	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 “Metal Fatigue”“”“”	Yes (SRP-SLR Section 3.1.2.2.1)	IV.C1.RP-44 IV.C2.RP-44	
	012	PWR	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, crevice corrosion	AMP XI.M1, ““ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,”“ and AMP XI.M2, ““Water Chemistry”“	Yes (SRP-SLR Sections 3.1.2.2.2.1 and 3.1.2.2.2.2)	IV.D1.RP-368

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	013	BWR/PWR	Steel (with 3.1-34 or 3.1-34icout ss or nickel-alloy cladding) reactor vessel beltline shell, nozzle, and weld components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA, SRP-SLR Section **Error! Unknown switch argument.** “Reactor Pressure Vessel” neutron Embrittlement”	Yes (SRP-SLR Section 3.1.2.2.3.1)	IV.A1.R-62 IV.A2.R-84
	014	BWR/PWR	Steel (with or without cladding) reactor vessel beltline shell, nozzle, and weld components, exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	AMP XI.M31, ““Reactor Vessel Material Surveillance,”“ and AMP X.M2, ““Neutron Fluence Monitoring”“	Yes (SRP-SLR Section 3.1.2.2.3.2)	IV.A1.RP-227 IV.A2.RP-229
3.1-34 or 3.1-34ic BWR	SS isolation condenser components exposed to reactor coolant	Cracking due to SCC, irradiation-assisted stress corrosion cracking (IGSCC)	AMP XI.M1, ““ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,”“ and AMP XI.M2, ““Water Chemistry”“	Yes (SRP-SLR Section 3.1.2.2.4.2)	IV.C1.R-15		

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	018	PWR	RV shell fabricated of SA508-Cl 2 forgings clad with SS using a high-heat-input welding process exposed to reactor coolant	Crack growth due to cyclic loading	TLAA, SRP-SLR Section 4.7 ""Other Plant-Specific TLAAs""	Yes (SRP-SLR Section 3.1.2.2.5)	IV.A2.R-85
M	019	PWR	SS RV bottom-mounted instrument guide tubes (external to RV) exposed to reactor coolant	Cracking due to stress corrosion cracking (SCC)	AMP XI.M1, ""ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,"" and AMP XI.M2, ""Water Chemistry""	No	IV.A2.RP-154
M	020	PWR	cast austenitic stainless steel (CASS) Class 1 piping, piping components exposed to reactor coolant	Cracking due to SCC	AMP XI.M1, ""ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,"" and AMP XI.M2,"""Water Chemist"y"""""""	No	IV.C2.R-05
	021	BWR3.1-35or 3.1-35ic and SS	Cracking due to cyclic loading	AMP XI.M1, ""ASME Section XI	Yes (SRP-SLR Section 3.1.2.2.7)	IV.C1.R-225	

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
		isolation condenser components exposed to reactor coolant		Inservice Inspection, Subsections IWB, IWC, and IWD”“			
	022	PWR	Steel steam generator (SG) feedwater impingement plate and support exposed to secondary feedwater	Loss of material due to erosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.8)	IV.D1.R-39
M	025	PWR	Steel (with nickel-alloy cladding) or nickel-alloy SG (primary side components: divider plate and tube-to-tube sheet welds exposed to reactor coolant	Cracking due to primary water SCC	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M19, ““Steam Generator s.”“ In addition, use of the One-Time Inspection AMP is to be evaluated	Yes (SRP-SLR Sections 3.1.2.2.11.1 and 3.1.2.2.11.2)	IV.D1.RP-367 IV.D1.RP-385 IV.D2.RP-185
M	028	PWR	Westinghouse-specific ““Existing Programs”“ co3.1-36 or 3.1-36ics: SS, nickel-alloy, and X-	Loss of material due to wear; cracking due to SCC, irradiation-assisted stress	AMP XI.M16A, ““PWR Vessel Internals,”“ and AMP XI.M2, ““Water Chemistry”“ (for	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-355 (if AMP XI.M16A is credited for aging management) IV.E.R-444 (if

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			750 control rod guide tube support pins (split pins) exposed to reactor coolant and neutron flux	corrosion cracking (IASCC), fatigue	SCC mechanisms only)		components are defined as ASME Section XI category components and the XI.M1 inservice inspection AMP is credited for aging management) IV.B2.RP-265 (if components can be placed in the “No Additional Measures” category)
M	029	BWR	Nickel-alloy core shroud and core plate access hole cover (welded covers) exposed to reactor coolant	Cracking due to SCC, IGSCC, IASCC	AMP XI.M9, ““BWR Vessel Internals,”“ and AMP XI.M2, ““Water Chemistry”“	No	IV.B1.R-94
	030	BWR	3.1-37teels, nickel-alloy penetration: drain line exposed to reactor coolant	Cracking due to SCC, IGSCC, cyclic loading	AMP XI.M1, ““ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,”“ and AMP XI.M2,	No	IV.A1.RP-371

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					““Water Chemistry”“ (SCC, IGSCC mechanisms only)		
	031	BWR	Steel and 3.1-38teels isolation condenser components exposed to reactor coolant	Loss of material due to general (steel only), pitting, crevice corrosion, wear	AMP XI.M1, ““ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,”“ and AMP XI.M2, ““Water Chemistry”“	No	IV.C1.RP-39
D	032			”	““””“		
	033	PWR	3.1-38teels, steel with 3.1-38teels cladding Class 1 reactor coolant pressure boundary components exposed to reactor coolant	Cracking due to SCC	AMP XI.M1, ““ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,”“ and AMP XI.M2, ““Water Chemistry”“	No	IV.C2.R-09 IV.C2.R-217 IV.C2.RP-344 IV.D1.RP-232
E	034	PWR	3.1-38teels, steel with 3.1-38teels cladding pressurizer relief	Cracking due to SCC	AMP XI.M1, ““ASME Section XI Inservice Inspection,	No	IV.C2.RP-231

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			tank (tank shell and heads, flanges, nozzles) exposed to treated borated water >60 °C (>140 °F)		Subsections IWB, IWC, and IWD,"" and AMP XI.M2, ""Water Chemistry""		
	035	PWR	3.1-39teels, steel with 3.1-39teels 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	AMP XI.M1, ""ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD""	No	IV.C2.R-56
	036	PWR	Steel, 3.1-39teels pressurizer integral support exposed to any environment	Cracking due to cyclic loading	AMP XI.M1, ""ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD""	No	IV.C2.R-19
	037	PWR	Steel reactor vessel flange	Loss of material due to wear	AMP XI.M1, ""ASME Section XI Inservice Inspection,	No	IV.A2.R-87

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					Subsections IWB, IWC, and IWD""		
	038	BWR/PWR	CASS Class 1 valve bodies and bonnets exposed to reactor coolant >250 °C (>482 °F)	Loss of fracture toughness due to thermal aging embrittlement	AMP XI.M1, ""ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD""	No	IV.C1.R-08 IV.C2.R-08
E	039	BWR/PWR	3.1-40teels, steel (with or without nickel-alloy or 3.1-40teels cladding), nickel-alloy Class 1 piping, fittings and branch connections <nominal pipe size (NPS) 4 exposed to reactor coolant	Cracking due to SCC (for SS or nickel-alloy surfaces exposed to reactor coolant only), IGSCC (for stainless steel or nickel-alloy surfaces exposed to reactor coolant only), or thermal, mechanical, or vibratory loading	AMP XI.M1, ""ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,"" AMP XI.M2, ""Water Chemistry,"" and XI.M35, ""ASME Code Class 1 Small-Bore Piping""	No	IV.C1.RP-230 IV.C2.RP-235
	040	PWR	Steel with 3.1-40teels or nickel-alloy cladding, or SS pressurizer components	Cracking due to cyclic loading	AMP XI.M1, ""ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD""	No	IV.C2.R-58

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			exposed to reactor coolant				
	040a	PWR	Nickel-alloy core support pads, core guide lugs exposed to reactor coolant	Cracking due to primary water SCC	AMP XI.M1, ““ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,”“ and AMP XI.M2, ““Water Chemistry” “	No	IV.A2.RP-57
M	041	BWR	Nickel-alloy core shroud and core plate access hole cover (mechanical covers) exposed to reactor coolant	Cracking due to SCC, IGSCC, IASCC	AMP XI.M9, ““BWR Vessel Internals,”“ and AMP XI.M2, ““Water Chemistry” “	No	IV.B1.R-95
	042	PWR	Steel with 3.1-41teels or nickel-alloy cladding, 3.1-41teels primary side components, SG upper and lower heads, and tubesheet welds pressurizer	Cracking due to SCC, primary water SCC	AMP XI.M1, ““ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,”“ and AMP XI.M2, ““Water Chemistry” “	No	IV.C2.R-25 IV.D2.RP-47

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			components exposed to reactor coolant				
	043	BWR	3.1-42teels and nickel-alloy RVI exposed to reactor coolant	Loss of material due to pitting, crevice corrosion	AMP XI.M1, ""ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,"" and AMP XI.M2, ""Water Chemistry" "	No	IV.B1.RP-26
	044	PWR	Steel SG secondary manway and handhole cover seating surfaces exposed to treated water, steam	Loss of material due to erosion	AMP XI.M1, ""ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD""	No	IV.D1.R-31 IV.D2.R-31
E	045	PWR	Nickel-alloy, steel with nickel-alloy cladding reactor coolant pressure boundary components exposed to reactor coolant	Cracking due to primary water SCC	AMP XI.M1, ""ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD,"" and AMP XI.M2, ""Water Chemistry,	No	IV.A2.R-90 IV.A2.RP-186 IV.A2.RP-59 IV.C2.RP-156 IV.C2.RP-159 IV.C2.RP-37 IV.D1.RP-36 IV.D2.RP-36

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					”“ and, for nickel-alloy, AMP XI.M11B, ““Cracking of Nickel-Alloy Components and Loss of Material due to Boric Acid-Induced Corrosion in reactor coolant pressure boundary (RCPB) Components (PWRs Only)”“		
E	046	PWR	3.1-43teels, nickel-alloy control rod drive head penetration pressure housings, RV nozzles, nozzle safe ends and welds exposed to reactor coolant	Cracking due to SCC, primary water SCC	AMP XI.M1, ““ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD,” “and AMP XI.M2, ““Water Chemistry, ”“ and, for nickel-alloy, AMP XI.M11B, ““Cracking of Nickel-Alloy Components and	No	IV.A2.RP-234

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					Loss of Material due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)""		
	047	PWR	3.1-44teels, nickel-alloy control rod drive head penetration pressure housing exposed to reactor coolant	Cracking due to SCC, primary water SCC	AMP XI.M1, ""ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD,"" and AMP XI.M2, ""Water Chemistry" "	No	IV.A2.RP-55
E	048	PWR	Steel external surfaces: RV top head, RV 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	AMP XI.M10, ""Boric Acid Corrosion,"" and AMP XI.M11B, ""Cracking of Nickel-Alloy Components and Loss of Material due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)""	No	IV.A2.RP-379 IV.C2.RP-380

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	049	PWR	Steel reactor, vessel, piping, piping components in the reactor coolant pressure boundary of PWRs, and applicable exterior attachments, or steel steam generators in PWRs: external surfaces or closure bolting exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, ““Boric Acid Corrosion”“	No	IV.A2.R-17 IV.C2.R-17 IV.C2.RP-167 IV.D1.R-17 IV.D2.R-17
	050	BWR/PWR	CASS Class 1 piping, piping components (including pump casings and control rod drive pressure housings) exposed to reactor coolant >250 °F (>482 °C)	Loss of fracture toughness due to thermal aging embrittlement	AMP XI.M12, ““Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)”“	No	IV.A2.R-77 IV.C1.R-52 IV.C2.R-52
M	051a	PWR	SS, nickel-alloy Babcock and Wilcox (B&W)	Cracking due to SCC, IASCC, fatigue	AMP XI.M16A, ““PWR Vessel Internals,”“ and	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B4.RP-241 IV.B4.RP-241a IV.B4.RP-242a

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			reactor internal ““Primary”“ components exposed to reactor coolant, neutron flux		AMP XI.M2, ““Water Chemistry”“ (for SCC mechanisms only)		IV.B4.RP-247 IV.B4.RP-247a IV.B4.RP-248 IV.B4.RP-248a IV.B4.RP-252c IV.B4.RP-256 IV.B4.RP-256a IV.B4.RP-261
M	051b	PWR	3.1-46teels, nickel-alloy B&W reactor internal ““Expansion”“ components exposed to reactor coolant, neutron flux	Cracking due to SCC, IASCC, fatigue, overload	AMP XI.M16A, ““PWR Vessel Internals,”“ and AMP XI.M2, ““Water Chemistry”“ (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B4.RP-244 IV.B4.RP-245 IV.B4.RP-245a IV.B4.RP-246 IV.B4.RP-246a IV.B4.RP-246c IV.B4.RP-246d IV.B4.RP-260a IV.B4.RP-262 IV.B4.RP-352
M	052a	PWR	3.1-46teels, nickel-alloy Combustion Engineering (CE) reactor internal ““Primary”“ components exposed to reactor coolant, neutron flux	Cracking due to SCC, IASCC, fatigue	AMP XI.M16A, ““PWR Vessel Internals,”“ and AMP XI.M2, ““Water Chemistry”“ (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B3.RP-312 IV.B3.RP-314 IV.B3.RP-322 IV.B3.RP-324 IV.B3.RP-327 IV.B3.RP-328 IV.B3.RP-338 IV.B3.RP-342

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							IV.B3.RP-343 IV.B3.RP-358 IV.B3.RP-362a
M	052b	PWR	3.1-47teels, nickel-alloy CE reactor internal ““Expansion”“ components exposed to reactor coolant, neutron flux	Cracking due to SCC, IASCC, fatigue	AMP XI.M16A, ““PWR Vessel Internals,”“ and AMP XI.M2, ““Water Chemistry”“ (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B3.RP-313 IV.B3.RP-316 IV.B3.RP-323 IV.B3.RP-325 IV.B3.RP-329 IV.B3.RP-330 IV.B3.RP-333 IV.B3.RP-335 IV.B3.RP-362c IV.B3.RP-363
M	052c	PWR	SS, nickel-alloy CE reactor internal ““Existing Programs”“ components exposed to reactor coolant, neutron flux	Cracking due to SCC, IASCC, fatigue	AMP XI.M16A, ““PWR Vessel Internals,”“ and AMP XI.M2, ““Water Chemistry”“ (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B3.RP-320 IV.B3.RP-320a IV.B3.RP-334
M	053a	PWR	3.1-47teels, nickel-alloy Westinghouse reactor internal ““Primary”“ components exposed to reactor	Cracking due to SCC, IASCC, fatigue	AMP XI.M16A, ““PWR Vessel Internals,”“ and AMP XI.M2, ““Water Chemistry”	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-270a IV.B2.RP-271 IV.B2.RP-275 IV.B2.RP-276 IV.B2.RP-296a IV.B2.RP-298

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			coolant, neutron flux		“ (for SCC mechanisms only)		IV.B2.RP-302 IV.B2.RP-387
M	053b	PWR	3.1-48teels Westinghouse reactor internal ““Expansion”“ components exposed to reactor coolant and neutron flux	Cracking due to SCC, IASCC, fatigue	AMP XI.M16A, ““PWR Vessel Internals,”“ and AMP XI.M2, ““Water Chemistry”“ (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-273 IV.B2.RP-280 IV.B2.RP-286 IV.B2.RP-291 IV.B2.RP-291a IV.B2.RP-291b IV.B2.RP-293 IV.B2.RP-294 IV.B2.RP-298a IV.B2.RP-387a
M	053c	PWR	3.1-48teels, nickel-alloy, or stellite Westinghouse reactor internal ““Existing Programs”“ components exposed to reactor coolant, neutron flux	Cracking due to SCC, IASCC, fatigue	AMP XI.M16A, ““PWR Vessel Internals,”“ and AMP XI.M2, ““Water Chemistry”“ (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-289 IV.B2.RP-301 IV.B2.RP-345a IV.B2.RP-346 IV.B2.RP-399
M	054	PWR	3.1-48teels Westinghouse-design bottom-mounted instrument system	Loss of material due to wear	AMP XI.M37, ““Flux Thimble Tube Inspection”“	No	IV.B2.RP-284

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			flux thimble tubes (with or without chrome plating) exposed to reactor coolant and neutron flux				
	055a	PWR	3.1-49teels, nickel alloy B&W reactor internal ""No Additional Measures"" components exposed to reactor coolant, neutron flux	No additional aging management for reactor internal ""No Additional Measures"" components unless required by ASME Section XI, Examination Category B-N-3 or relevant operating experience exists	AMP XI.M16A, ""PWR Vessel Internals""	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B4.RP-236
	055b	PWR	3.1-49teels, nickel-alloy CE reactor internal ""No Additional Measures"" components exposed to reactor coolant, neutron flux	No additional aging management for reactor internal ""No Additional Measures"" components unless required by ASME Section XI, Examination Category B-N-3 or	AMP XI.M16A, ""PWR Vessel Internals""	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B3.RP-306

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
				relevant operating experience exists			
	055c	PWR	3.1-50teels, nickel-alloy Westinghouse reactor internal ""No Additional Measures"" components exposed to reactor coolant, neutron flux	No additional aging management for reactor internal ""No Additional Measures"" components unless required by ASME Section XI, Examination Category B-N-3 or relevant operating experience exists	AMP XI.M16A, ""PWR Vessel Internals""	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-265
M	056a	PWR	SS, including CASS, precipitation-hardening (PH) SS or martensitic SS or nickel-alloy CE reactor internal ""Primary"" components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement, changes in dimensions due to void swelling, distortion, loss of preload due to	AMP XI.M16A, ""PWR Vessel Internals""	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B3.RP-315 IV.B3.RP-318 IV.B3.RP-326 IV.B3.RP-338a IV.B3.RP-359 IV.B3.RP-360 IV.B3.RP-362 IV.B3.RP-365 IV.B3.RP-366

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
				thermal and irradiation-enhanced stress relaxation or creep, loss of material due to wear			
M	056b	PWR	SS, including CASS, PH SS or martensitic SS CE ““Expansion”“ reactor internal components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement, changes in dimensions due to void swelling, distortion, loss of preload due to thermal and irradiation-enhanced stress relaxation or creep, loss of material due to wear	AMP XI.M16A, ““PWR Vessel Internals”“	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B3.RP-317 IV.B3.RP-331 IV.B3.RP-333a IV.B3.RP-359a IV.B3.RP-361 IV.B3.RP-362b IV.B3.RP-364 IV.B3.R-455

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
M	056c	PWR	SS, including CASS, PH SS or martensitic SS or nickel-alloy CE reactor internal ““Existing Programs”“ components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement, changes in dimensions due to void swelling, distortion, loss of preload due to thermal and irradiation-enhanced stress relaxation or creep, loss of material due to wear	AMP XI.M16A, ““PWR Vessel Internals”“	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B3.RP-319 IV.B3.RP-332 IV.B3.RP-336 IV.B3.RP-357
M	058a	PWR	SS, including CASS, PH SS or martensitic SS, nickel-alloy B&W reactor internal ““Primary”“ components exposed to reactor	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging	AMP XI.M16A, ““PWR Vessel Internals”“	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B4.RP-240 IV.B4.RP-240a IV.B4.RP-242 IV.B4.RP-247b IV.B4.RP-247c IV.B4.RP-248b IV.B4.RP-249 IV.B4.RP-251

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			coolant and neutron flux	embrittlement, or changes in dimensions due to void swelling or distortion, or loss of preload due to wear; or loss of material due to wear			IV.B4.RP-251a IV.B4.RP-252 IV.B4.RP-252b IV.B4.RP-256b IV.B4.RP-258 IV.B4.RP-259
M	058b	PWR	SS, including CASS, PH SS or martensitic SS, nickel-alloy B&W reactor internal ““Expansion”“ components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement, or changes in dimensions due to void swelling, or distortion, or loss of preload due to thermal and irradiation-enhanced stress relaxation or creep,	AMP XI.M16A, ““PWR Vessel Internals”“	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B4.RP-243 IV.B4.RP-243a IV.B4.RP-245b IV.B4.RP-245c IV.B4.RP-246b IV.B4.RP-246e IV.B4.RP-250 IV.B4.RP-252a IV.B4.RP-260 iv.B4.RP-386

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
				or loss of material due to wear			
	059a	PWR	SS, including CASS, PH SS or martensitic SS or nickel-alloy Westinghouse reactor internal ““Primary”“ components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement, changes in dimensions due to void swelling, distortion, loss of preload due to thermal and irradiation-enhanced stress relaxation or creep, loss of material due to wear	AMP XI.M16A, ““PWR Vessel Internals”“	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-270 IV.B2.RP-272 IV.B2.RP-296 IV.B2.RP-297 IV.B2.RP-302a IV.B2.RP-354 IV.B2.RP-388 IV.B2.RP-300
M	059b	PWR	SS, including CASS, PH SS or martensitic SS Westinghouse reactor internal ““Expansion”“	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and	AMP XI.M16A, ““PWR Vessel Internals”“	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-274 IV.B2.RP-280a IV.B2.RP-287 IV.B2.RP-290 IV.B2.RP-290a IV.B2.RP-290b

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			components exposed to reactor coolant and neutron flux	PH SS due to thermal aging embrittlement; changes in dimensions due to void swelling, distortion; loss of preload due to thermal and irradiation-enhanced stress relaxation or creep; loss of material due to wear			IV.B2.RP-292 IV.B2.RP-295 IV.B2.RP-297a IV.B2.RP-388a
M	059c	PWR	SS, including CASS, PH SS or martensitic SS, nickel-alloy, or stellite Westinghouse reactor internal ““Existing Programs”“ components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement, changes in dimensions due to void swelling, distortion, loss of preload due to	AMP XI.M16A, ““PWR Vessel Internals”“	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-285 IV.B2.RP-288 IV.B2.RP-299 IV.B2.RP-345

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
				thermal and irradiation-enhanced stress relaxation or creep, loss of material due to wear			
	060	BWR	Steel piping, piping components exposed to reactor coolant	Wall thinning due to flow-accelerated corrosion	AMP XI.M17, ““Flow-Accelerated Corrosion”“	No	IV.C1.R-23
	061	PWR	Steel SG steam nozzle and safe end, feedwater nozzle and safe end, auxiliary feedwater nozzles and safe ends exposed to secondary feedwater/steam	Wall thinning due to flow-accelerated corrosion	AMP XI.M17, ““Flow-Accelerated Corrosion”“	No	IV.D1.R-37 IV.D2.R-38
	062	BWR/PWR	High-strength steel, 3.1-56teels closure bolting; SS control rod drive head penetration flange bolting exposed to	Cracking due to SCC	AMP XI.M18, ““Bolting Integrity”“	No	IV.A2.R-78 IV.C1.R-11 IV.C2.R-11 IV.D1.R-10 IV.D2.R-10

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			air-indoor uncontrolled				
	063	BWR	Steel or 3.1-57teels closure bolting exposed to air – indoor uncontrolled	Loss of material due to general (steel only), pitting, crevice corrosion, wear	AMP XI.M18, ““Bolting Integrity”“	No	IV.C1.RP-42
	064	PWR	Steel or 3.1-57teels closure bolting exposed to air – indoor uncontrolled	Loss of material due to general (steel only), pitting, crevice corrosion, wear	AMP XI.M18, ““Bolting Integrity”“	No	IV.C2.RP-166 IV.D1.RP-166 IV.D2.RP-166
	065	PWR	3.1-57teels control rod drive head penetration flange bolting exposed to air-indoor uncontrolled	Loss of material due to wear	AMP XI.M18, ““Bolting Integrity”“	No	IV.A2.R-79
	066	PWR	Steel, 3.1-57teels closure bolting; 3.1-57teels control rod drive head penetration flange bolting exposed to air-indoor uncontrolled	Loss of preload due to thermal effects, gasket creep, self-loosening	AMP XI.M18, ““Bolting Integrity”“	No	IV.A2.R-80 IV.C2.R-12

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	067	BWR/PWR	Steel or 3.1-58teels closure bolting exposed to air – indoor uncontrolled (external)	Loss of preload due to thermal effects, gasket creep, self-loosening	AMP XI.M18, ““Bolting Integrity”“	No	IV.C1.RP-43 IV.D1.RP-46 IV.D2.RP-46
	068	PWR	Nickel-alloy SG tubes exposed to secondary feedwater or steam	Changes in dimension (““denting”“) due to corrosion of carbon steel tube support plate	AMP XI.M19, ““Steam Generators,”“ and AMP XI.M2, ““Water Chemistry”“	No	IV.D1.R-43 IV.D2.R-226
	069	PWR	Nickel-alloy SG tubes and sleeves exposed to secondary feedwater or steam	Cracking due to outer diameter SCC, intergranular attack	AMP XI.M19, ““Steam Generators,”“ and AMP XI.M2, ““Water Chemistry”“	No	IV.D1.R-47 IV.D2.R-47
	070	PWR	Nickel-alloy SG tubes, repair sleeves, and tube plugs exposed to reactor coolant	Cracking due to primary water SCC	AMP XI.M19, ““Steam Generators,”“ and AMP XI.M2, ““Water Chemistry” “	No	IV.D1.R-40 IV.D1.R-44 IV.D2.R-40 IV.D2.R-44
	071	PWR	Steel, chrome plated steel, 3.1-58teels, nickel-alloy SG U-bend	Cracking due to SCC or other mechanism(s); loss of material due	AMP XI.M19, ““Steam Generators,”“ and AMP XI.M2,	No	IV.D1.RP-226 IV.D1.RP-384

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			supports including anti- vibration bars exposed to secondary feedwater or steam	general (steel only), pitting, crevice corrosion	""Water Chemistry" "		
	072	PWR	Steel SG tube support plate, tube bundle wrapper, supports and mounting hardware exposed to secondary feedwater or steam	Loss of material due to general, pitting, crevice corrosion, erosion, ligament cracking due to corrosion	AMP XI.M19, ""Steam Generators,"" and AMP XI.M2, ""Water Chemistry"" (corrosion based aging effects and mechanisms only)	No	IV.D1.R-42 IV.D1.RP-161 IV.D2.R-42 IV.D2.RP-162
	073	PWR	Nickel-alloy SG tubes and sleeves exposed to phosphate chemistry in secondary feedwater or steam	Loss of material due to wastage, pitting corrosion	AMP XI.M19, ""Steam Generators,"" and AMP XI.M2, ""Water Chemistry""	No	IV.D1.R-50
	074	PWR	Steel SG upper assembly and separators including feedwater inlet ring and support exposed to	Wall thinning due to flow-accelerated corrosion	AMP XI.M19, ""Steam Generators,"" and AMP XI.M2, ""Water Chemistry""	No	IV.D1.RP-49

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			secondary feedwater or steam				
	075	PWR	Steel SG tube support lattice bars exposed to secondary feedwater or steam	Wall thinning due to flow-accelerated corrosion, general corrosion	AMP XI.M19, ““Steam Generators,”“ and AMP XI.M2, ““Water Chemistry”“	No	IV.D1.RP-48
	076	PWR	Steel, chrome plated steel, 3.1-60teels, nickel-alloy steam generator U-bend supports including anti-vibration bars exposed to secondary feedwater or steam	Loss of material due to wear, fretting	AMP XI.M19, ““Steam Generators”“	No	IV.D1.RP-225
	077	PWR	Nickel-alloy SG tubes and sleeves exposed to secondary feedwater or steam	Loss of material due to wear, fretting	AMP XI.M19, ““Steam Generators”“	No	IV.D1.RP-233 IV.D2.RP-233
	078	PWR	Nickel-alloy SG components such as, secondary side nozzles (vent,	Cracking due to SCC	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32,	No	IV.D2.R-36

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			drain, and instrumentation) exposed to secondary feedwater or steam		““One-Time Inspection,”“ or AMP XI.M1, ““ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD.”“		
	079	BWR	3.1-61teels; steel with nickel-alloy or 3.1-61teels cladding; and nickel-alloy reactor coolant pressure boundary components exposed to reactor coolant	Loss of material due to pitting, crevice corrosion	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	IV.C1.RP-158
	080	PWR	3.1-61teels or steel with 3.1-61teels cladding pressurizer relief tank: tank shell and heads, flanges, nozzles (none–ASME Section XI components) exposed to treated	Cracking due to SCC	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	IV.C2.RP-383

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			borated water >60 °C (>140 °F)				
	081	PWR	3.1-62teels pressurizer spray head exposed to reactor coolant	Cracking due to SCC	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	IV.C2.RP-41
	082	PWR	Nickel-alloy pressurizer spray head exposed to reactor coolant	Cracking due to SCC, primary water SCC	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	IV.C2.RP-40
	083	PWR	Steel SG shell assembly exposed to secondary feedwater or steam	Loss of material due to general, pitting, crevice corrosion	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	IV.D1.RP-372 IV.D2.RP-153
	084	BWR	Steel top head enclosure (without cladding): top head, top head nozzles (vent, top head spray, reactor core isolation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	IV.A1.RP-50

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			cooling, spare) exposed to reactor coolant				
	085	BWR	3.1-63teels, nickel-alloy, and steel with nickel-alloy or 3.1-63teels cladding reactor vessel flanges, nozzles, penetrations, safe ends, vessel shells, heads and welds exposed to reactor coolant	Loss of material due to pitting, crevice corrosion	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	IV.A1.RP-157
	086	PWR	3.1-63teels3.1-63 or SG primary side divider plate exposed to reactor coolant	Cracking due to SCC	AMP XI.M2, ““Water Chemistry” “	No	IV.D1.RP-17
	087	PWR	3.1-63teels, nickel-alloy PWR reactor internal components exposed to reactor coolant, neutron flux	Loss of material due to pitting, crevice corrosion	AMP XI.M2, ““Water Chemistry” “	No	IV.B2.RP-24 IV.B3.RP-24 IV.B4.RP-24

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	088	PWR	3.1-64teels; 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, crevice corrosion	AMP XI.M2, ““Water Chemistry” “	No	IV.A2.RP-28 IV.C2.RP-23
E	089	PWR	Steel piping, piping components exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, microbiologically-induced corrosion (MIC)	AMP XI.M21A, ““Closed Treated Water Systems”“	No	IV.C2.RP-221
	090	PWR	Copper alloy piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, ““Closed Treated Water Systems”“	No	IV.C2.RP-222
	091	BWR	Steel (including high-strength steel) RV closure flange assembly components	Cracking due to SCC; loss of material due to general, pitting,	AMP XI.M3, ““Reactor Head Closure Stud Bolting”“	No	IV.A1.RP-165 IV.A1.RP-51

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			(including flanges, nut, studs, and washers) exposed to air-indoor uncontrolled	crevice corrosion, wear			
	092	PWR	Steel (including high-strength steel) RV closure flange assembly components (including flanges, nut, studs, and washers) exposed to air-indoor uncontrolled	Cracking due to SCC, IGSCC; loss of material due to general, pitting, crevice corrosion, wear	AMP XI.M3, ““Reactor Head Closure Stud Bolting”“	No	IV.A2.RP-52 IV.A2.RP-53
	093	PWR	Copper alloy >15% zinc or >8% aluminum piping, piping components exposed to closed-cycle cooling water, treated water	Loss of material due to selective leaching	AMP XI.M33, ““Selective Leaching”“	No	IV.C2.RP-12
	094	BWR	3.1-65teels and nickel-alloy vessel shell attachment	Cracking due to SCC, IGSCC, cyclic loading	AMP XI.M4, ““BWR Vessel ID Attachment Welds,”“ and AMP	No	IV.A1.R-64

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			welds exposed to reactor coolant		XI.M2, ""Water Chemistry"" (SCC, IGSCC mechanisms only)		
	095	BWR	Steel (with or without 3.1-66teels or nickel-alloy cladding) feedwater nozzles exposed to reactor coolant	Cracking due to cyclic loading	AMP XI.M1, ""ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD""	No	IV.A1.R-65
	096	BWR	Steel (with or without 3.1-66teels cladding) control rod drive return line nozzles and their nozzle-to-vessel welds exposed to reactor coolant in BWR-3, BWR-4, BWR-5, and BWR-6 designs	Cracking due to SCC, IGSCC, cyclic loading	AMP XI.M1, ""ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD""	No	IV.A1.R-66
E	097	BWR	3.1-66teels and nickel-alloy piping, piping components ≥4 NPS; nozzle safe ends and	Cracking due to SCC, IGSCC	AMP XI.M7, ""BWR Stress Corrosion Cracking,"" and AMP XI.M2,	No	IV.A1.R-412 IV.C1.R-20 IV.C1.R-21

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			associated welds, control rod drive return line nozzle cap and associated cap-to-nozzle weld or cap-to-safe end weld in BWR-3, BWR 4, BWR 5, and BWR-6 designs		““Water Chemistry” “		
	098	BWR	3.1-67teels, nickel-alloy penetrations: instrumentation and standby liquid control exposed to reactor coolant	Cracking due to SCC, IGSCC, cyclic loading	AMP XI.M8, ““BWR Penetrations,”“ and AMP XI.M2, ““Water Chemistry” “ (SCC, IGSCC mechanisms only)	No	IV.A1.RP-369
M	099	BWR	SS (including CASS; PH martensitic 3.1-67teels; martensitic 3.1-67teels); nickel-alloy (including X-750 alloy) reactor internal components exposed to reactor	Loss of fracture toughness due to thermal aging, neutron irradiation embrittlement	AMP XI.M9, ““BWR Vessel Internals”“	No	IV.B1.RP-182 IV.B1.RP-200 IV.B1.RP-219 IV.B1.RP-220 IV.B1.R-416 IV.B1.R-417 IV.B1.R-419

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			coolant and neutron flux				
	100	BWR	3.1-68teels RVI components (jet pump wedge surface) exposed to reactor coolant	Loss of material due to wear	AMP XI.M9, ““BWR Vessel Internals”“	No	IV.B1.RP-377
	101	BWR	3.1-68teels steam dryers exposed to reactor coolant	Cracking due to flow-induced vibration, SCC, IGSCC; loss of material due to wear	AMP XI.M9, ““BWR Vessel Internals”“	No	IV.B1.RP-155
	102	BWR	3.1-68teels fuel supports and control rod drive assemblies control rod drive housing exposed to reactor coolant	Cracking due to SCC, IGSCC	AMP XI.M9, ““BWR Vessel Internals,”“ and AMP XI.M2, ““Water Chemistry” “	No	IV.B1.R-104
M	103	BWR	3.1-68teels, nickel-alloy reactor internal components exposed to reactor coolant and neutron flux	Cracking due to SCC, IGSCC, IASCC	AMP XI.M9, ““BWR Vessel Internals,”“ and AMP XI.M2, ““Water Chemistry” “	No	IV.B1.R-422 IV.B1.R-100 IV.B1.R-105 IV.B1.R-92 IV.B1.R-93 IV.B1.R-96 IV.B1.R-97

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							IV.B1.R-98 IV.B1.R-99
	104	BWR	Nickel-alloy RVI components exposed to reactor coolant and neutron flux	Cracking due to IGSCC	AMP XI.M9, ““BWR Vessel Internals,”“ and AMP XI.M2, ““Water Chemistry” “	No	IV.B1.RP-381
	105	BWR/PWR	Steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.1.2.2.15)	IV.E.RP-353
	106	BWR/PWR	Nickel-alloy piping, piping components exposed to air with borated water leakage	None	None	No	IV.E.RP-378
	107	BWR/PWR	3.1-69teels piping, piping components exposed to gas, air with borated water leakage	None	None	No	IV.E.RP-05 IV.E.RP-07
	110	BWR	Metallic piping, piping components exposed to reactor coolant	Wall thinning due to erosion	AMP XI.M17, ““Flow-Accelerated Corrosion”“	No	IV.C1.R-406

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	111	PWR	Nickel-alloy SG tubes exposed to secondary feedwater or steam	Reduction of heat transfer due to fouling	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M19, ““Steam Generators”“	No	IV.D1.R-407 IV.D2.R-407
	113	BWR	Steel RV external attachments exposed to indoor, uncontrolled air	Loss of material due to general, pitting, crevice corrosion, wear	AMP XI.M1, ““ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD”“	No	IV.A1.R-409
M	114	BWR/PWR	Reactor coolant system components defined as ASME Section XI Code Class components (ASME Code Class 1 reactor coolant pressure boundary components, RVI attachments, or core support structure components; or ASME Class 2 or 3 components —	Cracking due to SCC, IGSCC, primary water stress corrosion cracking (PWSCC), IASCC (SCC mechanisms for 3.1-70teels, nickel-alloy components only), fatigue, or cyclic loading; loss of material due to general corrosion (steel only), pitting corrosion, crevice corrosion, or wear	AMP XI.M1, ““ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,”“ and AMP XI.M2, ““Water Chemistry”“ (water chemistry-related or corrosion-related aging effect mechanisms only)	No	IV.E.R-444

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			including ASME defined appurtenances, component supports, and associated pressure boundary welds, or components subject to plant-specific equivalent classifications for these ASME Code classes)				
	115	BWR/PWR	3.1-71teels piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.1.2.2.15)	IV.E.RP-06
	116	PWR	Nickel-alloy control rod drive penetration nozzles exposed to reactor coolant	Loss of material due to wear	Plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.10.1)	IV.A2.R-413
	117	PWR	3.1-71teels, nickel-alloy control rod drive penetration nozzle thermal	Loss of material due to wear	Plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.10.2)	IV.A2.R-414

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			sleeves exposed to reactor coolant				
M	118	PWR	3.1-72teels, nickel-alloy PWR RVI components or license renewal applications (LRA)/subsequent license renewal application (SLRA) specified RVI component exposed to reactor coolant, neutron flux	Cracking due to SCC, IASCC, cyclic loading, fatigue	Plant-specific aging management program or AMP XI.M16A, ""PWR Vessel Internals,"" and AMP XI.M2, ""Water Chemistry"" (SCC and IASCC only), with an adjusted site-specific or component-specific aging management basis for a specified RVI component	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.R-423 IV.B3.R-423 IV.B4.R-423
M	119	PWR	3.1-72teels, nickel-alloy, stellite PWR RVI components or LRA/SLRA-specified RVI component exposed to reactor coolant, neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement or thermal aging embrittlement; changes in dimensions due to void swelling or distortion; loss of preload due to	Plant-specific aging management program or AMP XI.M16A, ""PWR Vessel Internals,"" with an adjusted site-specific or component-specific aging management basis for a specified	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.R-424 IV.B3.R-424 IV.B4.R-424

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
				thermal and irradiation-enhanced stress relaxation or creep; loss of material due to wear	reactor vessel internal component		
	120	BWR	3.1-73teels core plate rim holddown bolts exposed to reactor coolant and neutron flux	Loss of preload due to thermal or irradiation-enhanced stress relaxation	AMP XI.M9, ""BWR Vessel Internals,"" and TLAA SRP-SLR 4.7 ""Other Plant-Specific TLAAs"" [if an analysis is performed as part of the aging management basis and conforms to the definition of a TLAA in 10 CFR 54.3(a)]	Yes (SRP-SLR Section 3.1.2.2.14)	IV.B1.R-420
	121	BWR	SS jet pump assembly holddown beam bolts exposed to reactor coolant and neutron flux	Loss of preload due to thermal or irradiation-enhanced stress relaxation	AMP XI.M9, ""BWR Vessel Internals""	No	IV.B1.R-421
D	122						

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	124	BWR/PWR	Steel piping, piping components exposed to air-indoor uncontrolled, air outdoor, condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, ""External Surfaces Monitoring of Mechanical Components""	No	IV.C1.R-431 IV.C2.R-431
	125	PWR	Nickel-alloy SG tubes at support plate locations exposed to secondary feedwater or steam	Cracking due to flow-induced vibration, high-cycle fatigue	AMP XI.M19, ""Steam Generators""	No	IV.D1.R-437 IV.D2.R-442
	127	PWR	Steel (with 3.1-74teels or nickel-alloy cladding) SG heads and tubesheets exposed to reactor coolant	Loss of material due to boric acid corrosion	AMP XI.M2, ""Water Chemistry,"" and AMP XI.M19, ""Steam Generators""	No	IV.D1.R-436 IV.D2.R-440
	128	BWR	3.1-74teels, nickel-alloy nozzles safe ends and welds: high pressure core spray; low pressure core spray;	Cracking due to SCC, IGSCC	AMP XI.M7, ""BWR Stress Corrosion Cracking,"" and AMP XI.M2, ""Water Chemistry""	No	IV.A1.R-68

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			recirculating water, low pressure coolant injection or RHR injection mode exposed to reactor coolant				
	129	BWR	Steel and 3.1-75teels piping, piping components exposed to reactor coolant: welded connections between the re-routed control rod drive return line and the inlet piping system that delivers return line flow to the reactor pressure vessel exposed to reactor coolant	Cracking due to cyclic loading	AMP XI.M1, ""ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD""	No	IV.C1.R-432
D	130						
	133	BWR/PWR	Steel components exposed to treated water	Long-term loss of material due to general corrosion	AMP XI.M32, ""One-Time Inspection""	No	IV.A1.R-448 IV.C1.R-448

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	134	BWR/PWR	Nonmetallic thermal insulation exposed to air, condensation	Reduced thermal insulation resistance due to moisture intrusion	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	No	IV.A1.R-450 IV.A2.R-450 IV.C1.R-450 IV.C2.R-450 IV.D1.R-450 IV.D2.R-450
D	135						
	136	BWR/PWR	3.1-76teels, nickel-alloy piping, piping components exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, ““One-Time Inspection,”“ AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components,”“ AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,”“ or AMP XI.M42, ““Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat	Yes (SRP-SLR Section 3.1.2.2.16)	IV.C1.R-452a IV.C1.R-452b IV.C1.R-452c IV.C1.R-452d IV.C2.R-452a IV.C2.R-452b IV.C2.R-452c IV.C2.R-452d

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					Exchangers, and Tanks”“		
	137	BWR/PWR	Copper alloy piping, piping components exposed to air, condensation, gas	None	None	No	IV.E.R-453
	139	PWR	3.1-77teels, nickel-alloy RV top head enclosure flange leakage detection line exposed to air-indoor uncontrolled, reactor coolant leakage	Cracking due to SCC	AMP XI.M32, ““One-Time Inspection,”“ or AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	Yes (SRP-SLR Section 3.1.2.2.6.3)	IV.A2.R-74a IV.A2.R-74b
N	140	BWR/PWR	Steel, 3.1-77teels or nickel-alloy piping, piping components exposed to reactor coolant	Cracking due to thermal fatigue	Plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.17)	IV.C1.R-456 IV.C2.R-456
N	141	BWR/PWR	Steel, 3.1-77teels or nickel-alloy ASME Code Class 1 small-bore piping, and piping	Loss of material due to wear	Plant-specific or existing aging management program if loss of	Yes (SRP-SLR Section 3.1.2.2.10)	IV.A1.R-457 IV.A2.R-457

Table 3.1-1 Summary of Aging Management Programs for Reactor Vessel, Internals, and Reactor Coolant System Evaluated in Chapter IV of the GALL-SLR Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			components with reflective metal insulation exposed to air		material is not mitigated		

AMP = aging management program; ASME = American Society of Mechanical Engineers; B&W = Babcock and Wilcox; BWR = boiling water reactor; CASS = cast austenitic stainless steel; CE = Combustion Engineering; GALL-SLR = Generic Aging Lessons Learned for Subsequent License Renewal; IASCC = irradiation-assisted SCC; IGSCC = intergranular stress corrosion cracking; LRA = license renewal applications; MIC = microbiologically-induced corrosion; NPS = nominal pipe size; PH = precipitation-hardening; PWR = pressure water reactor; PWSCC = primary water stress corrosion cracking; RCPB = reactor coolant pressure boundary; RV = reactor vessel; RVI = reactor vessel internal; SCC = stress corrosion cracking; SG = steam generator; SLRA = subsequent license renewal application; SRP-SLR = Standard Review Plan for Review of Subsequent License Renewal; SS = stainless steel; TLAA = time-limited aging analyses.

Table 3.1-2 Aging Management Programs and Additional Guidance Appendices Recommended for Aging Management of Reactor Vessel, Internals, and Reactor Coolant System

Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) Chapter/Aging Management Programs (AMP)	Program Name
AMP X.M1	Fatigue Monitoring
AMP X.M2	Neutron Fluence Monitoring
AMP XI.M1	American Society of Mechanical Engineers (ASME) Section XI Inservice Inspection, Subsections IWB, IWC, and IWD
AMP XI.M2	Water Chemistry
AMP XI.M3	Reactor Head Closure Stud Bolting
AMP XI.M4	Boiling Water Reactor (BWR) Vessel ID Attachment Welds
AMP XI.M5	Deleted
AMP XI.M6	Deleted
AMP XI.M7	BWR Stress Corrosion Cracking
AMP XI.M8	BWR Penetrations
AMP XI.M9	BWR Vessel Internals
AMP XI.M10	Boric Acid Corrosion
AMP XI.M11B	Cracking of Nickel-Alloy Components And Loss Of Material Due To Boric Acid-Induced Corrosion In Reactor Coolant Pressure Boundary Components (Pressurized Water Reactor [PWRs] only)
AMP XI.M12	Thermal Aging Of Cast Austenitic Stainless Steel
AMP XI.M16A	PWR Vessel Internals
AMP XI.M17	Flow-Accelerated Corrosion
AMP XI.M18	Bolting Integrity
AMP XI.M19	Steam Generators
AMP XI.M21A	Closed Treated Water Systems
AMP XI.M31	Reactor Vessel Material Surveillance
AMP XI.M32	One-time Inspection
AMP XI.M33	Selective Leaching
AMP XI.M35	ASME Code Class 1 Small-Bore Piping
AMP XI.M36	External Surfaces Monitoring Of Mechanical Components
AMP XI.M37	Flux Thimble Tube Inspection
AMP XI.M38	Inspection of Internal Surfaces In Miscellaneous Piping And Ducting Components
AMP XI.M42	Internal Coatings/Linings For In-Scope Piping, Piping Components, Heat Exchangers, And Tanks
GALL-SLR Report Appendix A	Quality Assurance for AMPs

Table 3.1-2 Aging Management Programs and Additional Guidance Appendices Recommended for Aging Management of Reactor Vessel, Internals, and Reactor Coolant System (Continued)

Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) Chapter/Aging Management Programs (AMP)	Program Name
GALL-SLR Report Appendix B	Operating Experience for AMPs
Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants Appendix Section A.1	AMR—Generic (Branch Technical Position RLSB-1)

AMP = aging management programs; ASME = American Society of Mechanical Engineers; BWR = boiling water reactor; GALL-SLR = Generic Aging Lessons Learned for Subsequent License Renewal; PWR = pressurized water reactor.

3.2 Aging Management of Engineered Safety Features

Review Responsibilities

Primary — The branch(es) assigned responsibility by the PM for the safety review of the SLRA.

Secondary — None

3.2.1 Areas of Review

This section addresses AMR and the associated AMPs of the engineered safety features. For a recent vintage plant, the information related to the engineered safety features is contained in Chapter 6, "Engineered Safety Features," of the plant's FSAR, consistent with the SRP-SLR"" (NRC 2021-TN8013). The engineered safety features contained in this review plan section are generally consistent with those contained in NUREG–0800 except for the refueling water, control room habitability, and residual heat removal systems. For older plants, the location of applicable information is plant-specific because an older plant's FSAR may have predated NUREG–0800.

The engineered safety features consist of containment spray, standby gas treatment (BWR), containment isolation components, and emergency core cooling systems.

The responsible review organization is to review the following SLRA AMR and AMP items assigned to it, per SRP-SLR Section 1.2:

AMRs

- AMR results consistent with the GALL-SLR Report
- AMR results for which further evaluation is recommended
- AMR results not consistent with or not addressed in the GALL-SLR Report

AMPs

- Consistent with the GALL-SLR Report AMPs
- Plant-specific AMPs

FSAR Supplement

- The responsible review organization is to review the FSAR Supplement associated with each assigned AMP.

3.2.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the 'NRC regulations in 10 CFR 54.21.

3.2.2.1 Aging Management Review Results Consistent 3.2-2tee the Generic Aging Lessons Learned for Subsequent License Renewal Report

The AMR and the AMPs applicable to the engineered safety features are described and evaluated in Chapter V of the GALL-SLR Report.

The applicant's SLRA should provide sufficient information so that the NRC reviewer is able to confirm that the specific SLRA AMR item and the associated SLRA AMP are consistent with the cited GALL-SLR Report AMR item. The reviewer should then confirm that the SLRA AMR item is consistent with the GALL-SLR Report AMR item to which it is compared.

When the applicant is crediting a different AMP than recommended in the GALL-SLR Report, the reviewer should confirm that the alternate AMP is valid for aging management and that it will be capable of managing the effects of aging as adequately as the AMP recommended by the GALL-SLR Report.

3.2.2.2 Aging Management Review Results for Which Further Evaluation Is Recommended by the Generic Aging Lessons Learned for Subsequent License Renewal Report

The basic acceptance criteria defined in Section 3.2.2.1 need to be applied first for all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL-SLR Report AMR item to which the SLRA AMR item is compared identifies that "Further Evaluation Recommended," then additional criteria apply as identified by the GALL-SLR Report for each of the following aging effect/aging mechanism combinations. Refer to Table 3.2-1, comparing the "Further Evaluation Recommended" and the "GALL-SLR Item" column, for the AMR items that reference the following sections.

3.2.2.2.1 Cumulative Fatigue Damage

Evaluations involving time-dependent fatigue or cyclical loading parameters may be TLAAs, as defined in 10 CFR 54.3 (TN4878). The TLAAs are required to be evaluated in accordance with 10 CFR 54.21I(1). This TLAA is addressed separately in Section 4.3, "Metal Fatigue," or Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses," of this SRP-SLR. For plant-specific cumulative usage factor calculations that are based on stress-based input methods, the methods are to be appropriately defined and discussed in the applicable TLAAs.

3.2.2.2.2 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and Nickel Alloys

Loss of material due to pitting and crevice corrosion could occur in indoor or outdoor SS and nickel-alloy piping, piping components, and tanks exposed to any air, condensation, or underground environment when the component is: (i) uninsulated; (ii) insulated; (iii) in the vicinity of insulated components; or (iv) in the vicinity of potentially transportable halogens. Loss of material due to pitting and crevice corrosion can occur on SS and nickel alloys in environments containing sufficient halides (e.g., chlorides) in the presence of moisture.

Insulated SS and nickel-alloy components exposed to air, condensation, or underground environments are susceptible to loss of material due to pitting or crevice corrosion if the insulation contains certain contaminants. Leakage of fluids through mechanical connections such as bolted flanges and valve packing can result in contaminants leaching onto the component surface or into the surfaces of other components below the component. For outdoor insulated SS and nickel-alloy components, rain and changing weather conditions can result in moisture intrusion into the insulation.

Plant-specific OE and the condition of SS and nickel-alloy components are evaluated to determine if prolonged exposure to the plant-specific environments has resulted in pitting or crevice corrosion. Loss of material due to pitting and crevice corrosion is not an aging effect that requires management for SS and nickel-alloy components if: (i) plant-specific OE does not reveal a history of loss of material due to pitting or crevice corrosion, and (ii) a one-time inspection demonstrates that the aging effect is not occurring or is occurring so slowly that it will not affect the intended function of the components during the subsequent period of extended operation. The applicant documents the results of the plant-specific OE review in the SLRA.

In the environment of air-indoor controlled, pitting and crevice corrosion is only expected to occur in the presence of a source of moisture or halides. Inspections focus on the most susceptible locations.

The GALL-SLR Report recommends further evaluation of SS and nickel-alloy piping, piping components, and tanks exposed to an air, condensation, or underground environment to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion. The GALL-SLR Report AMP XI.M32, “One-Time Inspection,” describes an acceptable program to demonstrate that loss of material due to pitting and crevice corrosion is not occurring at a rate that affects the intended function of the components. If loss of material due to pitting or crevice corrosion has occurred and is sufficient to potentially affect the intended function of SSCs, the following AMPs describe acceptable programs to manage loss of material due to pitting or crevice corrosion: (i) the GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” for tanks; (ii) the GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” for external surfaces of piping and piping components; (iii) the GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” for underground piping, piping components and tanks; and (iv) the GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” for internal surfaces of components that are not included in other AMPs. The timing of the one-time or periodic inspections is consistent with that recommended in the AMP selected by the applicant during the development of the SLRA. For example, a one-time inspection would be conducted between the 50th and 60th year of operation, as recommended by the “Detection of Aging Effects” program element in AMP XI.M32.

The applicant may mitigate or prevent the loss of material due to pitting and crevice corrosion through the use of a barrier coating to isolate the component from aggressive or corrosive environments. However, the applicant should identify loss of material as applicable for SLR and identify the AMP that will be used to manage the integrity of the coating. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and air that contain moisture or halides. The GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks,” describes an acceptable program to manage the integrity of a barrier coating for internal or external coatings.

3.2.2.2.3 Loss of Material Due to General Corrosion and Flow Blockage Due to Fouling

Loss of material due to general corrosion (as applicable) and flow blockage due to fouling for all materials can occur in the spray nozzles and flow orifices in the drywell and suppression chamber spray system exposed to air-indoor uncontrolled. This aging effect and mechanism will apply since the carbon steel piping upstream of the spray nozzles and flow orifices is occasionally wetted, even though the majority of the time this system remains in standby. The wetting and drying of these components can accelerate corrosion in the system and lead to flow blockage from an accumulation of corrosion products. Aging effects sufficient to result in a loss of intended function are not anticipated if: (i) the applicant identifies those portions of the system that are normally dry but subject to periodic wetting; (ii) plant-specific procedures exist to drain the normally dry portions that have been wetted during normal plant operation or inadvertently; (iii) the plant-specific configuration of the drains and piping allow sufficient draining to empty the normally dry pipe; (iv) plant-specific OE has not revealed loss of material or flow blockage due to fouling; and (v) a one-time inspection is conducted to verify that loss of material or flow blockage due to fouling has not occurred. The GALL-SLR Report AMP XI.M32, “One-Time Inspection,” describes an acceptable program to conduct the one-time inspections. The GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” describes an acceptable program to manage loss of material due to general corrosion and flow blockage due to fouling when the above conditions are not met.

3.2.2.2.4 Cracking Due to Stress Corrosion Cracking in Stainless Steel Alloys

Cracking due to SCC could occur in indoor or outdoor SS piping, piping components, and tanks exposed to any air, condensation, or underground environment when the component is: (i) uninsulated; (ii) insulated; (iii) in the vicinity of insulated components, or (iv) in the vicinity of potentially transportable halogens. Cracking can occur in environments containing sufficient halides (e.g., chlorides) in the presence of moisture.

Insulated SS components exposed to indoor air, outdoor air, condensation, or underground environments are susceptible to SCC if the insulation contains certain contaminants. Leakage of fluids through bolted connections (e.g., flanges, valve packing) can result in contaminants present in the insulation to leach onto the component surface or into the surfaces of other components below the component. For outdoor insulated SS components, rain and changing weather conditions can result in moisture intrusion compromising the insulation.

Plant-specific OE and the condition of SS components are evaluated to determine if prolonged exposure to the plant-specific environments has resulted in SCC. The SCC in SS components is not an aging effect that requires management if: (i) plant-specific OE does not reveal a history of SCC and (ii) a one-time inspection demonstrates that the aging effect is not occurring.

In the environment of air-indoor controlled, SCC is only expected to occur due to the presence of a source of moisture and/or halides. Inspections focus on the most susceptible locations. The applicant documents the results of the plant-specific OE review in the SLRA.

The GALL-SLR Report recommends further evaluation of SS piping, piping components, and tanks exposed to an air, condensation, or underground environment to determine whether an AMP is needed to manage the aging effect of SCC. The GALL-SLR Report AMP XI.M32, “One-Time Inspection,” describes an acceptable program to demonstrate that SCC is not occurring. If SCC is applicable, the following AMPs describe acceptable programs to manage cracking due to SCC: (i) the GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” for tanks; (ii) the GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” for external surfaces of piping and piping components; (iii) the GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” for underground piping, piping components and tanks; and (iv) the GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” for internal surfaces of components that are not included in other AMPs. The timing of the one-time or periodic inspections is consistent with that recommended in the AMP selected by the applicant during the development of the SLRA. For example, one-time inspections would be conducted between the 50th and 60th year of operation, as recommended by the "Detection of Aging Effects" program element in AMP XI.M32.

The applicant may mitigate or prevent cracking due to SCC through the use of a barrier coating to isolate the component from aggressive environments. However, the applicant should identify SCC as applicable for SLR and identify the AMP that will be used to manage the integrity of the coating. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and air that contain halides. The GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," describes an acceptable program to manage the integrity of a barrier coating for internal or external coatings.

3.2.2.2.5 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in BTP IQMB-1 (Appendix Section A.2 of this SRP-SLR).

3.2.2.2.6 Ongoing Review of Operating Experience

Acceptance criteria are described in Appendix Section A.4, "Operating Experience for Aging Management Programs."

3.2.2.2.7 Loss of Material Due to Recurring Internal Corrosion

Recurring internal corrosion can result in the need to augment AMPs beyond the recommendations in the GALL-SLR Report. During the search of plant-specific OE conducted during the SLRA development, recurring internal corrosion can be identified by the number of occurrences of aging effects and the extent of degradation at each localized corrosion site. This further evaluation item is applicable if the search of plant-specific OE reveals repetitive occurrences. The criteria for recurrence is: (i) a 10 year search of plant-specific OE reveals the aging effect has occurred in three or more refueling outage cycles; or (ii) a 5 year search of plant-specific OE revealing that the aging effect has occurred in two or more refueling outage cycles and resulted in the component either not meeting plant-specific acceptance criteria or experiencing a reduction in wall thickness greater than 50 percent (regardless of the minimum wall thickness).

The GALL-SLR Report recommends that the GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," be evaluated for inclusion of augmented requirements to assure any recurring aging effect(s) are adequately managed. Alternatively, a plant-specific AMP may be proposed. Potential augmented requirements include: alternative examination methods (e.g., volumetric versus external visual), augmented inspections (e.g., a greater number of locations, additional locations based on risk insights based on susceptibility to aging effect and consequences of failure, a greater frequency of inspections), and additional trending parameters and decision points where increased inspections would be implemented.

The applicant states: (i) why the program's examination methods will be sufficient to detect the recurring aging effect before affecting the ability of a component to perform its intended function, (ii) the basis for the adequacy of augmented or lack of augmented inspections, (iii) the trend of which parameters will be followed as well as the decision points where increased inspections would be implemented (e.g., the extent of degradation at individual corrosion sites, the rate of degradation change), (iv) how inspections of components that are not easily accessed (i.e., buried, underground) will be conducted, and (v) how leaks in any involved buried or underground components will be identified.

Plant-specific OE examples should be evaluated to determine if the chosen AMP should be augmented even if the thresholds for significance of aging effect or frequency of occurrence of aging effect have not been exceeded. For example, during a 10 year search of plant-specific OE, two instances of a 360º 30 percent wall loss occurred at copper alloy to steel joints. Neither the significance of the aging effect nor the frequency of occurrence of aging effect threshold was exceeded. Nevertheless, the OE should be evaluated to determine if the AMP that is proposed to manage the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of inspections) to provide reasonable assurance that the CLB intended functions of the component will be met throughout the subsequent period of extended operation. While recurring internal corrosion is not as likely in environments other than raw water and waste water (e.g., treated water), the aging effect should be addressed in a similar manner.

3.2.2.2.8 Cracking Due to Stress Corrosion Cracking in Aluminum Alloys

The SCC is a form of environmentally assisted cracking which is known to occur in high and moderate strength aluminum alloys. The three conditions necessary for SCC to occur in a component are a sustained tensile stress, aggressive environment, and material with a susceptible microstructure. Cracking due to SCC can be mitigated by eliminating one of the three necessary conditions. For the purposes of SLR, acceptance criteria for this further evaluation are provided for demonstrating that the specific material is not susceptible to SCC or the ambient environment is not aggressive in nature. Cracking due to SCC is an aging effect which requires management unless it is demonstrated by the applicant that one of the two necessary conditions discussed below is absent.

<u>Susceptible Material</u>: If the material is not susceptible to SCC, then cracking is not an aging effect which requires management. The microstructure of an aluminum alloy, of which alloy composition is only one factor that determines whether the alloy is susceptible to SCC. Therefore, determining susceptibility based on alloy composition alone is not adequate to conclude whether a particular material is susceptible to SCC. The temper type, condition, and product form of the alloy is considered when assessing if a material is susceptible to SCC. Aluminum alloys that are susceptible to SCC include:

- 2xxx series alloys in the as fabricated (F), solution heat-treated (W), annealed (O)x, thermally treated (T)3x, T4x, or T6x temper;
- 5xxx series alloys with a magnesium content of 3.5 weight percent (wt%) or greater;
- 6xxx series alloys in the F temper;
- 7xxx series alloys in the F, T5x, or T6x temper;
- 2xx.x and 7xx.x series alloys;
- 3xx.x series alloys that contain copper; and
- 5xx.x series alloys with a magnesium content of greater than 8 wt%.

The material is evaluated to verify that it is not susceptible to SCC and that the basis used to make the determination is technically substantiated. Tempers have been specifically developed to improve the SCC resistance for some aluminum alloys. Aluminum alloy and temper combination which are not susceptible to SCC when used in piping, piping component, and tank applications include 1xxx series, 3xxx series, 6061-T6x, 6063-T6, and 5454-x, respectively. If it is determined that a material is not susceptible to SCC, the SLRA provides the components/locations where it is used, alloy composition, temper or condition, and3.2-7orduct form. For tempers not addressed above, the basis used to determine that the alloy is not susceptible and technical information substantiating the basis is added to the SLRA.

Aggressive Environment: If the environment to which an aluminum alloy is exposed is not aggressive, such as dry gas or treated water, then cracking due to SCC will not occur and it is not an aging effect which requires management. Aggressive environments that are known to result in cracking due to SCC of susceptible aluminum alloys include the presence of aqueous solutions, air, condensation, and underground locations that contain halides (e.g., chloride). Halide concentrations should be considered high enough to facilitate SCC of aluminum alloys in uncontrolled or untreated aqueous solutions and air, such as raw water, waste water, condensation, underground locations, and outdoor air, unless demonstrated otherwise.

Halides could be present on the surface of the aluminum material if the component is encapsulated in a material such as insulation layer or concrete. In a controlled or uncontrolled indoor air, condensation, or underground environment, halide concentrations sufficient to cause SCC could be present due to secondary sources such as leakage from nearby components (e.g., leakage from insulated flanged connections or valve packing). If an aluminum component is exposed to a halide-free indoor air environment, not encapsulated in materials containing halides, and the exposure to secondary sources of moisture or halides is precluded, cracking due to SCC is not expected to occur. The plant-specific configuration can be used to demonstrate that exposure to halides will not occur. If it is determined that SCC will not occur because the environment is not aggressive, the SLRA provides the components and locations exposed to the environment, a description of the environment, basis used to determine the environment is not aggressive, and technical information substantiating the basis. The GALL-SLR Report AMP XI.M32, “One-Time Inspection,” and a review of plant-specific OE describe an acceptable means to confirm the absence of moisture or halides within the proximity of the aluminum component.

If the environment potentially contains halides, the GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” describes an acceptable program to manage cracking due to SCC of aluminum tanks. The GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” describes an acceptable program to manage cracking due to SCC of aluminum piping and piping components. The GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” describes an acceptable program to manage cracking due to SCC of aluminum piping and tanks, which are buried or underground. The GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” describes an acceptable program to manage cracking due to SCC of aluminum components that are not included in other AMPs.

The applicant may mitigate or prevent cracking due to SCC through the use of a barrier coating to isolate the component from aggressive environments. However, the applicant should identify SCC as applicable for SLR and identify the AMP that will be used to manage the integrity of the coating. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and air that contain halides. The GALL-SLR Report AMP

XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” describes an acceptable program to manage the integrity of a barrier coating for internal or external coatings.

3.2.2.2.9 Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to Stress Corrosion Cracking

Loss of material due to general (steel only), crevice, or pitting corrosion and cracking due to SCC (SS only) can occur in steel and SS piping and piping components exposed to concrete. Concrete provides a highly alkaline environment that can mitigate the effects of loss of material for steel piping, thereby significantly reducing the corrosion rate. However, if water intrudes through the concrete, the pH can be reduced and ions that promote loss of material such as chlorides, which can penetrate the protective oxide layer created in the highly alkaline environment, can reach the surface of the metal. Carbonation can reduce the pH within concrete. The rate of carbonation is reduced by using concrete with a low water-to-cement ratio and low permeability. Concrete with low permeability also reduces the potential for penetration of water. Adequate air entrainment improves the ability of the concrete to resist freezing and thawing cycles and therefore reduces the potential for cracking and intrusion of water. Cracking due to SCC, as well as pitting and crevice corrosion can occur due to halides present in the water that penetrate the surface of the metal.

If the following conditions are met, loss of material is not considered to be an applicable aging effect for steel: (i) 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; (ii) plant-specific OE indicates no degradation of the concrete that could lead to penetration of water to the metal surface; and (iii) the piping is not potentially exposed to groundwater. For SS components loss of material and cracking due to SCC are not considered to be applicable aging effects as long as the piping is not potentially exposed to groundwater. Where these conditions are not met, loss of material due to general (steel only), crevice or pitting corrosion and cracking due to SCC (SS only) are identified as applicable aging effects. The GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” describes an acceptable program to manage these aging effects.

3.2.2.2.10 Loss of Material Due to Pitting and Crevice Corrosion in Aluminum Alloys

Loss of material due to pitting and crevice corrosion could occur in aluminum piping, piping components, and tanks exposed to an air, condensation, underground, raw water, or waste water environment for a sufficient duration of time. Environments that can result in pitting and/or crevice corrosion of aluminum alloys are those that contain halides (e.g., chloride) in the presence of moisture. The moisture level and halide concentration in atmospheric and uncontrolled air greatly depends on the geographical location and site-specific conditions. Moisture level and halide concentration should be considered high enough to facilitate pitting and/or crevice corrosion of aluminum alloys in atmospheric and uncontrolled air, unless demonstrated otherwise. The periodic introduction of moisture or halides into an environment from secondary sources should also be considered. Leakage of fluids from mechanical connections (e.g., insulated bolted flanges and valve packing); onto a component in indoor controlled air is an example of a secondary source that should be considered. Halide concentrations should be considered high enough to facilitate loss of material of aluminum alloys in untreated aqueous solutions, unless demonstrated otherwise. Plant-specific OE and the condition of aluminum alloy components are evaluated to determine if prolonged exposure to the plant-specific air, condensation, underground, or water environments has resulted in pitting or crevice corrosion. Loss of material due to pitting and crevice corrosion is not an aging effect that requires management for aluminum alloys if: (i) plant-specific OE does not reveal a history of loss of material due to pitting or crevice corrosion and (ii) a one-time inspection demonstrates that the aging effect is not occurring or is occurring so slowly that it will not affect the intended function of the components. Alternatively, loss of material due to pitting and crevice corrosion need not be managed if the type of aluminum is not susceptible to cracking and plant-specific OE does not reveal any issues related to loss of material due to pitting or crevice corrosion. The applicant documents the results of the plant-specific OE review in the SLRA.

In the environment of air-indoor controlled, pitting and crevice corrosion is only expected to occur in the presence of a source of moisture and halides. Alloy susceptibility may be considered when reviewing OE and interpreting inspection results. Inspections focus on the most susceptible alloys and locations.

The GALL-SLR Report recommends the further evaluation of aluminum piping, piping components, and tanks exposed to an air, condensation, or underground environment to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion. The GALL-SLR Report AMP XI.M32, “One-Time Inspection,” describes an acceptable program to demonstrate that the aging effect of loss of material due to pitting and crevice corrosion is not occurring at a rate that will affect the intended function of the components. If loss of material due to pitting or crevice corrosion has occurred and is sufficient to potentially affect the intended function of an SSC, the following AMPs describe acceptable programs to manage loss of material due to pitting and crevice corrosion: (i) the GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” for tanks; (ii) the GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” for external surfaces of piping and piping components; (iii) the GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” for underground piping, piping components and tanks; and (iv) the GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” for internal surfaces of components that are not included in other AMPs. The timing of the one-time or periodic inspections is consistent with that recommended in the AMP selected by the applicant during the development of the SLRA. For example, one-time inspections would be conducted between the 50th and 60th year of operation, as recommended by the “Detection of Aging Effects” program element in AMP XI.M32.

The applicant may mitigate or prevent the loss of material due to pitting and crevice corrosion through the use of a barrier coating to isolate the component from aggressive environments. However, the applicant should identify loss of material as applicable for SLR and identify the AMP that will be use to manage the integrity of the coating. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and air that contain halides. The GALL- SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” or equivalent program, describes an acceptable program to manage the integrity of a barrier coating for internal or external coatings.

3.2.2.2.11 Loss of Material Due to Wear

Industry OE indicates that significant loss of material due to wear can occur in ASME Code Class 2, small-bore piping. For example, loss of material can occur in the presence of RMI, and flow-induced vibrations of ASME Code Class 2 small-bore piping. This type of wear is difficult to identify unless the insulation is removed and the OD of the piping is visually examined for wear marks (Ref. 8). This type of wear is called OD pipe wear, and in some instances can be potentially near 360º around the OD of the subject pipe and could significantly reduce the load-bearing capacity of the subject pipe. Therefore, the applicant should perform further evaluation to confirm the absence of the specific aging effect. If moderate or no degradation is evident, but it is determined that the insulation is such that it has the potential to cause wear, the applicant may choose to mitigate the loss of material due to wear or alternatively use an existing program for management of the aging effect. The applicant may use the acceptance criteria, which are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR), to demonstrate the adequacy of a plant-specific AMP. The reviewer should make sure that the that the applicant has verified through inspections that OD pipe wear is not an applicable aging effect that needs to be monitored or provide for periodic inspection program so that significant OD loss of material is detected prior to loss of intended function.

3.2.2.3 Aging Management Review Results Not Consistent With or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report

Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.2.2.4 Aging Management Programs

For those AMPs that will be used for aging management and are based on the program elements of an AMP in the GALL-SLR Report, the NRC reviewer performs an audit of AMPs credited in the SLRA to confirm consistency with the GALL-SLR Report AMPs identified in Sections X and XI.

If the applicant identifies an exception to any of the program elements of the cited GALL-SLR Report AMP, the SLRA AMP should include a basis demonstrating how the criteria of 10 CFR 54.21(a)(3) (TN4878) would still be met. The NRC reviewer should then confirm that the SLRA AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the SLRA AMP, the reviewer identifies a difference between the SLRA AMP and the GALL-SLR Report AMP that should have been identified as an exception to the GALL-SLR Report AMP, the difference should be reviewed and dispositioned appropriately. The reviewer should document the disposition of all SLRA-defined exceptions and NRC staff-identified differences.

The SLRA should identify any enhancements that are needed to permit an existing AMP to be declared consistent with the GALL-SLR Report AMP to which the SLRA AMP is compared. The reviewer is to confirm that the enhancement when implemented, would allow the existing plant AMP to be consistent with the GALL-SLR Report AMP and also that the applicant has a commitment in the FSAR Supplement to implement the enhancement prior to the subsequent period of extended operation. The reviewer should review and document the disposition of all enhancements.

If the applicant chooses to use a plant-specific program that is not a GALL-SLR Report AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

3.2.2.5 Final Safety Analysis Report Supplement

The summary description of the programs and activities for managing the effects of aging for the subsequent period of extended operation in the FSAR Supplement should be sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59 (TN249). The description should contain information associated with the basis for determining that aging effects will be managed during the subsequent period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the subsequent period of extended operation. Table X-01 and Table XI-01 of the GALL-SLR Report provide examples of the type of information to be included in the FSAR Supplement. Table 3.2-2 lists the programs that are applicable for this SRP-SLR section.

3.2.3 Review Procedures

For each area of review, the following review procedures are to be followed:

3.2.3.1 Aging Management Review Results Consistent With the Generic Aging Lessons Learned for Subsequent License Renewal Report

The applicant may reference the GALL-SLR Report in its SLRA, as appropriate, and demonstrate that the AMRs and AMPs at its facility are consistent with those reviewed and approved in the GALL-SLR Report. The reviewer should not conduct a re-review of the substance of the matters described in the GALL-SLR Report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL-SLR Report, the reviewer should find acceptable the applicant’s reference to the GALL-SLR Report in its SLRA. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms that the applicable aging effects have been addressed based on the NRC staff’s review of industry and plant-specific OE.

Furthermore, the reviewer should confirm that the applicant has addressed OE identified after the issuance of the GALL-SLR Report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects accurately for maintaining the engineered safety features SCs that are contained in the GALL-SLR Report as applicable to that plant.

3.2.3.2 Aging Management Review Results for which Further Evaluation Is Recommended by the Generic Aging Lessons Learned for Subsequent License Renewal Report

The basic review procedures defined in Section 3.2.3.1 need to be applied first to all of the AMRs and AMPs provided in this section. In addition, if the GALL-SLR Report AMR item to which the SLRA AMR item is compared identifies that “Further Evaluation Recommended,” then additional criteria apply as identified by the GALL-SLR Report for each of the following aging effect/aging mechanism combinations.

3.2.3.2.1 Cumulative Fatigue Damage

Evaluations involving time-dependent fatigue or cyclical loading parameters may be TLAAs, as defined in 10 CFR 54.3 (TN4878). The TLAAs are required to be evaluated in accordaI with 10 CFR 54.21(c)(1).

The staff reviews the information on a case-by-case basis consistent with the review procedures in SRP-SLR Section 4.3 or 4.7 (as applicable) to determine whether the applicant has provided a sufficient basis for dispositioning the TLAAs in accordance with the acceptance Iteria in 10 CFR 54.21(c)(1)(i), (ii), or (iii). This includes staff’s review of those cumulative usage factor analyses that qualify as TLAAs and are based on plant-specific methods utilized for stress-based calculations.

3.2.3.2.2 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and Nickel Alloys

The GALL-SLR Report recommends further evaluation to manage loss of material due to pitting and crevice corrosion of SS and nickel-alloy piping and piping components exposed to any air, condensation, or underground environment, when the component is: (i) uninsulated; (ii) insulated; (iii) in the vicinity of insulated components where the presence of sufficient halides (e.g., chlorides) and moisture is possible; or (iv) in the vicinity of potentially transportable halogens. The possibility of pitting and crevice corrosion also extends to indoor components located in close proximity to sources of outdoor air (e.g., components near intake vents).

The reviewer independently verifies the sufficiency of the applicant's evaluation of plant-specific OE. If the review of plant-specific OE reveals loss of material due to pitting or crevice corrosion in SS and nickel alloys, the reviewer determines whether an adequate program is credited to manage the aging effect. If the review of plant-specific OE reveals that loss of material due to pitting and crevice corrosion is not applicable, the reviewer verifies that GALL-SLR Report AMP XI.M32, "One-Time Inspection," is cited for all applicable AMR line items.

An applicant may refine its OE search, and subsequent one-time inspections, by binning plant-specific environments into subcategories. For example, the OE search could be based on two environments including outdoor air and indoor air. The results could be that loss of material due to pitting and crevice corrosion has occurred in the outdoor air environment but not the indoor air environment. The applicant could further categorize the indoor air locations as those where leakage could impinge on the SS or nickel-alloy component's surface (e.g., leakage from mechanical connections) and those where there is no potential for leakage. When the applicant chooses to conduct its OE search in this manner, the reviewer should also confirm that the applicant has adequately addressed the potential for the periodic introduction of either moisture or halides from secondary sources. Secondary sources of moisture or halides should be considered for all environments including indoor conditioned air. Typical secondary sources of moisture or halides include: leakage from mechanical connections; leakage into vaults; insulation containing halides; and outdoor air intrusion. Grouping of environments consistent with that described in the detection of aging effects program element of GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," is appropriate.

If the applicant uses a barrier coating to mitigate or prevent the loss of material due to pitting and crevice corrosion, the reviewer verifies that loss of coating integrity is being managed for the associated components with a program equivalent to the GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks."

3.2.3.2.3 Loss of Material Due to General Corrosion and Flow Blockage Due to Fouling

The GALL-SLR Report recommends further evaluation of programs to manage loss of material due to general corrosion and flow blockage due to fouling in the spray nozzles and flow orifices of the drywell and suppression chamber spray system spray exposed to air—indoor uncontrolled. This is necessary to prevent the plugging of spray nozzles and flow orifices of the BWR drywell and suppression chamber spray system. The wetting and drying of these components can accelerate corrosion in the system and lead to flow blockage from an accumulation of corrosion products. The reviewer evaluates the applicant's proposed program on a case-by-case basis to make sure that an adequate program will be in place for the management of loss of material due to general corrosion and flow blockage due to fouling of these components. If the applicant has cited GALL-SLR Report AMP XI.M32, "One-Time Inspection," to manage the aging effects, the reviewer determines whether: (i) plant-specific procedures exist to drain the normally dry portions that have been wetted during normal plant operation or inadvertently; (ii) the applicant has documented that the plant-specific configuration of the drains and piping allow sufficient draining to empty the normally dry pipe; and (iii) loss of material or flow blockage due to fouling has not occurred, which is based on a review of a sample of plant-specific OE.

3.2.3.2.4 Cracking Due to Stress Corrosion Cracking in Stainless Steel Alloys

The GALL-SLR Report recommends further evaluation to manage cracking due to SCC of SS piping, piping components, and tanks exposed to air and underground environments containing sufficient halides (e.g., chlorides) and in which condensation is possible. The possibility of cracking also extends to components exposed to air which has recently been introduced into buildings (i.e., components near intake vents) or where the component is in the vicinity of insulated components.

The reviewer independently verifies the sufficiency of the applicant's evaluation of plant-specific OE. If the review of plant-specific OE reveals SCC in SS alloys, the reviewer determines whether an adequate program is credited to manage the aging effect. If the review of plant-specific OE reveals that SCC is not applicable, the reviewer verifies that the GALL-SLR Report AMP XI.M32, "One-Time Inspection," is cited for all applicable AMR line items.

An applicant may refine its OE search, and subsequent one-time inspections, by binning plant-specific environments into subcategories. For example, the OE search could be based on two environments which includes the outdoor air and indoor air. The results could be that SCC has occurred in the outdoor air environment but not the indoor air environment. The applicant could further categorize the indoor air locations as those where leakage could impinge on the SS component's surface (e.g., leakage from mechanical connections) and those where there is no potential for leakage. When the applicant chooses to conduct its OE search in this manner, the reviewer should also confirm that the applicant has adequately addressed the potential for the periodic introduction of either moisture or halides from secondary sources. Secondary sources of moisture or halides should be considered for all environments including indoor conditioned air. Typical secondary sources of moisture or halides include: leakage from mechanical connections; leakage into vaults; insulation containing halides; and outdoor air intrusion. Grouping of environments consistent with that described in the detection of aging effects program element of GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," is appropriate.

If the applicant uses a barrier coating to mitigate or prevent cracking due to SCC, the reviewer verifies that loss of coating integrity is being managed for the associated components with a program equivalent to the GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks."

3.2.3.2.5 Quality Assurance for Aging Management of Nonsafety-Related Components

The applicant's AMPs for SLR should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered by 10 CFR Part 50 (TN249), Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an AMR for SLR. Nevertheless, the applicant has the option to expand the scope of its 10 CFR Part 50, Appendix B program to include these components and address the associated program elements. If the applicant chooses this option, the reviewer verifies that the applicant has documented such a commitment in the FSAR Supplement. If the applicant chooses alternative means, the branch responsible for QA should be requested to review the applicant's proposal on a case-by-case basis.

3.2.3.2.6 Ongoing Review of Operating Experience

The applicant's AMPs should contain the element of OE. The reviewer verifies that the applicant has appropriate programs or processes for the ongoing review of both plant-specific and industry OE concerning age-related degradation and aging management. Such reviews are used to ascertain that the AMPs are effective in managing the aging effects for which they are created. The AMPs are either enhanced or new AMPs are developed, as appropriate, when it is determined through the evaluation of the OE that the effects of aging may not be adequately managed. Additional information is in Appendix Section A.4, "Operating Experience for Aging Management Programs."

3.2.3.2.7 Loss of Material Due to Recurring Internal Corrosion

The GALL-SLR Report recommends further evaluation to manage recurring internal corrosion aging effects. The reviewer conducts an independent review of plant-specific OE to determine whether the plant is currently experiencing recurring events of internal corrosion. This further evaluation item is applicable if the search of plant-specific OE reveals repetitive occurrences. The criteria for recurrence is: (i) a 10 year search of plant-specific OE reveals the aging effect has occurred in three or more refueling outage cycles; or (ii) a 5 year search of plant-specific OE reveals the aging effect has occurred in two or more refueling outage cycles as a result of which the component either did not meet plant-specific acceptance criteria or experienced a reduction in wall thickness greater than 50 percent (regardless of the minimum wall thickness).

The reviewer should evaluate plant-specific OE examples to determine if the chosen AMP should be augmented. For example, during a 10 year search of plant-specific OE, two instances of a 360º 30 percent wall loss occurred at copper alloy to steel joints. Neither the significance of the aging effect nor the frequency of occurrence of aging effect threshold has been exceeded. Nevertheless, the OE should be evaluated to determine if the AMP that is proposed to manage the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of inspections) to provide reasonable assurance that the CLB intended functions of the component will be met throughout the subsequent period of extended operation.

The reviewer determines whether a proposed program is adequate to manage recurring internal corrosion by evaluating the proposed AMP against the criteria in SRP-SLR Section 3.2.2.2.7.

3.2.3.2.8 Cracking Due to Stress Corrosion Cracking in Aluminum Alloys

The GALL-SLR Report recommends the further evaluation of aluminum components (i.e., piping, piping components, and tanks) exposed to air, condensation, underground, or aqueous solutions that contain halides to manage cracking due to SCC. The reviewer must first determine if cracking due to SCC is applicable and requires aging management. Cracking is to be considered applicable unless it is demonstrated that one of the two acceptance criteria are met by demonstrating that an aggressive environment is not present or the specific material is not susceptible, as discussed in Section 3.2.2.2.8. Additionally, guidance is also provided on the review of the third condition necessary for SCC to occur, a sustained tensile stress. Each of three conditions is evaluated based on the review procedures below.

If the material used to fabricate the component being evaluated is not susceptible to SCC then cracking due to SCC is not an aging effect that requires management. When determining if an aluminum alloy is susceptible to SCC the reviewer is to verify the material's: (i) alloy composition, (ii) condition or temper properties, and (iii) product form. Additionally, if the material was produced using a process specifically developed to provide a SCC resistant microstructure then the reviewer will consider the effects of this processing in the review. Once the material information has been established the reviewer is to evaluate the technical justification used to substantiate that the material is not susceptible to SCC when exposed to an aggressive environment and sustained tensile stress. The reviewer will evaluate all documentation and references used by the applicant as part of a technical justification.

If the environment to which an aluminum alloy is exposed is not aggressive, such as dry gas, or treated water, then cracking due to SCC is not an aging effect that requires management. The environments cited in the AMR line items in the GALL-SLR Report that reference this further evaluation are considered to be aggressive and potentially containing halide concentrations that facilitate SCC of aluminum alloys. The reviewer is to verify that components are not also periodically exposed to nontypical environments that would be categorized as aggressive, such as secondary sources of moisture or halides, including outdoor air which has recently been introduced into a building or the leakage/seepage of untreated aqueous solutions into a building or underground vault are taken into consideration. Controlled indoor air is not considered aggressive unless secondary sources of moisture or halides are present. When applicable, the staff reviews the basis for the applicant's claim that the plant configuration precludes the potential presence of secondary sources of moisture or halides. Using information provided by the applicant, the reviewer will also evaluate the chemical composition of applicable encapsulating materials (e.g., concrete, insulation) for halides.

If the applicant uses a barrier coating to mitigate or prevent cracking due to SCC, the reviewer verifies that loss of coating integrity is being managed for the associated components with a program equivalent to the GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks."

If the sustained tensile stress being experienced by a component is below the SCC threshold value, then cracking is not an aging effect that requires management. Many aluminum alloys do not have a true SCC threshold stress, although a practical SCC threshold value can be determined based on the material, service environment, and duration of intended function. The basis for the SCC threshold value is to be evaluated to determine its applicability. The magnitude of the maximum tensile service stress (applied and residual) experienced by the component is to be evaluated to verify that the stress levels are bounded by the SCC threshold value.

The information necessary to determine if SCC is applicable based on the sustained service stress is often not readily available. The SCC threshold stress level is dependent on both the alloy (e.g., chemical composition, processing history, and microstructure) and service environment. Furthermore, the magnitude and state of the residual stress sustained by a component is typically not fully characterized. The reviewer must determine the adequacy of both the SCC threshold value being used by the applicant and the magnitude of the tensile stress being experienced by the component. The evaluation of the SCC threshold value includes the verification that the: (i) test method used to establish the threshold value is standardized and recognized by the industry, (ii) data are statistically significant or conservative, and (iii) data are relevant for the alloy, temper, product form, and environment. The evaluation of the tensile stress being experienced by the component includes the verification that the stress analysis accounts for: (i) all applied and residual stresses and (ii) stress inducer that can initiate SCC cracks, such as corrosion pits and fabrication defects.

Documentation that may assist the reviewer in determining if cracking due to SCC is applicable and requires aging management include: (i) component drawings, (ii) applicable codes or specifications used in the design, fabrication, and installation of the component, (iii) material specific certification data and lot release data, (iv) maintenance records, and (v) plant-specific OE.

If it is determined that cracking due to SCC is applicable, the reviewer is to evaluate the applicant’s proposed AMP to make sure that cracking is adequately managed so that the component’s intended functions will be maintained to be consistent with the CLB for the subsequent period of extended operation. The GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” describes an acceptable program to manage cracking due to SCC of aluminum tanks. The GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” describes an acceptable program to manage cracking due to SCC of aluminum piping and piping components. The GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” describes an acceptable program to manage cracking due to SCC of aluminum piping and tanks which are buried or located underground. The GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” describes an acceptable program to manage cracking due to SCC of aluminum components that are not included in other AMPs.

3.2.3.2.9 Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to Stress Corrosion Cracking

The GALL-SLR Report recommends that for steel piping and piping components exposed to concrete, loss of material is not considered to be an applicable aging effect for steel if the following conditions are met: (i) 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; (ii) plant-specific OE indicates no degradation of the concrete that could lead to penetration of water to the metal surface; and (iii) the piping is not potentially exposed to groundwater. For SS piping and piping components, loss of material and cracking due to SCC are not considered to be applicable aging effects as long as the piping is not potentially exposed to groundwater. Where these conditions are not met, loss of material due to general (steel only), crevice or pitting corrosion and cracking due to SCC (SS only) are identified as applicable aging effects. The GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” describes an acceptable program to manage these aging effects.

The reviewer verifies that the concrete was specified to meet ACI 318 or ACI 349 (low water-to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG–1557. The reviewer should evaluate plant-specific OE to determine whether sufficient concrete degradation has occurred which would allow water intrusion.

3.2.3.2.10 Loss of Material Due to Pitting and Crevice Corrosion in Aluminum Alloys

The GALL-SLR Report recommends a further evaluation to determine whether an AMP is needed to manage loss of material due to pitting and crevice corrosion of aluminum piping, piping components, and tanks exposed to an air, condensation, underground, raw water, or waste water environment. The reviewer is to conduct an independent assessment of plant-specific OE during the AMP audit to confirm that the applicant's evaluation of its OE is adequate.

The reviewer is to confirm that the applicant has adequately addressed the potential for the periodic introduction of either moisture or halides from secondary sources. Secondary sources of moisture or halides should be considered for all environments including indoor conditioned air. Typical secondary sources of moisture or halides include leakage from mechanical connections, leakage into vaults, insulation containing halides, and outdoor air intrusion. Grouping of environments should be consistent with that found in the GALL-SLR Report Section IX.D as appropriate.

The grouping of OE search results based on environmental factors or plant configuration may be appropriate. The reviewer is to verify that the considerations given to groupings based on environmental factors and/or plant configuration have a substantiated technical basis. Components in the vicinity of secondary sources of moisture or halides may be treated as a separate population when performing inspections and interpreting results due to plant-specific configurations.

The grouping of alloys based on relative susceptibility to loss of material may also be appropriate. The reviewer is to verify that the considerations given to alloy susceptibility and/or grouping have a substantiated technical basis. The high-strength heat treatable aluminum alloys (2xxx and 7xxx series) may be treated as a separate population when performing inspections and interpreting results due to their relatively lower corrosion resistance. The relative susceptibility of moderate and lower strength alloys varies based on composition (primarily wt% copper, magnesium, and iron) and temper designation.

The reviewer is to determine whether an adequate program is credited to manage the aging effect if the OE reveals that loss of material is applicable or the applicant elects to manage loss of material due to pitting or crevice corrosion. The reviewer is to verify that the SLRA cites the use of the GALL-SLR Report AMP XI.M32, "One-Time Inspection," for all aluminum piping, piping components, and tanks exposed to air, condensation, or underground environments when confirming that the aging effect is not applicable based on the OE evaluation.

If the applicant uses a barrier coating to mitigate or prevent the loss of material due to pitting and crevice corrosion, the reviewer verifies that loss of coating integrity is being managed for the associated components with a program equivalent to the GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks."

3.2.3.2.11 Loss of Material Due to Wear

Industry OE indicates that significant loss of material due to wear can occur in ASME Code Class 2, small-bore piping. For example, loss of material can occur in the presence of RMI and flow-induced vibrations of ASME Code Class 2 small-bore piping. This type of wear is difficult to identify unless the insulation is removed and the OD of the piping is visually examined for wear marks (Ref. 8). This type of wear is called OD pipe wear, and in some instances can be potentially near 360º around the OD of the subject pipe and could significantly reduce the load-bearing capacity of the subject pipe. Therefore, the applicant should perform a further evaluation to confirm the absence of the specific aging effect. If moderate or no degradation is evident, but it is determined that the insulation has the potential to cause wear, the applicant may choose to mitigate the loss of material due to wear or alternatively use an existing program for management of the aging effect. The applicant may use the acceptance criteria, which are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR), to demonstrate the adequacy of a plant-specific AMP. The reviewer should make sure that the applicant has verified through inspections that OD pipe wear is not an applicable aging effect that needs to be monitored or provide for periodic inspection program so that significant OD loss of material is detected prior to loss of intended function.

3.2.3.3 Aging Management Review Results Not Consistent With or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report

The reviewer should confirm that the applicant in its SLRA, has identified applicable aging effects, listed the appropriate combination of materials and environments, and AMPs that will adequately manage the aging effects. The AMP credited by the applicant could be an AMP that is described and evaluated in the GALL-SLR Report or a plant-specific program. The review procedures are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.2.3.4 Aging Management Programs

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR Report AMP. If the applicant identifies, in the SLRA AMP, an exception to any of the program elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3) (TN4878). If the reviewer identifies a difference, not identified by the SLRA between the SLRA AMP and the GALL-SLR Report AMP with which the SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions, or differences. The AMPs evaluated in the GALL-SLR Report pertinent to the engineered safety features components are summarized in Table 3.2-1 of this SRP-SLR. The “GALL-SLR Item” column identifies the AMR item numbers in the GALL-SLR Report, Chapter V, presenting detailed information summarized by this row.

If the applicant chooses to use a plant-specific program that is not a GALL-SLR Report AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix 0 of this SRP-SLR).

3.2.3.5 Final Safety Analysis Report Supplement

The reviewer confirms that the applicant has provided in its FSAR Supplement information equivalent to that provided in GALL-SLR Table X-01 and Table XI-01 for aging management of the engineered safety features. Table 3.2-2 lists the AMPs that are applicable for this SRP-SLR Section. The reviewer also confirms that the applicant has provided information equivalent to that in GALL-SLR Table X-01 and Table XI-01 and Section 3.2.3.3 of this SRP-SLR, “Aging Management Review Results Not Consistent With or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report.”

The NRC staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update reqIed pursuant to 1IFR 50.71(e)(4) (TN249). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR Supplement before the license is renewed, no condition will be necessary.

An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.2.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of this section, then an evaluation finding similar to the following text should be included in the NRC staff’s SER:

> On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated that the aging effects associated with the engineered safety features systems components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the subsequent period of extended operation, as required by 10 CFR 54.21(a)(3) (TN4878).
>
> The staff also reviewed the applicable FSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the engineered safety features systems, as required by 10 CFR 54.21(d).

3.2.5 Implementation

Except for cases in which the applicant proposes an alternative method for complying with specified portions of NRC regulations, the NRC staff members follow the methods described herein in their evaluation of conformance with NRC regulations. The staff evaluates these alternatives and finds them acceptable if the staff determines that the alternatives provide reasonable assurance that the component’s intended functions will be maintained.

3.2.6 References

1. NRC. NUREG–0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, LWR Edition.” Agencywide Documents Access and Management System (ADAMS) Accession No. ML070630046. Washington, DC: U.S. Nuclear Regulatory Commission. March 2007. NRC 2021-TN8013

2. NRC. NUREG–1557, “Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal.” Washington, DC: U.S. Nuclear Regulatory Commission. October 1996.

3. ACI. ACI Standard 318-95, “Building Code Requirements for Reinforced Concrete and Commentary.” Farmington Hills, Michigan: American Concrete Institute. 1995.

4. ACI. ACI Standard 349 85, “Code Requirements for Nuclear Safety-Related Concrete Structures.” Farmington Hills, Michigan: American Concrete Institute. 1985.

5. ANSI. ANSI Standard H35.1/H35.1M, “Alloy and Temper Designation Systems for Aluminum.” New York, New York: American National Standards Institute, Inc. 2013.

6. ASM. Corrosion of Aluminum and Aluminum Alloys. J. R. Davis, ed. Materials Park, Ohio: ASM International. 1999.

7. NRL. Stress-Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys. B. F. Brown, ed. Washington, DC: Naval Research Laboratory. 1972.

8. NRC Information Notice 2007-21, “Pipe Wear Due to Interaction of Flow-Induced Vibrations,” Supplement 1, ADAMS Accession No. ML20225A204. Washington, DC: U.S. Nuclear Regulatory Commission. December 11, 2020

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	001	Boiling water reactor (BWR)/pressurized water reactor (PWR)	Stainless steel (SS), steel piping, piping components exposed to any environment	Cumulative fatigue damage due to fatigue	TLAA, Standard Review Plan for Review of Subsequent License Renewal (SRP-SLR) Section 4.3 ““Metal Fatigue”“	Yes (SRP-SLR Section 3.2.2.1)	V.D1.E-13 V.D2.E-10
D	002						
E	005	PWR	SS orifice (miniflow recirculation when centrifugal high-pressure safety injection (HPSI) pumps are used for normal charging) exposed to treated borated water	Loss of material due to erosion	AMP XI.M32, ““One-Time Inspection”“	No	V.D1.E-24
	006	BWR	Metallic drywell and suppression chamber spray system (internal surfaces): flow orifice; spray nozzles exposed to air – indoor uncontrolled, condensation	Loss of material due to general, pitting, crevice corrosion; flow blockage due to fouling	AMP XI.M32, ““One-Time Inspection,”“ or AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”“	Yes (SRP-SLR Section 3.2.2.2.3)	V.D2.EP-113a V.D2.EP-113b

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	007	BWRSS piping, piping components, tanks exposed to air, condensation	Cracking due to stress corrosion cracking (SCC)	AMP XI.M32, ""One-Time Inspection,"" AMP XI.M36, ""External Surfaces Monitoring of Mechanical Components,"" AMP XI.M38, ""Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,"" or AMP XI.M42, ""Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks""	Yes (SRP-SLR Section 3.2.2.2.4)	V.A.EP-103b V.A.EP-103c V.A.EP-103d V.A.EP-103e V.B.EP-103b V.B.EP-103c V.B.EP-103d V.B.EP-103e V.C.EP-103b V.C.EP-1—c V.C.EP-10— V.C.EP-103e V.D1.EP-103b V.D1.EP-103c V.D1.EP-103d V.D1.EP-103e V.D2.EP-103b V.D2.EP-103c V.D2.EP-103d V.D2.EP-103e	
	008	PWR	Copper alloy (>15% Zinc) piping, piping components exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, ""Boric Acid Corrosion""	No	V.E.EP-38

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	009	PWR	Steel external surfaces exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, ““Boric Acid Corrosion”“	No	V.E.E-28
	010	BWR/PWR	Cast austenitic stainless steel (CASS) piping, piping components exposed to treated borated water >250 °C (>482 °F), treated water >250 °C (>482 °F)	Loss of fracture toughness due to thermal aging embrittlement	AMP XI.M12, ““Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)”“	No	V.D1.E-47 V.D2.E-11
E	011	BWR/PWR	Steel piping, piping components exposed to steam, treated water	Wall thinning due to flow-accelerated corrosion	AMP XI.M17, ““Flow Accelerated Corrosion”“	No	V.C.E-09 V.D1.E-09 V.D2.E-07 V.D2.E-09
	012	BWR/PWR	High-strength steel closure bolting exposed to air, soil, underground	Cracking due to “SCC; cyclic loadin”g”	AMP XI.M18, “Bolting Integrity”	No	V.E.E-03
D	01						
	014	BWR/PWR	SS, steel, nickel-alloy closure bolting exposed to air-indoor uncontrolled, air outdoor, condensation	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M18, ““Bolting Integrity”“	No	V.E.E-02

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	015	BWR/PWR	Metallic closure bolting exposed to any environment, soil underground	Loss of preload due to thermal effects, gasket creep, self-loosening	AMP XI.M18, ““Bolting Integrity”“	No	V.E.EP-116
E	016	BWR/PWR	Steel piping, piping components exposed to treated water	Loss of material due to general, pitting, crevice corrosion, microbiologically-induced corrosion (MIC)	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	V.C.EP-62 V.D2.EP-60
E	017	BWR/PWR	Aluminum piping, piping components exposed to treated water, treated borated water	Loss of material due to pitting, crevice corrosion	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	V.D1.EP-71 V.D2.EP-71
D	018						
M	019	BWR/PWR	Stainless steel, nickel-alloy heat exchanger tubes exposed to treated water, treated borated water	Reduction of heat transfer due to fouling	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	V.A.E-20 V.D2.EP-74 V.D1.E-20
	020	PWR	3.2-24 or 3.2-24icSS, steel (with SS or nickel-alloy cladding) piping, piping components, tanks	Cracking due to SCC	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	V.A.E-12 V.D1.E-12

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			exposed to treated borated water >60 °C (>140 °F)				
D	021						
	0223.2-25 or 3.2-25icR	Nickel-alloy, SS heat exchanger components, piping, piping components, tanks exposed to treated water, treated borated water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	V.A.E-428 V.A.EP-41 V.C.EP-63 V.D1.E-428 V.D2.E-428 V.D1.EP-41 V.D2.EP-73	
	023	BWR/PWR	Steel heat exchanger components, piping, piping components exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, ““Open Cycle Cooling Water System”“	No	V.A.EP-90 V.C.E-22 V.D1.EP-90 V.D2.EP-90
	024	PWR	SS piping, piping components exposed to raw water	Loss of material due to pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, ““Open Cycle Cooling Water System”“	No	V.C.E-34 V.D1.EP-55
	025	BWR/PWR	SS heat exchanger components exposed to raw water	Loss of material due to pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, ““Open Cycle Cooling Water System”“	No	V.A.EP-91 V.D1.EP-91 V.D2.EP-91

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
D	02						
	027	BWR/PWR	SS, steel heat exchanger tubes exposed to raw water	Reduction of heat transfer due to fouling	AMP XI.M20, ""Open Cycle Cooling Water System""	No	V.A.E-21 V.D1.E-21 V.D2.E-21 V.D2.E-23
	028	BWR/PWR	SS piping, piping components exposed to closed-cycle cooling water >60 °C (>140 °F)	Cracking due to SCC	AMP XI.M21A, ""Closed Treated Water Systems""	No	V.A.EP-98 V.C.EP-98 V.D1.EP-98 V.D2.EP-98
	029	BWR/PWR	Steel piping, piping components exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, ""Closed Treated Water Systems""	No	V.C.EP-99
	030	BWR/PWR	Steel heat exchanger components exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, ""Closed Treated Water Systems""	No	V.A.EP-92 V.D1.EP-92 V.D2.EP-92
	031	BWR/PWR	SS heat exchanger components, piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, ""Closed Treated Water Systems""	No	V.A.EP-93 V.A.EP-95 V.C.EP-95 V.D1.EP-93 V.D1.EP-95 V.D2.EP-93 V.D2.EP-95

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	032	BWR/PWR	Copper alloy heat exchanger components, piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, ""Closed Treated Water Systems""	No	V.A.EP-94 V.A.EP-97 V.B.EP-97 V.D1.EP-94 V.D1.EP-97 V.D2.EP-94 V.D2.EP-97
	033	BWR/PWR	Copper alloy, SS heat exchanger tubes exposed to closed-cycle cooling water	Reduction of heat transfer due to fouling	AMP XI.M21A, ""Closed Treated Water Systems""	No	V.A.EP-100 V.A.EP-96 V.D1.EP-96 V.D2.EP-96
	034	BWR/PWR	Copper alloy (>15% zinc or >8% aluminum) piping, piping components, heat exchanger components exposed to closed-cycle cooling water, treated water	Loss of material due to selective leaching	AMP XI.M33, ""Selective Leaching""	No	V.A.EP-27 V.A.EP-37 V.B.EP-27 V.B.EP-37 V.D1.EP-27 V.D1.EP-37 V.D2.EP-27 V.D2.EP-37
	035	PWR	Gray cast iron motor cooler exposed to closed-cycle cooling water, treated water	Loss of material due to selective leaching	AMP XI.M33, ""Selective Leaching""	No	V.A.E-43 V.D1.E-43
M	036	PWR	Gray cast iron, ductile iron, malleable iron	Loss of material due to selective leaching	AMP XI.M33, ""Selective Leaching""	No	V.D1.EP-52

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			piping, piping components exposed to closed-cycle cooling water, treated water				
M	037	BWR/PWR	Gray cast iron, ductile iron, malleable iron piping, piping components exposed to soil	Loss of material due to selective leaching	AMP XI.M33, ““Selective Leaching”“	No	V.B.EP-54 V.D1.EP-54 V.D2.EP-54
	038	BWR/PWR	Elastomer piping, piping components, seals exposed to air, condensation	Hardening or loss of strength due to elastomer degradation	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	No	V.E.EP-59
D	039						
	040	BWR/PWR	Steel external surfaces exposed to air – indoor uncontrolled, air – outdoor, condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	No	V.E.E-44
D	041						
	042	BWR/PWR	Aluminum piping, piping components, tanks exposed to air,	Loss of material due to pitting, crevice corrosionAMP XI.M32, ““One-Time	Yes (SRP-SLR Section 3.2.2.2.10)	V.E.EP-114b V.E.EP-114c V.E.EP-114d	

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			condensation (external)	Inspection,"" AMP XI.M36, ""External Surfaces Monitoring of Mechanical Components,"" or AMP XI.M42, ""Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks""			
M	043	BWR/PWR	Elastomer piping, piping components, seals exposed to air, condensation	Hardening or loss of strength due to elastomer degradation	AMP XI.M38, ""Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components""	No	V.B.EP-58 V.A.E-427 V.B.E-427 V.D1.E-427 V.D2.E-427
M	044	BWR/PWR	Steel piping, piping components, ducting, ducting components exposed to air – indoor uncontrolled	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, ""Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components""	No	V.A.E-29 V.B.E-25 V.D2.E-29
	045	PWR	Steel encapsulation components exposed to air – indoor uncontrolled	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, ""Inspection of Internal Surfaces in Miscellaneous	No	V.A.EP-42 V.C.EP-42 V.D1.EP-42

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
					Piping and Ducting Components""		
	046	BWR/PWR	Steel piping, piping components exposed to condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, ""Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components""	No	V.B.E-27 V.D1.E-27 V.D2.E-27
	047	PWR	Steel encapsulation components exposed to air with borated water leakage	Loss of material due to general, pitting, crevice, boric acid corrosion	AMP XI.M38, ""Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components""	No	V.A.EP-43 V.C.EP-43 V.D1.EP-43
E	048	BWR/PWR	SS, nickel-alloy piping, piping components, tanks exposed to air, condensation (internal)	Loss of material due to pitting, crevice corrosion	AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks,"" AMP XI.M32, ""One-Time Inspection,"" AMP XI.M38, ""Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,"" or AMP XI.M42, ""Internal	Yes (SRP-SLR Section 3.2.2.2.2)	V.A.EP-81a V.A.EP-81b V.A.EP-81c V.A.EP-81d V.D1.EP-81a V.D1.EP-81b V.D1.EP-81c V.D1.EP-81d V.D2.EP-61a V.D2.EP-61b V.D2.EP-61c V.D2.EP-61d

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
					Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”“		
E	049	BWR/PWR	Steel piping, piping components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, ““Lubricating Oil Analysis,”“ and AMP XI.M32, ““One-Time Inspection”“	No	V.A.EP-77 V.D1.EP-77 V.D2.EP-77
E	050	BWR/PWR	Copper alloy, stainless steel piping, piping components exposed to lubricating oil	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M39, ““Lubricating Oil Analysis,”“ and AMP XI.M32, ““One-Time Inspection”“	No	V.A.EP-76 V.D1.EP-76 V.D1.EP-80 V.D2.EP-76
	051	BWR/PWR	Steel, copper alloy, stainless steel heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	AMP XI.M39, ““Lubricating Oil Analysis,”“ and AMP XI.M32, ““One-Time Inspection”“	No	V.A.EP-75 V.A.EP-78 V.A.EP-79 V.D1.EP-75 V.D1.EP-78 V.D1.EP-79 V.D2.EP-75 V.D2.EP-78 V.D2.EP-79
	052	BWR/PWR	Steel piping, piping components exposed to soil,	Loss of material due to general, pitting,	AMP XI.M41, ““Buried and	No	V.E.EP-111 V.E.EP-123

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			concrete, underground	crevice corrosion, MIC (soil only)	Underground Piping and Tanks”“		
	053	BWR/PWR	SS, nickel-alloy piping, piping components, tanks, exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, ““Buried and Underground Piping and Tanks”“	No	V.E.EP-72
D	053a						
E	054	BWR	SS, nickel-alloy piping, piping components ≥4 nominal pipe size exposed to treated water >93 °C (>200 °F)	Cracking due to SCC, intergranular stress corrosion cracking (IGSCC)	AMP XI.M7, ““BWR Stress Corrosion Cracking,”“ and AMP XI.M2, ““Water Chemistry”“	No	V.D2.E-37
	055	BWR/PWR	Steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.2.2.2.9)	V.F.EP-112
	056	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation (internal)	Loss of material due to pitting, crevice corrosion	AMP XI.M32, ““One-Time Inspection,”“ AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,”“ or AMP XI.M42, ““Internal	Yes (SRP-SLR Section 3.2.2.2.10)	V.A.EP-3b V.A.EP-3c V.A.EP-3d V.D1.EP-3b V.D1.EP-3c V.D1.EP-3d V.D2.EP-3b V.D2.EP-3c V.D2.EP-3d

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
					Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”“		
	057	BWR/PWR	Copper alloy piping, piping components exposed to air, condensation, gas	None	None	No	V.F.EP-10
	058	PWR	Copper alloy, copper alloy (>8% aluminum) piping, piping components exposed to air with borated water leakage	None	None	No	V.F.EP-12
	059	BWR/PWR	Galvanized steel ducting, ducting components, piping, piping components exposed to air – indoor controlled	None	None	No	V.F.EP-14
	060	BWR/PWR	Glass piping elements exposed to air, underground, lubricating oil, raw water, treated water, treated borated	None	None	No	V.F.EP-15 V.F.EP-16 V.F.EP-28 V.F.EP-29 V.F.EP-30 V.F.EP-65

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			water, air with borated water leakage, condensation, gas, closed-cycle cooling water				V.F.EP-66 V.F.EP-67 V.F.EP-68
D	061						
	062	BWR/PWR	Nickel-alloy piping, piping components exposed to air with borated water leakage	None	None	No	V.F.EP-115
	063	BWR/PWR	SS piping, piping components exposed to air with borated water leakage, gas	None	None	No	V.F.EP-19 V.F.EP-22
	064	BWR/PWR	Steel piping, piping components exposed to air – indoor controlled, gas	None	None	No	V.F.EP-4 V.F.EP-7
	065	BWR/PWR	Metallic piping, piping components exposed to treated water, treated borated water	Wall thinning due to erosion	AMP XI.M17, ““Flow Accelerated Corrosion”	No	V.D1.E-407 V.D2.E-408

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	066	BWR/PWR	Metallic piping, piping components, tanks exposed to raw water, waste water	Loss of material due to recurring internal corrosion	AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”“	Yes (SRP-SLR Section 3.2.2.2.7)	V.A.E-400 V.B.E-400 V.C.E-400 V.D1.E-400 V.D2.E-400
	067	BWR/PWR	SS tanks (within the scope of AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks”“) exposed to soil, concrete	Cracking due to SCC	AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks”“	No	V.D1.E-405 V.D2.E-405
	068	BWR/PWR	Steel tanks (within the scope of AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks”“) exposed to soil, concrete, air, condensation	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks”“	No	V.D1.E-402 V.D2.E-402
	069	BWR/PWR	Insulated steel piping, piping components, tanks (within the scope of AMP XI.M29,	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“ or	No	V.E.E-403a V.E.E-403b

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			““Outdoor and Large Atmospheric Metallic Storage Tanks”“) exposed to air, condensation		AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks”“		
	070	BWR/PWR	Steel, SS, aluminum tanks (within the scope of AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks”“) exposed to treated water, treated borated water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC (steel, stainless steel only)	AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks”“	No	V.A.E-404 V.D1.E-404 V.D2.E-404
	071	BWR/PWR	Insulated copper alloy (>15% zinc or >8% aluminum) piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	No	V.E.E-406
M	072	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, or physical	AMP XI.M42, ““Internal Coatings/Linings for In-Scope Piping, Piping Components,	No	V.A.E-401 V.B.E-401 V.C.E-401 V.D1.E-401 V.D2.E-401

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			cycle cooling water, raw water, treated water, treated borated water, lubricating oil, condensation	damage; loss of material or cracking for cementitious coatings/linings	Heat Exchangers, and Tanks”“		
	073	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, treated borated water, lubricating oil, condensation	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M42, ““Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	No	V.A.E-414 V.B.E-414 V.C.E-414 V.D1.E-414 V.D2.E-414
	074	BWR/PWR	Gray cast iron, ductile iron, malleable iron piping, piping components with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, treated	Loss of material due to selective leaching	AMP XI.M42, ““Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	No	V.A.E-415 V.B.E-415 V.C.E-415 V.D1.E-415 V.D2.E-415

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			borated water, waste water				
D	075						
	076	BWR/PWR	SS, steel, nickel-alloy, copper alloy closure bolting exposed to treated water, treated borated water, raw water, waste water, lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC (steel, copper alloy in raw water, waste water only)	AMP XI.M18, ““Bolting Integrity”“	No	V.E.E-418
D	077						
	078	BWR/PWR	SS, steel, aluminum piping, piping components, tanks exposed to soil, concrete	Cracking due to SCC (steel in carbonate/bicarbonate environment only)	AMP XI.M41, ““Buried and Underground Piping and Tanks”“	No	V.E.E-420
	079	BWR/PWR	SS closure bolting exposed to air, soil, concrete, underground	Cracking due to SCC	AMP XI.M18, ““Bolting Integrity”“	No	V.E.E-421
E	080	BWR/PWR	SS underground piping, piping components, tanks	Cracking due to SCCAMP XI.M32, ““One Time Inspection,”“ AMP XI.M41, ““Buried and Underground Piping and Tanks,”“ or AMP	Yes (SRP-SLR Section 3.2.2.2.4)	V.E.E-423a V.E.E-423b V.E.E-423c	

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
				XI.M42, ""Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks""			
	081	BWR/PWR	SS, steel, aluminum, copper alloy, titanium heat exchanger tubes exposed to air, condensation	Reduction of heat transfer due to fouling	AMP XI.M36, ""External Surfaces Monitoring of Mechanical Components""	No	V.E.E-424
D	083						
D	084						
D	085						
D	086						
	087	BWR/PWR	Nonmetallic thermal insulation exposed to air, condensation	Reduced thermal insulation resistance due to moisture intrusion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.E-422
D	089						
	090	BWR/PWR	Steel components exposed to treated water, treated borated water, raw water	Long-term loss of material due to general corrosion	AMP XI.M32, ""One Time Inspection""	No	V.A.E-434 V.B.E-434 V.C.E-434 V.D1.E-434 V.D2.E-434

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	091	BWR/PWR	SS piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.2.2.2.9)	V.F.EP-20
D	092						
D	095						
	096	BWR/PWR	Steel, SS piping, piping components exposed to raw water (for components not covered by NRC GL 89-13)	Loss of material due to general (steel only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M38, ""Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components""	No	V.D1.E-439 V.D2.E-440
D	097						
	098	BWR/PWR	Copper alloy (>15% zinc or >8% aluminium) piping, piping components exposed to soil	Loss of material due to selective leaching	AMP XI.M33, ""Selective Leaching""	No	V.D1.E-441 V.D2.E-441
	099	BWR/PWR	SS, nickel-alloy tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosionAMP XI.M32, ""One Time Inspection,"" AMP XI.M36, ""External Surfaces Monitoring of Mechanical Components,"" AMP XI.M38, ""Inspection	Yes (SRP-SLR Section 3.2.2.2.2)	V.E.E-442a V.E.E-442b V.E.E-442c V.E.E-442d	

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
				of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks""			
	100	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation (internal), raw water, waste water	Cracking due to SCCAMP XI.M32, ""One Time Inspection,"" AMP XI.M38, ""Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,"" or AMP XI.M42, ""Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks""	Yes (SRP-SLR Section 3.2.2.2.8)	V.A.E-443b V.A.E-443c V.A.E-443d V.B.E-443b V.B.E-443c V.B.E-443d V.D1.E-443b V.D1.E-443c V.D1.E-443d V.D2.E-443b V.D2.E-443c V.D2.E-443d	

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	101	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation (external)	Cracking due to SCCAMP XI.M32, ““One Time Inspection,”“ AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components,”“ or AMP XI.M42, ““Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	Yes (SRP-SLR Section 3.2.2.2.8)	V.E.E-444b V.E.E-444c V.E.E-444d	
	102	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks”“) exposed to air, condensation, soil, concrete, raw water, waste water	Cracking due to SCC	AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks,”“ AMP XI.M32, ““One-Time Inspection,”“ or AMP XI.M42, ““Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	Yes (SRP-SLR Section Error**! Unknown switch argument.**)	V.D1.E-445a V.D1.E-445b V.D1.E-445c V.D2.E-445a V.D2.E-445b V.D2.E-445c

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	103	BWR/PWR	SS tanks (within the scope of AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks"") exposed to air, condensation	Cracking due to SCC	AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks,"" AMP XI.M32, ""One Time Inspection,"" or AMP XI.M42, ""Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks""	Yes (SRP-SLR Section Error**! Unknown switch argument.**)	V.D1.E-446a V.D1.E-446b V.D1.E-446c V.D2.E-446a V.D2.E-446b V.D2.E-446c
	104	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks"") exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks""	No	V.D1.E-447 V.D2.E-447
	105	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks"") exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks,"" AMP XI.M32, ""One Time Inspection,"" or AMP XI.M42, ""Internal	Yes (SRP-SLR Section 3.2.2.2.10)	V.D1.E-448a V.D1.E-448b V.D1.E-448c V.D2.E-448a V.D2.E-448b V.D2.E-448c

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
					Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks""		
N	106	BWR/PWR	SS, nickel alloy tanks (within the scope of AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks"") exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks,"" AMP XI.M32, "One Time Inspection,"" or AMP XI.M42, ""Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks""	Yes (SRP-SLR Section Error**! Unknown switch argument.**)	V.D1.E-449a V.D1.E-449b V.D1.E-449c V.D2.E-449a V.D2.E-449b V.D2.E-449c
	107	BWR/PWR	Insulated SS, nickel-alloy piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks,"" AMP XI.M32, ""One Time Inspection,"" AMP XI.M36, ""External Surfaces Monitoring of Mechanical Components,"" or	Yes (SRP-SLR Section 3.2.2.2.2)	V.E.E-450a V.E.E-450b V.E.E-450c V.E.E-450d

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
					AMP XI.M42, ""Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks""		
	108	BWR/PWR	Insulated SS piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks,"" AMP XI.M32, ""One-Time Inspection,"" AMP XI.M36, ""External Surfaces Monitoring of Mechanical Components,"" or AMP XI.M42, ""Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks""	Yes (SRP-SLR Section 3.2.2.2.4)	V.E.E-451a V.E.E-451b V.E.E-451c V.E.E-451d
	109	BWR/PWR	Insulated aluminum piping, piping components, tanks	Cracking due to SCC	AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks,""	Yes (SRP-SLR Section 3.2.2.2.8)	V.E.E-452a V.E.E-452b V.E.E-452c V.E.E-452d

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			exposed to air, condensation		AMP XI.M32, ""One Time Inspection,"" AMP XI.M36, ""External Surfaces Monitoring of Mechanical Components,"" or AMP XI.M42, ""Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks""		
	110	BWR/PWR	Aluminum underground piping, piping components, tanks	Cracking due to SCCAMP XI.M32, ""One Time Inspection,"" AMP XI.M41, ""Buried and Underground Piping and Tanks,"" or AMP XI.M42, ""Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks""	Yes (SRP-SLR Section 3.2.2.2.8)	V.E.E-453a V.E.E-453b V.E.E-453c	

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	111	BWR/PWR	Aluminum underground piping, piping components, tanks	Loss of material due to pitting, crevice corrosionAMP XI.M32, ““One-Time Inspection,”“ AMP XI.M41, ““Buried and Underground Piping and Tanks,”“ or AMP XI.M42, ““Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	Yes (SRP-SLR Section 3.2.2.2.10)	V.E.E-454a V.E.E-454b V.E.E-454c	
	112	BWR/PWR	Stainless steel, nickel-alloy underground piping, piping components, tanks	Loss of material due to pitting, crevice corrosionAMP XI.M32, ““One Time Inspection,”“ AMP XI.M41, ““Buried and Underground Piping and Tanks,”“ or AMP XI.M42, ““Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	Yes (SRP-SLR Section 3.2.2.2.2)	V.E.E-455a V.E.E-455b V.E.E-455c	
D	113						

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	114	BWR/PWR	SS, nickel-alloy piping, piping components exposed to treated water >60 °C (>140 °F)	Cracking due to SCC	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	V.B.E-457 V.C.E-457 V.D2.E-457
	115	BWR/PWR	Titanium heat exchanger tubes exposed to treated water	Cracking due to SCC, reduction of heat transfer due to fouling	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	V.A.E-458 V.D1.E-458 V.D2.E-458
E	116	BWR/PWR	Titanium ([ASTM] Grades 1, 2, 7, 9, 11, or 12) heat exchanger components other than tubes, piping, piping components exposed to treated water	None	None	No	V.F.E-459
	117	BWR/PWR	Titanium heat exchanger tubes exposed to closed-cycle cooling water	Cracking due to SCC, reduction of heat transfer due to fouling	AMP XI.M21A, ““Closed Treated Water Systems”“	No	V.A.E-460 V.D1.E-460 V.D2.E-460
	118	BWR/PWR	Titanium (ASTM Grades 1, 2, 7, 9, 11, or 12) heat exchanger	None	None	No	V.F.E-461

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			components other than tubes, piping, piping components exposed to closed-cycle cooling water				
E	119	BWR/PWR	Insulated aluminum piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks,”“ AMP XI.M32, ““One-Time Inspection,”“ AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components,”“ or AMP XI.M42, ““Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	Yes (SRP-SLR Section 3.2.2.2.10)	V.E.E-462a V.E.E-462b V.E.E-462c V.E.E-462d
	120	BWR/PWR	Aluminum piping, piping components, tanks exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M41, ““Buried and Underground Piping and Tanks”“	No	V.E.E-463

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	121	BWR/PWR	Aluminum piping, piping components, tanks exposed to raw water, waste water	Loss of material due to pitting, crevice corrosion	AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks,”“ AMP XI.M32, ““One-Time Inspection,”“ AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,”“ or AMP XI.M42, ““Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	Yes (SRP-SLR Section 3.2.2.2.10)	V.E.E-464a V.E.E-464b V.E.E-464c V.E.E-464d
	122	BWR/PWR	Elastomer piping, piping components, seals exposed to air	Loss of material due to wear	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	No	V.E.E-465
	123	BWR/PWR	Elastomer piping, piping components, seals exposed to air	Loss of material due to wear	AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous	No	V.A.E-466 V.B.E-466 V.C.E-466 V.D1.E-466 V.D2.E-466

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
					Piping and Ducting Components”“		
	124	BWR/PWR	Aluminum piping, piping components, tanks exposed to air with borated water leakage	None	None	No	V.F.E-467
	125	BWR/PWR	Steel closure bolting exposed to soil, concrete, underground	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, ““Buried and Underground Piping and Tanks”“	No	V.E.E-468
	126	BWR/PWR	Titanium, super austenitic piping, piping components, tanks, closure bolting exposed to soil, concrete, underground	Loss of material due to pitting, crevice corrosion, MIC (except for titanium; soil environment only)	AMP XI.M41, ““Buried and Underground Piping and Tanks”“	No	V.E.E-469
	127	BWR/PWR	Copper alloy piping, piping components exposed to concrete	None	None	No	V.F.E-470
	128	BWR/PWR	Copper alloy piping, piping components exposed to soil, underground	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, ““Buried and Underground Piping and Tanks”“	No	V.E.E-471
	129	BWR/PWR	Stainless steel tanks exposed to soil, concrete	Loss of material due to pitting, crevice	AMP XI.M29, ““Outdoor and Large	No	V.D1.E-472 V.D2.E-472

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
				corrosion, MIC (soil only)	Atmospheric Metallic Storage Tanks”“		
	130	BWR/PWR	Steel heat exchanger components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, ““Lubricating Oil Analysis,”“ and AMP XI.M32, ““One Time Inspection”“	No	V.A.E-473 V.D1.E-473 V.D2.E-473
	131	BWR/PWR	Aluminum piping, piping components exposed to raw water	Flow blockage due to fouling	AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”“	No	V.A.E-474 V.B.E-474 V.D1.E-474 V.D2.E-474
M	132	BWR/PWR	Titanium (ASTM Grades 3, 4, or 5) heat exchanger tubes exposed to raw water	Cracking due to SCC, flow blockage due to fouling	AMP XI.M20, ““Open Cycle Cooling Water System”“	No	V.A.E-475 V.D1.E-475 V.D2.E-475
	133	BWR/PWR	Titanium piping, piping components, heat exchanger components exposed to raw water	Cracking due to SCC, flow blockage due to fouling	AMP XI.M20, ““Open Cycle Cooling Water System”“	No	V.B.E-476 V.C.E-476 V.D2.E-476
M	134	BWR/PWR	Polymeric piping, piping components, ducting, ducting components, seals	Hardening or loss of strength due to polymeric degradation; loss of	AMP XI.M36, ““External Surfaces Monitoring of Mechanical	No	V.A.E-477b V.B.E-477b V.D1.E-477b

Table 3.2-1 Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			exposed to air, condensation, raw water, raw water (potable), treated water, waste water, underground, concrete, soil	material due to peeling, delamination, wear; cracking or blistering due to exposure to ultraviolet light, ozone, radiation, or chemical attack; flow blockage due to fouling (Inspection of Internal Surfaces only)	Components,”“ AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components“		V.D2.E-477b V.E.E-477a
N	135	BWR/PWR	Steel, stainless steel or nickel-alloy ASME Code Class 2 small-bore piping, and piping components with reflective metal insulation exposed to air	Loss of material due to wear	Plant-specific or existing aging management program if loss of material is not mitigated	Yes (SRP-SLR Section 3.2.2.2.11)	V.A.E-457 V.B.E-457 V.C.E-457 V.D1.E-457 V.D2.E-457 V.E.E-457

AMP = aging management program; BWR = boiling water reactor; CASS = cast austenitic stainless steel; HPSI = high-pressure safety injection; IGSCC = intergranular stress corrosion cracking; MIC = microbiologically-induced corrosion; PWR = pressurized water reactor; SCC = stress corrosion cracking; SRP-SLR = Standard Review Plan for Review of Subsequent License Renewal; SS = stainless steel; TLAA = Time-Limited Aging Analyses.

Table 3.2-2 Aging Management Programs and Additional Guidance Appendices Recommended for Aging Management of Engineered Safety Features

Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report Chapter/Aging Management Program (AMP)	Program Name
AMP XI.M2	Water Chemistry
AMP XI.M7	Boiling Water Reactor Stress Corrosion Cracking
AMP XI.M10	Boric Acid Corrosion
AMP XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel
AMP XI.M17	Flow-Accelerated Corrosion
AMP XI.M18	Bolting Integrity
AMP XI.M20	Open Cycle Cooling Water System
AMP XI.M21A	Closed Treated Water Systems
AMP XI.M29	Outdoor and Large Atmospheric Metallic Storage Tanks
AMP XI.M32	One-Time Inspection
AMP XI.M33	Selective Leaching
AMP XI.M36	External Surfaces Monitoring of Mechanical Components
AMP XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
AMP XI.M39	Lubricating Oil Analysis
AMP XI.M41	Buried and Underground Piping and Tanks
AMP XI.M42	Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks
GALL-SLR Report Appendix A	Quality Assurance for Aging Management Programs
GALL-SLR ReporAppendix B	Operating Experience for Aging Management Programs
Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants Appendix Section A.1	Aging Management Review—Generic (Branch Technical Position RLSB-1)

3.3 Aging Management of Auxiliary Systems

Review Responsibilities

Primary—The branch(es) assigned responsibility by the PM for the safety review of the SLRA.

Secondary—None

3.3.1 Areas of Review

This section addresses the AMR and the associated AMP of the auxiliary systems for SLR. For a recent vintage plant, the information related to the auxiliary systems contained in Chapter 9, "Auxiliary Systems," of the plant's FSAR consistent with the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NRC 2021-TN8013). The auxiliary systems contained in this review plan section are generally consistent with those contained in NUREG–0800 except for refueling water, chilled water, heat removal, condenser circulating water, and condensate storage system. For older plants, the location of applicable information is plant-specific because an older plant's FSAR may have predated NUREG–0800.

Typical auxiliary systems that are subject to an AMR for SLR are new fuel storage, spent fuel storage, spent fuel pool cooling and cleanup (BWR/PWR), suppression pool cleanup (BWR), overhead heavy load and light load (related to refueling) handling, open cycle cooling water, closed-cycle cooling water, ultimate heat sink, compressed air, chemical and volume control (PWR), standby liquid control (BWR), reactor water cleanup (BWR), shutdown cooling (older BWR), control room area ventilation, auxiliary and radioactive waste area ventilation, primary containment heating and ventilation, diesel generator building ventilation, fire protection, diesel fuel oil, and emergency diesel generator. This review plan section also includes SCs in nonsafety-related systems that are not connected to safety-related SSCs but have a spatial relationship such that their failure could adversely impact the performance of a safety-related SSC intended function. Examples of such nonsafety-related systems may be plant drains, liquid waste processing, potable/sanitary water, water treatment, process sampling, and cooling water systems.

Aging management is reviewed, following the guidance in this SRP-SLR Section 3.1, for portions of the chemical and volume control system for PWRs, and for standby liquid control, reactor water cleanup, and shutdown cooling systems extending up to the first isolation valve outside of containment for BWRs (the shutdown cooling systems for older BWRs). The following systems have portions that are classified as Group B quality standard: open cycle cooling water (service water system), closed-cycle cooling water, compressed air, standby liquid control, shutdown cooling system (older BWR), control room area ventilation, and auxiliary and radioactive waste area ventilation. Aging management for these portions is reviewed following the guidance in Section 3.3. The AMP for the cooling towers is reviewed following the guidance in Section 3.5 for "Group 6" structures.

The responsible review organization is to review the following SLR application AMR and AMP items assigned to it, per SRP-SLR Section 1.2:

AMRs

- AMR results consistent with the GALL-SLR Report

- AMR results for which further evaluation is recommended
- AMR results not consistent with or not addressed in the GALL-SLR Report

<u>AMPs</u>

- Consistent with GALL-SLR Report AMPs
- Plant-specific AMPs

<u>FSAR Supplement</u>

- The responsible review organization is to review the FSAR Supplement associated with each assigned AMP.

3.3.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the NRC regulations in 10 CFR 54.21.

3.3.2.1 Aging Management Review Results Consistent With the Generic Aging Lessons Learned for Subsequent License Renewal Report

The AMR and the AMPs applicable to the auxiliary system features are described and evaluated in Chapter VII of the GALL-SLR Report.

The applicant's SLRA should provide sufficient information so that the NRC reviewer is able to confirm that the specific SLRA AMR item and the associated SLRA AMP are consistent with the cited GALL-SLR Report AMR item. The reviewer should then confirm that the SLRA AMR item is consistent with the GALL-SLR Report AMR item to which it is compared.

When the applicant is crediting a different AMP than recommended in the GALL-SLR Report, the reviewer should confirm that the alternate AMP is valid to use for aging management and will be capable of managing the effects of aging as adequately as the AMP recommended by the GALL-SLR Report.

3.3.2.2 Aging Management Review Results for Which Further Evaluation Is Recommended by the Generic Aging Lessons Learned for Subsequent License Renewal Report

The basic acceptance criteria, defined in Section 3.3.2.1, need to be applied first for all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL-SLR Report AMR item to which the SLRA AMR item is compared identifies that "Further Evaluation Recommended," then additional criteria apply as identified by the GALL-SLR Report for each of the following aging effect/aging mechanism combinations. Refer to Table 3.3-1, comparing the "Further Evaluation Recommended" and the "GALL-SLR Item" column, for the AMR items that reference the following subsections.

3.3.2.2.1 Cumulative Fatigue Damage

Evaluations involving time-dependent fatigue or cyclical loading parameters may be TLAAs, as defined in 10 CFR 54.3 (TN4878). The TLAAs are required to be evaluatIin accordance with 10 CFR 54.21(c)(1). This TLAA is addressed separately in Section 4.3, "Metal Fatigue," or Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses," of this SRP-SLR. For plant-specific cumulative usage factor calculations that are based on stress-based input methods, the methods are to be appropriately defined and discussed in the applicable TLAAs.

3.3.2.2.2 Cracking Due to Stress Corrosion Cracking and Cyclic Loading

Cracking due to SCC and cyclic loading could occur in SS PWR nonregenerative heat exchanger tubing exposed to treated borated water greater than 60 °C (140 °F) in the chemical and volume control system. The existing AMP for monitoring and control of primary water chemistry in PWRs (GALL-SLR Report AMP XI.M2, “Water Chemistry”) 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. If a search of plant-specific OE does not reveal that cracking has occurred in nonregenerative heat exchanger tubing, this aging effect can be considered to be adequately managed by GALL-SLR Report AMP XI.M2. However, if cracking has occurred in nonregenerative heat exchanger tubing, the GALL-SLR Report recommends that AMP XI.M21A, “Closed Treated Water Systems,” be evaluated for inclusion of augmented requirements to conduct temperature and radioactivity monitoring of the shell-side water, and where component configuration permits, periodic eddy current testing of tubes.

3.3.2.2.3 Cracking Due to Stress Corrosion Cracking in Stainless Steel Alloys

Cracking due to SCC could occur in indoor or outdoor SS piping, piping components, and tanks exposed to any air, condensation, or underground environment when the component is: (i) uninsulated, (ii) insulated, (iii) in the vicinity of insulated components, or (iv) in the vicinity of potentially transportable halogens. Cracking can occur in environments containing sufficient halides (e.g., chlorides) in the presence of moisture.

Insulated SS components exposed to indoor air, outdoor air, condensation, or underground environments are susceptible to SCC if the insulation contains certain contaminants. Leakage of fluids through bolted connections (e.g., flanges, valve packing) can result in contaminants present in the insulation leaching onto the component surface or the surfaces of other components below the component. For outdoor insulated SS components, rain and changing weather conditions can result in moisture intrusion into the insulation.

Plant-specific OE and the condition of SS components are evaluated to determine if prolonged exposure to the plant-specific environments has resulted in SCC. SCC in SS components is not an aging effect which requires management if: (i) plant-specific OE does not reveal a history of SCC and (ii) a one-time inspection demonstrates that the aging effect is not occurring.

In the environment of air-indoor controlled, SCC is only expected to occur as the result of a source of moisture and halides. Inspections focus on the most susceptible locations. The applicant documents the results of the plant-specific OE review in the LRA.

The GALL-SLR Report recommends further evaluation of SS piping, piping components, and tanks exposed to an air, condensation, or underground environment to determine whether an AMP is needed to manage the aging effect of SCC. The GALL-SLR Report AMP XI.M32, “One-Time Inspection,” describes an acceptable program to demonstrate that SCC is not occurring. If SCC is applicable, the following AMPs describe acceptable programs to manage cracking due to SCC: (i) GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” for tanks; (ii) GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of

Mechanical Components," for external surfal of piping and piping components; (c) GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," for underground piping, piping components and tanks; and (d) GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," for internal surfaces of components that are not included in other AMPs. The timing of the one-time or periodic inspections is consistent with that recommended in the AMP selected by the applicant during the development of the SLRA. For example, one-time inspections would be conducted between the 50th and 60th year of operation, as recommended by the "Detection of Aging Effects" program element in GALL-SLR Report AMP XI.M32.

The applicant may mitigate or prevent cracking due to SCC through the use of a barrier coating to isolate the component from aggressive environments. However, the applicant should identify SCC as applicable for SLR and identify the AMP will be used to manage the integrity of the coating. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and air that contain halides. The GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," describes an acceptable program to manage the integrity of a barrier coating for internal or external coatings.

3.3.2.2.4 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and Nickel Alloys

Loss of material due to pitting and crevice corrosion could occur in indoor or outdoor SS and nickel-alloy piping, piping components, and tanks exposed to any air, condensation, or underground environment when the component is: (i) uninsulated; (ii) insulated; (iii) in the vicinity of insulated components; or (iv) in the vicinity of potentially transportable halogens. Loss of material due to pitting and crevice corrosion can occur on SS and nickel alloys in environments containing sufficient halides (e.g., chlorides) in the presence of moisture.

Insulated SS and nickel-alloy components exposed to air, condensation, or underground environments are susceptible to loss of material due to pitting or crevice corrosion if the insulation contains certain contaminants. Leakage of fluids through mechanical connections such as bolted flanges and valve packing can result in contaminants leaching onto the component surface or the surfaces of other parts below the component. For outdoor insulated SS and nickel-alloy components, rain and changing weather conditions can result in moisture intrusion into the insulation.

Plant-specific OE and the condition of SS and nickel-alloy components are evaluated to determine if prolonged exposure to the plant-specific environments has resulted in pitting or crevice corrosion. Loss of material due to pitting and crevice corrosion is not an aging effect which requires management for SS and nickel-alloy components if: (i) plant-specific OE does not reveal a history of loss of material due to pitting or crevice corrosion; and (ii) a one-time inspection demonstrates that the aging effect is not occurring or is occurring so slowly that it will not affect the intended function of the components during the subsequent period of extended operation. The applicant documents the results of the plant-specific OE review in the SLRA.

In the environment of air-indoor controlled, pitting and crevice corrosion is only expected to occur in the presence of a source of moisture and halides. Inspections focus on the most susceptible locations.

The GALL-SLR Report recommends further evaluation of SS and nickel-alloy piping, piping components, and tanks exposed to an air, condensation, or underground environment to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion. GALL-SLR Report AMP XI.M32, “One-Time Inspection,” describes an acceptable program to demonstrate that loss of material due to pitting and crevice corrosion is not occurring at a rate that affects the intended function of the components. If loss of material due to pitting or crevice corrosion has occurred and is sufficient to potentially affect the intended function of an SSC, the following AMPs describe acceptable programs to manage loss of material due to pitting or crevice corrosion: (a) GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” for tanks; (b) GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” for external surfaces of piping and piping components; (c) GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” for underground piping, piping components and tanks; and (d) GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” for internal surfaces of components that are not included in other AMPs. The timing of the one-time or periodic inspections is consistent with that recommended in the AMP selected by the applicant during the development of the SLRA. For example, one-time inspections would be conducted between the 50th and 60th year of operation, as recommended by the “detection of aging effects” program element in GALL-SLR Report AMP XI.M32.

The applicant may mitigate or prevent the loss of material due to pitting and crevice corrosion through the use of a barrier coating to isolate the component from aggressive environments. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and air that contain halides. GALL- SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” describes an acceptable program to manage the integrity of a barrier coating for internal or external coatings.

3.3.2.2.5 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in BTP IQMB-1 (Appendix A.2 of this SRP-SLR.)

3.3.2.2.6 Ongoing Review of Operating Experience

Acceptance criteria are described in Appendix A.4, “Operating Experience for Aging Management Programs.”

3.3.2.2.7 Loss of Material Due to Recurring Internal Corrosion

Recurring internal corrosion can result in the need to augment AMPs beyond the recommendations in the GALL-SLR Report. During the search of plant-specific OE conducted during the SLRA development, recurring internal corrosion can be identified by the number of occurrences of aging effects and the extent of degradation at each localized corrosion site. This further evaluation item is applicable if the search of plant-specific OE reveals repetitive occurrences. The criteria for recurrence is: (i) a 10 year search of plant-specific OE reveals the aging effect has occurred in three or more refueling outage cycles; or (ii) a five year search of plant-specific OE reveals the aging effect has occurred in two or more refueling outage cycles and resulted in the component either not meeting plant-specific acceptance criteria or experiencing a reduction in wall thickness greater than 50% (regardless of the minimum wall thickness).

The GALL-SLR Report recommends that GALL-SLR Report AMP XI.M20, “Open Cycle Cooling Water System,” GALL-SLR Report AMP XI.M27, “Fire Water System,” or GALL-SLR Report Section AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” be evaluated for inclusion of augmented requirements to ensure the adequate management of any recurring aging effect(s). Alternatively, a plant-specific AMP may be proposed. Potential augmented requirements include: alternative examination methods (e.g., volumetric versus external visual), augmented inspections (e.g., a greater number of locations, additional locations based on risk insights based on susceptibility to aging effect and consequences of failure, a greater frequency of inspections), and additional trending parameters and decision points where increase3.3-6or3.3-6icanttions would be implemented.

The applicant states: (i) why the program’s examination methods will be sufficient to detect the recurring aging effect before affecting the ability of a component to perform its intended function, (ii) the basis for the adequacy of augmented or lack of augmented inspections, (iii) the trend of which parameters will be followed as well as the decision points where increased inspections would be implemented (e.g., the extent of degradation at individual corrosion sites, the rate of degradation change), (iv) how inspections of components that are not easily accessed (i.e., buried, underground) will be conducted, and (v) how leaks in any involved buried or underground components will be identified.

Plant-specific OE examples should be evaluated to determine if the chosen AMP should be augmented even if the thresholds for significance of aging effect or frequency of occurrence of aging effect have not been exceeded. For example, during a 10 year search of plant-specific OE, two instances of 360 º 30% wall loss occurred at copper alloy to steel joints. Neither the significance of the aging effect nor the frequency of occurrence of aging effect threshold has been exceeded. Nevertheless, the OE should be evaluated to determine if the AMP that is proposed to manage the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of inspections) to provide reasonable assurance that the CLB intended functions of the component will be met throughout the subsequent period of extended operation. While recurring internal corrosion is not as likely in environments other than raw water and waste water (e.g., treated water), the aging effect should be addressed in a similar manner.

3.3.2.2.8 Cracking Due to Stress Corrosion Cracking in Aluminum Alloys

The SCC is a form of environmentally assisted cracking which is known to occur in high and moderate strength aluminum alloys. The three conditions necessary for SCC to occur in a component are a sustained tensile stress, aggressive environment, and material with a susceptible microstructure. Cracking due to SCC can be mitigated by eliminating one of the three necessary conditions. For the purposes of SLR, acceptance criteria for this further evaluation are provided for demonstrating that the specific material is not susceptible to SCC the ambient environment is not aggressive in nature. Cracking due to SCC is an aging effect that requires management unless it is demonstrated by the applicant that one of the two necessary conditions discussed below is absent.

<u>Susceptible Material</u>: If the material is not susceptible to SCC then cracking is not an aging effect which requires management. The microstructure of an aluminum alloy, of which alloy composition is only one factor, that determines whether the alloy is susceptible to SCC. Therefore, determining susceptibility based on alloy composition alone is not adequate to conclude whether a particular material is susceptible to SCC. The temper type, condition, and product form of the alloy is considered when assessing if a material is susceptible to SCC. Aluminum alloys that are susceptible to SCC include:

- 2xxx series alloys in the F, W, Ox, T3x, T4x, or T6x temper;
- 5xxx series alloys with a magnesium content of 3.5 wt% or greater;
- 6xxx series alloys in the F temper;
- 7xxx series alloys in the F, T5x, or T6x temper;
- 2xx.x and 7xx.x series alloys;
- 3xx.x series alloys that contain copper; and
- 5xx.x series alloys with a magnesium content of greater than 8 wt%.

The material is evaluated to verify that it is not susceptible to SCC and that the basis used to make the determination is technically substantiated. Tempers have been specifically developed to improve the SCC resistance for some aluminum alloys. Aluminum alloy and temper combination which are not susceptible to SCC when used in piping, piping component, and tank applications include 1xxx series, 3xxx series, 6061-T6x, 6063-T6, and 5454-x. If it is determined that a material is not susceptible to SCC, the SLRA provides the components/locations where it is used, alloy composition, temper or condition, and product form. For tempers not addressed above, the basis used to determine that the alloy is not susceptible and technical information substantiating the basis is added to the SLRA.

<u>Aggressive Environment</u>: If the environment to which an aluminum alloy is exposed is not aggressive, such as dry gas or treated water, then cracking due to SCC will not occur and it is not an aging effect that requires management. Aggressive environments that are known to result in cracking due to SCC of susceptible aluminum alloys include the presence of aqueous solutions, air, condensation, and underground locations that contain halides (e.g., chloride). Halide concentrations should be considered high enough to facilitate SCC of aluminum alloys in uncontrolled or untreated aqueous solutions and air, such as raw water, waste water, condensation, underground locations, and outdoor air, unless demonstrated otherwise.

Halides could be present on the surface of the aluminum material if the component is encapsulated in a material such as insulation layer or concrete. In a controlled or uncontrolled indoor air, condensation, or underground environment, halide concentrations sufficient to cause SCC could be present due to secondary sources such as leakage from nearby components (e.g., leakage from insulated flanged connections or valve packing). If an aluminum component is exposed to a halide-free indoor air environment, not encapsulated in materials containing halides, and the exposure to secondary sources of moisture or halides is precluded, cracking due to SCC is not expected to occur. The plant-specific configuration can be used to demonstrate that exposure to halides will not occur. If it is determined that SCC will not occur because the environment is not aggressive, the SLRA provides the components and locations exposed to the environment, a description of the environment, basis used to determine the environment is not aggressive, and technical information substantiating the basis. The GALL-SLR Report AMP XI.M32, “One-Time Inspection,” and a review of plant-specific OE describe an acceptable means to confirm the absence of moisture or halides within the proximity of the aluminum component.

If the environment potentially contains halides, GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” describes an acceptable program to manage cracking due to SCC of aluminum tanks. The GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” describes an acceptable program to manage cracking due to SCC of aluminum piping and piping components. The GALL-SLR Report AMP

XI.M41, “Buried and Underground Piping and Tanks,” describes an acceptable program to manage cracking due to SCC of aluminum piping and tanks which are buried or underground. The GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” describes an acceptable program to manage cracking due to SCC of aluminum components that are not included in other AMPs.

The applicant may mitigate or prevent cracking due to SCC through the use of a barrier coating to isolate the component from aggressive environments. However, the applicant should identify SCC as applicable for SLR and identify the AMP that will be used to manage the integrity of the coating. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and air that contain halides. GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” describes an acceptable program to manage the integrity of a barrier coating for internal or external coatings for internal or external coatings.

3.3.2.2.9 Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to Stress Corrosion Cracking

Loss of material due to general (steel only), crevice, or pitting corrosion, and cracking due to SCC (SS only) can occur in steel and SS piping and piping components exposed to concrete. Concrete provides a highly alkaline environment that can mitigate the effects of loss of material for steel piping, thereby significantly reducing the corrosion rate. However, if water intrudes through the concrete, the pH can be reduced and ions that promote loss of material such as chlorides, which can penetrate the protective oxide layer created in the highly alkaline environment, can reach the surface of the metal. Carbonation can reduce the pH within concrete. The rate of carbonation is reduced by using concrete with a low water-to-cement ratio and low permeability. Concrete with low permeability also reduces the potential for penetration of water. Adequate air entrainment improves the ability of the concrete to resist freezing and thawing cycles and therefore reduces the potential for cracking and intrusion of water. Cracking due to SCC, as well as pitting and crevice corrosion can occur due to halides present in the water that penetrate the surface of the metal.

If the following conditions are met, loss of material is not considered to be an applicable aging effect for steel: (i) 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; (ii) plant-specific OE indicates no degradation of the concrete that could lead to penetration of water to the metal surface; and (iii) the piping is not potentially exposed to groundwater. For SS components, loss of material and cracking due to SCC are not considered to be applicable aging effects as long as the piping is not potentially exposed to groundwater. Where these conditions are not met, loss of material due to general (steel only), crevice, or pitting corrosion, and cracking due to SCC (SS only) are identified as applicable aging effects. The GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” describes an acceptable program to manage these aging effects.

3.3.2.2.10 Loss of Material Due to Pitting and Crevice Corrosion in Aluminum Alloys

Loss of material due to pitting and crevice corrosion could occur in aluminum piping, piping components, and tanks exposed to an air, condensation, underground, raw water, or waste water environment for a sufficient duration of time. Environments that can result in pitting and/or crevice corrosion of aluminum alloys are those that contain halides (e.g., chloride) in the presence of moisture. The moisture level and halide concentration in atmospheric and uncontrolled air greatly depends on the geographical location and site-specific conditions. Moisture level and halide concentration should be considered high enough to facilitate pitting and/or crevice corrosion of aluminum alloys in atmospheric and uncontrolled air, unless demonstrated otherwise. The periodic introduction of moisture or halides into an environment from secondary sources should also be considered. Leakage of fluids from mechanical connections (e.g., insulated bolted flanges and valve packing); onto a component in indoor controlled air is an example of a secondary source that should be considered. Halide concentrations should be considered high enough to facilitate loss of material of aluminum alloys in untreated aqueous solutions, unless demonstrated otherwise. Plant-specific OE and the condition of aluminum alloy components are evaluated to determine if prolonged exposure to the plant-specific air, condensation, underground, or water environments has resulted in pitting or crevice corrosion. Loss of material due to pitting and crevice corrosion is not an aging effect which requires management for aluminum alloys if: (i) plant-specific OE does not reveal a history of loss of material due to pitting or crevice corrosion and (ii) a one-time inspection demonstrates that the aging effect is not occurring or is occurring so slowly that it will not affect the intended function of the components. Alternatively, loss of material due to pitting and crevice corrosion need not be managed if the type of aluminum is not susceptible to cracking and plant-specific operating experience does not reveal any issues related to loss of material due to pitting or crevice corrosion. The applicant documents the results of the plant-specific OE review in the SLRA.

In the environment of air-indoor controlled, pitting and crevice corrosion is only expected to occur in the presence of a source of moisture and halides. Alloy susceptibility may be considered when reviewing OE and interpreting inspection results. Inspections focus on the most susceptible alloys and locations.

The GALL-SLR Report recommends the further evaluation of aluminum piping, piping components, and tanks exposed to an air, condensation, or underground environment to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion. The GALL-SLR Report AMP XI.M32, “One-Time Inspection,” describes an acceptable program to demonstrate that the aging effect of loss of material due to pitting and crevice corrosion is not occurring at a rate that will affect the intended function of the components. If loss of material due to pitting or crevice corrosion has occurred and is sufficient to potentially affect the intended function of an SSC, the following AMPs describe acceptable programs to manage loss of material due to pitting and crevice corrosion: (i) GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” for tanks; (ii) GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” for external surfaces of piping and piping components; (iii) GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” for underground piping, piping components and tanks; and (iv) GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” for internal surfaces of components that are not included in other AMPs. The timing of the one-time or periodic inspections is consistent with that recommended in the AMP selected by the applicant during the development of the SLRA. For example, one-time inspections would be conducted between the 50th and 60th year of operation, as recommended by the “Detection of Aging Effects“ program element in GALL-SLR Report AMP XI.M32.

The applicant may mitigate or prevent the loss of material due to pitting and crevice corrosion through the use of a barrier coating to isolate the component from aggressive environments. However, the applicant should identify loss of material as applicable for SLR and identify the AMP that will be used to manage the integrity of the coating. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and air that contain halides. The GALL- SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” or equivalent program, describes an acceptable program to manage the integrity of a barrier coating for internal or external coatings.

3.3.2.3 Aging Management Review Results Not Consistent With or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report

Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

3.3.2.4 Aging Management Programs

For those AMPs that will be used for aging management and are based on the program elements of an AMP in the GALL-SLR Report, the NRC reviewer performs an audit of AMPs credited in the SLRA to confirm consistency with the GALL-SLR Report AMPs identified in Chapters X and XI.

If the applicant identifies an exception to any of the program elements of the cited GALL-SLR Report AMP, the SLRA AMP should include a basis demonstrating how the criteria of 10 CFR 54.21(a)(3) (TN4878) would still be met. The NRC reviewer should then confirm that the SLRA AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the SLRA AMP, the reviewer identifies a difference between the SLRA AMP and the GALL-SLR Report AMP that should have been identified as an exception to the GALL-SLR Report AMP, the difference should be reviewed and dispositioned appropriately. The reviewer should document the disposition of all SLRA-defined exceptions and NRC staff-identified differences.

The SLRA should identify any enhancements that are needed to permit an existing SLRA AMP to be declared consistent with the GALL-SLR Report AMP to which the SLRA AMP is compared. The reviewer is to confirm that the enhancement, when implemented, would allow the existing SLRA AMP to be consistent with the GALL-SLR Report AMP and also that the applicant has a commitment in the FSAR Supplement to implement the enhancement prior to the subsequent period of extended operation. The reviewer should document the disposition of all enhancements.

If the applicant chooses to use a plant-specific program that is not a GALL-SLR Report AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix 0 of this SRP-SLR).

3.3.2.5 Final Safety Analysis Report Supplement

The summary description of the programs and activities for managing the effects of aging for the subsequent period of extended operation in the FSAR Supplement should be sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59 (TN249). The description should contain information associated with the bases for determining that aging effects will be managed during the subsequent period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the period of extended operation. Table X-01 and Table XI-01 of the GALL-SLR Report provide examples of the type of information to be included in the FSAR Supplement. Table 3.3-2 lists the programs that are applicable for this SRP-SLR section.

3.3.3 Review Procedures

For each area of review, the following review procedures are to be followed.

3.3.3.1 Aging Management Review Results Consistent with the Generic Aging Lessons Learned for Subsequent License Renewal Report

The applicant may reference the GALL-SLR Report in its SLRA, as appropriate, and demonstrate that the AMRs and AMPs at its facility are consistent with those reviewed and approved in the GALL-SLR Report. The reviewer should not conduct a re-review of the substance of the matters described in the GALL-SLR Report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL-SLR Report, the reviewer should find acceptable the applicant's reference to the GALL-SLR Report in its SLRA. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms that the applicable aging effects have been addressed based in the staff's review of industry and plant-specific OE.

Furthermore, the reviewer should confirm that the applicant has addressed OE identified after the issuance of the GALL-SLR Report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the auxiliary system components that are contained in the GALL-SLR Report as applicable to its plant.

3.3.3.2 Aging Management Review Results for Which Further Evaluation is Recommended by the Generic Aging Lessons Learned for Subsequent License Renewal Report

The basic review procedures defined in Section 3.3.3.1 need to be applied first for all of the AMRs and AMPs provided in this section. In addition, if the GALL-SLR Report AMR item to which the SLRA AMR item is compared identifies that "Further Evaluation Recommended," then additional criteria apply as identified by the GALL-SLR Report for each of the following aging effect/aging mechanism combinations. Refer to Table 3.3-1 for the items that reference the following subsections.

3.3.3.2.1 Cumulative Fatigue Damage

Evaluations involving time-dependent fatigue or cyclical loading parameters may be TLAAs, as defined in 10 CFR 54.3 (TN4878). The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1).

The staff reviews the information on a case-by-case basis consistent with the review procedures in SRP-SLR Section 4.3 or 4.7 (as applicable) to determine whether the applicant has provided a sufficient basis for dispositioning the TLAAs in accordance with the acceptance criteria in 10 CFR 54.21(c)(1)(i), (ii), or (iii). This includes staff's review of those cumulative usage factor analyses that qualify as TLAAs and are based on plant-specific, methods utilized for stress-based calculations.

3.3.3.2.2 Cracking Due to Stress Corrosion Cracking and Cyclic Loading

The GALL-SLR Report recommends further evaluation of programs to manage cracking due to SCC and cyclic loading in the SS nonregenerative heat exchanger tubing in the chemical and volume control system (PWR) exposed to treated borated water >60 °C (>140 °F). The Water

Chemistry Program relies on monitoring and control of water chemistry to manage cracking due to SCC and cyclic loading. The GALL-SLR Report recommends the effectiveness of the chemistry control program be verified to ensure that cracking is not occurring. The absence of cracking due to SCC and cyclic loading is to be verified. An acceptable verification program is to include temperature and radioactivity monitoring of the shell-side water, and eddy current testing of tubes. The reviewer reviews plant-specific OE to determine whether cracking has occurred in the applicant's nonregenerative heat exchanger tubes. If cracking has occurred, the reviewer reviews the applicant's proposed changes to GALL-SLR Report AMP XI.M21A to determine whether the proposed augmented features of the program will be adequate to manage these aging effects.

3.3.3.2.3 Cracking Due to Stress Corrosion Cracking in Stainless Steel Alloys

The GALL-SLR Report recommends further evaluation to manage cracking due to SCC of SS piping, piping components, and tanks exposed to air and underground environments containing sufficient halides (e.g., chlorides) and in which condensation is possible. The possibility of cracking also extends to components exposed to air which has recently been introduced into buildings (i.e., components near intake vents) or where the component is in the vicinity of insulated components.

The reviewer independently verifies the sufficiency of the applicant's evaluation of plant-specific OE. If the review of plant-specific OE reveals SCC in SS alloys, the reviewer determines whether an adequate program is credited to manage the aging effect. If the review of plant-specific OE reveals that SCC is not applicable, the reviewer verifies that GALL-SLR Report AMP XI.M32, "One-Time Inspection," is cited for all applicable AMR line items.

An applicant may refine its OE search, and subsequent one-time inspections, by binning plant-specific environments into subcategories. For example, the OE search could be based on two environments including outdoor air and indoor air. The results could be that SCC has occurred in the outdoor air environment but not the indoor air environment. The applicant could further categorize the indoor air locations as those where leakage could impinge on the SS component's surface (e.g., leakage from mechanical connections) and those where there is no potential for leakage. When the applicant chooses to conduct its OE search in this manner, the reviewer should also confirm that the applicant has adequately addressed the potential for the periodic introduction of either moisture or halides from secondary sources. Secondary sources of moisture or halides should be considered for all environments including indoor conditioned air. Typical secondary sources of moisture or halides include leakage from mechanical connections, leakage into vaults, insulation containing halides, and outdoor air intrusion. Grouping of environments consistent with that described in the detection of aging effects program element of GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," is appropriate.

If the applicant uses a barrier coating to mitigate or prevent cracking due to SCC, the reviewer verifies that loss of coating integrity is being managed for the associated components with a program equivalent to the GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks."

3.3.3.2.4 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and Nickel Alloys

The GALL-SLR Report recommends further evaluation to manage loss of material due to pitting and crevice corrosion in SS and nickel-alloy piping and piping components exposed to any air, condensation, or underground environment, when the component is: (i) uninsulated; (ii) insulated; (iii) in the vicinity of insulated components where the presence of sufficient halides (e.g., chlorides) and moisture is possible; or (iv) in the vicinity of potentially transportable halogens. The possibility of pitting and crevice corrosion also extends to indoor components located in close proximity to sources of outdoor air (e.g., components near intake vents).

The reviewer independently verifies the sufficiency of the applicant's evaluation of plant-specific OE. If the review of plant-specific OE reveals loss of material due to pitting or crevice corrosion in SS and nickel alloys, the reviewer determines whether an adequate program is credited to manage the aging effect. If the review of plant-specific OE reveals that loss of material due to pitting and crevice corrosion is not applicable, the reviewer verifies that GALL-SLR Report AMP XI.M32, "One-Time Inspection," is cited for all applicable AMR line items.

An applicant may refine its OE search, and subsequent one-time inspections, by binning plant-specific environments into subcategories. For example, the OE search could be based on two environments including outdoor air and indoor air. The results could be that loss of material due to pitting and crevice corrosion has occurred in the outdoor air environment but not the indoor air environment. The applicant could further categorize the indoor air locations as those where leakage could impinge on the SS and nickel-alloy component's surface (e.g., leakage from mechanical connections) and those where there is no potential for leakage. When the applicant chooses to conduct its OE search in this manner, the reviewer should also confirm that the applicant has adequately addressed the potential for the periodic introduction of either moisture or halides from secondary sources. Secondary sources of moisture or halides should be considered for all environments including indoor conditioned air. Typical secondary sources of moisture or halides include leakage from mechanical connections, leakage into vaults, insulation containing halides, and outdoor air intrusion. Grouping of environments consistent with that described in the detection of aging effects program element of GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," is appropriate.

If the applicant uses a barrier coating to mitigate or prevent the loss of material due to pitting and crevice corrosion, the reviewer verifies that loss of coating integrity is being managed for the associated components with a program equivalent to the GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks."
Quality Assurance for Aging Management of Nonsafety-Related Components.

The applicant's AMPs for SLR should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered by 10 CFR Part 50 (TN249), Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an AMR for SLR. Nevertheless, the applicant has the option to expand the scope of its 10 CFR Part 50, Appendix B program to include these components and address the associated program elements. If the applicant chooses this option, the reviewer verifies that the applicant has documented such a commitment in the FSAR Supplement. If the applicant chooses alternative means, the branch responsible for QA should be requested to review the applicant's proposal on a case-by-case basis.

3.3.3.2.5 Ongoing Review of Operating Experience

The applicant's AMPs should contain the element of OE. The reviewer verifies that the applicant has appropriate programs or processes for the ongoing review of both plant-specific and industry OE concerning age-related degradation and aging management. Such reviews are used to ensure that the AMPs are effective in managing the aging effects for which they are created. The AMPs are either enhanced or new AMPs are developed, as appropriate, when it is determined through the evaluation of the OE that the effects of aging may not be adequately managed. Additional information is in Appendix A.4, "Operating Experience for Aging Management Programs" of this SRP-SLR.

3.3.3.2.6 Loss of Material Due to Recurring Internal Corrosion

The GALL-SLR Report recommends further evaluation to manage recurring internal corrosion aging effects. The reviewer conducts an independent review of plant-specific OE to determine whether the plant is currently experiencing recurring internal corrosion. This further evaluation item is applicable if the search of plant-specific OE reveals repetitive occurrences. The criteria for recurrence is: (i) a 10 year search of plant-specific OE reveals the aging effect has occurred in three or more refueling outage cycles; or (ii) a 5 year search of plant-specific OE reveals the aging effect has occurred in two or more refueling outage cycles as a result of which the component either did not meet plant-specific acceptance criteria or experienced a reduction in wall thickness greater than 50 percent (regardless of the minimum wall thickness).

The reviewer should evaluate plant-specific OE examples to determine if the chosen AMP should be augmented. For example, during a 10 year search of plant-specific OE, two instances of 360 º 30 percent wall loss occurred at copper alloy to steel joints. Neither the significance of the aging effect nor the frequency of occurrence of aging effect threshold has been exceeded. Nevertheless, the OE should be evaluated to determine if the AMP that is proposed to manage the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of inspections) to provide reasonable assurance that the CLB intended functions of the component will be met throughout the subsequent period of extended operation.

The reviewer determines whether a proposed program is adequate to manage recurring internal corrosion by evaluating the proposed AMP against the criteria in SRP-SLR Section 3.3.2.2.7.

3.3.3.2.7 Cracking Due to Stress Corrosion Cracking in Aluminum Alloys

The GALL-SLR Report recommends the further evaluation of aluminum components (i.e., piping, piping components, and tanks) exposed to air, condensation, underground or aqueous solutions that contain halides to manage cracking due to SCC. The reviewer must first determine if cracking due to SCC is applicable and requires aging management. Cracking is to be considered applicable unless it is demonstrated that one of the two acceptance criteria are met by demonstrating that an aggressive environment is not present or the specific material is not susceptible, as discussed previously in Section 3.3.2.2.8. Additionally, guidance is also provided on the review of the third condition necessary for SCC to occur, a sustained tensile stress. Each of three conditions is evaluated based on the review procedures below.

If the material used to fabricate the component being evaluated is not susceptible to SCC then cracking due to SCC is not an aging effect that requires management. When determining if an aluminum alloy is susceptible to SCC the reviewer is to verify the materials: (i) alloy composition, (ii) condition or temper, and (iii) product form. Additionally, if the material was produced using a process specifically developed to provide a SCC resistant microstructure then the reviewer will consider the effects of this processing in the review. Once the material information has been established the reviewer is to evaluate the technical justification used to substantiate that the material is not susceptible to SCC when exposed to an aggressive environment and sustained tensile stress. The reviewer will evaluate all documentation and references used by the applicant as part of a technical justification.

If the environment to which an aluminum alloy is exposed is not aggressive, such as dry gas, or treated water, then cracking due to SCC is not an aging effect that requires management. The environments cited in the AMR line items in the GALL-SLR Report that reference this further evaluation are considered to be aggressive and potentially containing halide concentrations that facilitate SCC of aluminum alloys. The reviewer is to verify that components are not also periodically exposed to nontypical environments that would be categorized as aggressive, such as secondary sources of moisture or halides, including outdoor air which has recently been introduced into a building and the leakage/seepage of untreated aqueous solutions into a building or underground vault. Controlled indoor air is not considered aggressive unless secondary sources of moisture or halides are present. When applicable, the staff reviews the basis for the applicant’s claim that the plant configuration precludes the potential presence of secondary sources of moisture or halides. Using information provided by the applicant, the reviewer will also evaluate the chemical composition of applicable encapsulating materials (e.g., concrete, insulation) for halides.

If the applicant uses a barrier coating to mitigate or prevent cracking due to SCC, the reviewer verifies that loss of coating integrity is being managed for the associated components with a program equivalent to the GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks.”

If the sustained tensile stress being experienced by a component is below the SCC threshold value, then cracking is not an aging effect that requires management. Many aluminum alloys do not have a true SCC threshold stress, although a practical SCC threshold value can be determined based on the material, service environment, and duration of intended function. The basis for the SCC threshold value is to be evaluated to determine its applicability. The magnitude of the maximum tensile service stress (applied and residual) experienced by the component is to be evaluated to verify that the stress levels are bounded by the SCC threshold value.

The information necessary to determine if SCC is applicable based on the sustained service stress is often not readily available. The SCC threshold stress level is dependent on both the alloy (e.g., chemical composition, processing history, and microstructure) and service environment. Furthermore, the magnitude and state of the residual stress sustained by a component is typically not fully characterized. The reviewer must determine the adequacy of both the SCC threshold value being used by the applicant and the magnitude of the tensile stress being experienced by the component. The evaluation of the SCC threshold value includes the verification that the: (i) test method used to establish the threshold value is standardized and recognized by the industry, (ii) data are statistically significant or conservative, and (iii) data are for a relevant alloy, temper, product form, and environment. The evaluation of the tensile stress being experienced by the component includes the verification that the stress analysis accounts for: (i) all applied and residual stresses and (ii) stress riser that can initiate SCC cracks, such as corrosion pits and fabrication defects.

Documentation that may assist the reviewer in determining if cracking due to SCC is applicable and requires aging management include: (i) component drawings, (ii) applicable codes or specifications used in the design, fabrication, and installation of the component, (iii) material specific material certification data and lot release data, (iv) maintenance records, and (v) plant-specific OE.

If it is determined that cracking due to SCC is applicable the reviewer is to evaluate the applicants proposed AMP to ensure that cracking is adequately managed so that the component's intended functions will be maintained consistent with the CLB for the subsequent period of extended operation. The GALL-SLR Report AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," describes an acceptable program to manage cracking due to SCC of aluminum tanks. The GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," describes an acceptable program to manage cracking due to SCC of aluminum piping and piping components. The GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," describes an acceptable program to manage cracking due to SCC of aluminum piping and tanks which are buried or underground. The GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components" describes an acceptable program to manage cracking due to SCC of aluminum components that are not included in other AMPs.

3.3.3.2.8 Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to Stress Corrosion Cracking

The GALL-SLR Report recommends that for steel piping and piping components exposed to concrete, if the following conditions are met, loss of material is not considered to be an applicable aging effect for steel: (i) 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; (ii) plant-specific OE indicates no degradation of the concrete that could lead to penetration of water to the metal surface; and (iii) the piping is not potentially exposed to groundwater. For SS piping and piping components, loss of material and cracking due to SCC are not considered to be applicable aging effects as long as the piping is not potentially exposed to groundwater. Where these conditions are not met, loss of material due to general (steel only), crevice, or pitting corrosion and cracking due to SCC (SS only) are identified as applicable aging effects. GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," describes an acceptable program to manage these aging effects.

The reviewer verifies that the concrete was specified to meet ACI 318 or ACI 349 (low water-to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG–1557. The reviewer should evaluate plant-specific OE to determine whether concrete degradation sufficient to allow water intrusion has occurred.

3.3.3.2.9 Loss of Material Due to Pitting and Crevice Corrosion in Aluminum Alloys

The GALL-SLR Report recommends a further evaluation to determine whether an AMP is needed to manage loss of material due to pitting and crevice corrosion of aluminum piping, piping components, and tanks exposed to an air, condensation, underground, raw water, or waste water environment. The reviewer is to conduct an independent assessment of plant-specific OE during the AMP audit to confirm that the applicant's evaluation of its OE is adequate.

The reviewer is to confirm that the applicant has adequately addressed the potential for the periodic introduction of either moisture or halides from secondary sources. Secondary sources of moisture or halides should be considered for all environments including indoor conditioned air. Typical secondary sources of moisture or halides include leakage from mechanical connections, leakage into vaults, insulation containing halides, and outdoor air intrusion. Grouping of environments consistent with that found in the GALL-SLR Report Section IX.D is appropriate.

The grouping of OE search results based on environmental factors or plant configuration may be appropriate. The reviewer is to verify that the considerations given to groupings based on environmental factors and/or plant configuration have a substantiated technical basis. Components in the vicinity of secondary sources of moisture or halides may be treated as a separate population when performing inspections and interpreting results due to plant-specific configurations.

The grouping of alloys based on relative susceptibility to loss of material may also be appropriate. The reviewer is to verify that the considerations given to alloy susceptibility and/or grouping have a substantiated technical basis. The high-strength heat treatable aluminum alloys (2xxx and 7xxx series) may be treated as a separate population when performing inspections and interpreting results due to their relatively lower corrosion resistance. The relative susceptibility of moderate and lower strength alloys varies based on composition (primarily wt% copper, magnesium, and iron) and temper designation.

The reviewer is to determine whether an adequate program is credited to manage the aging effect if the OE reveals that loss of material is applicable or the applicant elects to manage loss of material due to pitting or crevice corrosion. The reviewer is to verify that the SLRA cites the use of GALL-SLR Report AMP XI.M32, “One-Time Inspection,” for all aluminum piping, piping components, and tanks exposed to air, condensation, or underground environments when confirming that the aging effect is not applicable based on the OE evaluation.

If the applicant uses a barrier coating to mitigate or prevent the loss of material due to pitting and crevice corrosion, the reviewer verifies that loss of coating integrity is being managed for the associated components with a program equivalent to the GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks.”

3.3.3.3 Aging Management Review Results Not Consistent With or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report

The reviewer should confirm that the applicant, in its SLRA, has identified applicable aging effects, listed the appropriate combination of materials and environments, and has credited AMPs that will adequately manage the aging effects. The AMP credited by the applicant could be an AMP that is described and evaluated in the GALL-SLR Report or a plant-specific program. The review procedures are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.3.3.4 Aging Management Programs

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR

Report AMP. If the applicant identifies, in the SLRA AMP, an exception to any of the program elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3) (TN4878). If the reviewer identifies a difference, not identified by the SLRA, between the SLRA AMP and the GALL-SLR Report AMP with which the SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions, or differences. The AMPs evaluated in the GALL-SLR Report pertinent to the auxiliary systems components are summarized in Table 3.3-1 of this SRP-SLR. The "GALL-SLR Item" column identifies the AMR item numbers in the GALL-SLR Report, Chapter VII, presenting detailed information summarized by this row.

3.3.3.5 Final Safety Analysis Report Supplement

The reviewer confirms that the applicant has provided in its FSAR Supplement information equivalent to that provided in GALL-SLR Table X-01 and Table XI-01 on aging management of the auxiliary systems. Table 3.3-2 lists the AMPs that are applicable for this SRP-SLR section. The reviewer also confirms that the applicant has provided information equivalent to that in GALL-SLR Table X-01 and Table XI-01 and Section 3.3.3.3 of this SRP-SLR, "Aging Management Review Results Not Consistent With or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report."

The NRC staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursuant to 10 CFR 50.71(e)(4) (TN249). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR Supplement before the license is renewed, no condition will be necessary.

An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.3.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of this section, then an evaluation finding similar to the following text should be included in the NRC staff's SER:

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has demonstrated that the aging effects associated with the auxiliary systems components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the subsequent period of extended operation, as required by 10 CFR 54.21(a)(3) (TN4878).

The NRC staff also reviewed the applicable FSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the auxiliary systems, as required by 10 CFR 54.21(d).

3.3.5 Implementation

Except for cases in which the applicant proposes an alternative method for complying with specified portions of NRC regulations, the NRC staff members follow the methods described herein in their evaluation of conformance with NRC regulations. The staff evaluates these alternatives and finds them acceptable if the staff determines that the alternatives provide reasonable assurance that the component's intended functions will be maintained.

3.3.6 References

1. NRC. NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." Agencywide Documents Access and Management System (ADAMS) Accession No. ML070630046. Washington, DC: U.S. Nuclear Regulatory Commission. March 2007.
2. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54–The License Renewal Rule." Revision 6. ADAMS Accession No. ML051860406. Washington, DC: Nuclear Energy Institute. June 2005.
3. ASME. ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components." ASME Boiler and Pressure Vessel Code, 2004 Edition. New York, New York: The American Society of Mechanical Engineers.
4. ASTM International. "Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation." D95-83. West Conshohocken, Pennsylvania: American Society for Testing and Materials. 1990.
5. NRC. NUREG–1557, "Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal." Washington, DC: U.S. Nuclear Regulatory Commission. October 1996.
6. ACI. ACI Standard 318-95, "Building Code Requirements for Reinforced Concrete and Commentary." Farmington Hills, Michigan: American Concrete Institute. 1995.
7. ACI. ACI Standard 349 85, "Code Requirements for Nuclear Safety-Related Concrete Structures." Farmington Hills, Michigan: American Concrete Institute. 1985.
8. ANSI. ANSI Standard H35.1/H35.1M, "Alloy and Temper Designation Systems for Aluminum." New York, New York: American National Standards Institute, Inc. 2013.
9. ASM. *Corrosion of Aluminum and Aluminum Alloys*. J.R. Davis, ed. Materials Park, Ohio: ASM International. 1999.
10. NRL. *Stress-Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys*. B.F. Brown, ed. Washington, DC: Naval Research Laboratory. 1972.

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	001	Boiling water reactor (BWR)/pressurized water reactor (PWR)	Steel cranes: bridges, structural members, structural components exposed to any environment	Cumulative fatigue damage due to fatigue	TLAA, Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Section 4.7 ““Other Plant-Specific TLAAs”“	Yes (SRP-SLR Section 3.3.2.2.1)	VII.B.A-06
	002	BWR/PWR	Stainless steel (SS), steel heat exchanger components and tubes, piping, piping components exposed to any environment	Cumulative fatigue damage due to fatigue	TLAA, SRP-SLR Section 4.3 ““Metal Fatigue”“	Yes (SRP-SLR Section 3.3.2.2.1)	VII.E1.A-100 VII.E1.A-34 VII.E1.A-57 VII.E3.A-34 VII.E3.A-62 VII.E4.A-62
	003	PWR	SS heat exchanger tubing, non-regenerative exposed to treated borated water >60 °C (>140 °F)	Cracking due to systems, structures, and components (SCCs) cyclic loading	AMP XI.M2, ““Water Chemistry”“	Yes (SRP-SLR Section 3.3.2.2.2)	VII.E1.A-69

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	003a	PWR	SS heat exchanger tubing, nonregenerative exposed to treated borated water >60 °C (>140 °F)	Cracking due to SCC, cyclic loading	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M21A, ““Closed Treated Water Systems”“	Yes (SRP-SLR Section 3.3.2.2.2)	VII.E1.A-69a
	004	BWR/PWR	SS piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M32, ““One Time Inspection,”“ AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components,”“ AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,”“ or AMP XI.M42, ““Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	Yes (SRP-SLR Section 3.3.2.2.3)	VII.C1.AP-209a VII.C1.AP-209b VII.C1.AP-209c VII.C1.AP-209d VII.C2.AP-209a VII.C2.AP-209b VII.C2.AP-209c VII.C2.AP-209d VII.C3.AP-209a VII.C3.AP-209b VII.C3.AP-209c VII.C3.AP-209d VII.D.AP-209a VII.D.AP-209b VII.D.AP-209c VII.D.AP-209d VII.E1.AP-209a VII.E1.AP-209b VII.E1.AP-209c VII.E1.AP-209d VII.E4.AP-209a VII.E4.AP-209b VII.E4.AP-209c

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							VII.E4.AP-209d VII.F1.AP-209a VII.F1.AP-209b VII.F1.AP-209c VII.F1.AP-209d VII.F2.AP-209a VII.F2.AP-209b VII.F2.AP-209c VII.F2.AP-209d VII.F3.AP-209a VII.F3.AP-209b VII.F3.AP-209c VII.F3.AP-209d VII.F4.AP-209a VII.F4.AP-209b VII.F4.AP-209c VII.F4.AP-209d VII.G.AP-209a VII.G.AP-209b VII.G.AP-209c VII.G.AP-209d VII.H1.AP-209a VII.H1.AP-209b VII.H1.AP-209c VII.H1.AP-209d VII.H2.AP-209a VII.H2.AP-209b

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							VII.H2.AP-209c VII.H2.AP-209d
D	005						
	006	BWR/PWR	SS, nickel-alloy piping, piping components exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, ""One Time Inspection,"" AMP XI.M36, ""External Surfaces Monitoring of Mechanical Components,"" AMP XI.M38, ""Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,"" or AMP XI.M42, ""Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks""	Yes (SRP-SLR Section 3.3.2.2.4)	VII.C1.AP-221a VII.C1.AP-221b VII.C1.AP-221c VII.C1.AP-221d VII.C2.AP-221a VII.C2.AP-221b VII.C2.AP-221c VII.C2.AP-221d VII.C3.AP-221a VII.C3.AP-221b VII.C3.AP-221c VII.C3.AP-221d VII.D.AP-221a VII.D.AP-221b VII.D.AP-221c VII.D.AP-221d VII.E1.AP-221a VII.E1.AP-221b VII.E1.AP-221c VII.E1.AP-221d VII.E4.AP-221a VII.E4.AP-221b VII.E4.AP-221c VII.E4.AP-221d VII.F1.AP-221a

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							VII.F1.AP-221b VII.F1.AP-221c VII.F1.AP-221d VII.F2.AP-221a VII.F2.AP-221b VII.F2.AP-221c VII.F2.AP-221d VII.F3.AP-221a VII.F3.AP-221b VII.F3.AP-221c VII.F3.AP-221d VII.F4.AP-221a VII.F4.AP-221b VII.F4.AP-221c VII.F4.AP-221d VII.G.AP-221a VII.G.AP-221b VII.G.AP-221c VII.G.AP-221d VII.H1.AP-221a VII.H1.AP-221b VII.H1.AP-221c VII.H1.AP-221d VII.H2.AP-221a VII.H2.AP-221b VII.H2.AP-221c VII.H2.AP-221d

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	007	PWR	SS high pressure pump, casing exposed to treated borated water	Cracking due to cyclic loading	AMP XI.M1, ““ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD”“	No	VII.E1.AP-115
	008	PWR	SS heat exchanger components and tubes exposed to treated borated water >60 °C (>140 °F)	Cracking due to cyclic loading	AMP XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD”	No	VII.E1.AP-119
	009	PWR	Steel, copper alloy (>15% zinc) external surfaces, piping, piping components exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, ““Boric Acid Corrosion”“	No	VII.I.A-79 VII.I.AP-66
	010	BWR/PWR	High-strength steel closure bolting exposed to air, soil, underground	Cracking due to SCC, cyclic loading	AMP XI.M18, ““Bolting Integrity”“	No	VII.I.A-04
D	011						
	012	BWR/PWR	Steel; SS, nickel-alloy closure bolting exposed to air – indoor uncontrolled, air – outdoor, condensation	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M18, ““Bolting Integrity”“	No	VII.I.A-03
	013						
	014						

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	015	BWR/PWR	Metallic closure bolting exposed to any environment, soil, underground	Loss of preload due to thermal effects, gasket creep, self-loosening	AMP XI.M18, ““Bolting Integrity”“	No	VII.I.AP-124
	016	BWR	SS piping, piping components outboard the second containment isolation valves with a diameter ≥4 in. nominal pipe size (NPS) exposed to treated water >93 °C (>200 °F)	Cracking due to SCC, intergranular stress corrosion cracking (IGSCC)	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M25, ““BWR Reactor Water Cleanup System”“	No	VII.E3.AP-283
	017	BWR/PWR	SS heat exchanger tubes exposed to treated water, treated borated water	Reduction of heat transfer due to fouling	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	VII.A4.AP-139 VII.A3.A-101 VII.E1.A-101
	018	BWR/PWR	SS high pressure pump casing, piping, piping components, tanks exposed to treated borated water >60 °C (>140 °F), sodium pentaborate solution >60 °C (>140 °F)	Cracking due to SCC	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One Time Inspection”“	No	VII.E1.AP-114 VII.E2.AP-181
	019	BWR	SS regenerative heat exchanger components	Cracking due to SCC	AMP XI.M2, ““Water Chemistry,”“ and	No	VII.E3.AP-120

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			exposed to treated water >60 °C (>140 °F)		AMP XI.M32, ""One Time Inspection""		
	020	BWR/PWR	SS, steel with SS cladding heat exchanger components exposed to treated borated water >60 °C (>140 °F), treated water >60 °C (>140 °F)	Cracking due to SCC	AMP XI.M2, ""Water Chemistry,"" and AMP XI.M32, " "One-Time Inspection""	No	VII.E1.AP-118 VII.E3.AP-112
	021	BWR	Steel piping, piping components exposed to treated water	Loss of material due to general, pitting, crevice corrosion, microbiologically-induced corrosion (MIC)	AMP XI.M2, ""Water Chemistry,"" and AMP XI.M32, ""One Time Inspection""	No	VII.E3.AP-106 VII.E4.AP-106
	022	BWR	Copper alloy piping, piping components exposed to treated water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M2, ""Water Chemistry,"" and AMP XI.M32, ""One Time Inspection""	No	VII.A4.AP-140 VII.E3.AP-140 VII.E4.AP-140
D	023						
D	024						
	025	BWR/PWR	Aluminum piping, piping components exposed to treated water, treated borated water	Loss of material due to pitting, crevice corrosion	AMP XI.M2, ""Water Chemistry,"" and AMP XI.M32, ""One Time Inspection""	No	VII.A4.AP-130 VII.C2.AP-130 VII.E3.AP-130 VII.E4.AP-130 VII.H2.AP-130
	026	BWR	Steel (with SS cladding) piping, piping	Loss of material due to general (only	AMP XI.M2, ""Water Chemistry,"" and	No	VII.A4.AP-108

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			components exposed to treated water	after cladding degradation), pitting, crevice corrosion, MIC	AMP XI.M32, ““One Time Inspection”“		
	027	BWR	SS heat exchanger tubes exposed to treated water	Reduction of heat transfer due to fouling	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	VII.E3.AP-139
	028	PWR	SS piping, piping components, tanks exposed to treated borated water >60 °C (>140 °F)	Cracking due to SCC	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	VII.E1.AP-82
D	029						
	030	BWR/PWR	Concrete, concrete cylinder piping, reinforced concrete, asbestos cement, cementitious piping, piping components exposed to raw water	Cracking due to chemical reaction, weathering, settlement, or corrosion of reinforcement (reinforced concrete only); loss of material due to delamination, exfoliation, spalling, popout, scaling, or cavitation; flow	AMP XI.M20, ““Open Cycle Cooling Water System”“	No	VII.C1.AP-250

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
				blockage due to fouling			
M	030a	BWR/PWR	Fiberglass, high-density polyethylene (HDPE) piping, piping components exposed to raw water	Cracking, blistering, loss of material due to exposure to radiation, temperature, or moisture; flow blockage due to fouling	AMP XI.M20, ""Open-Cycle Cooling Water System"" or AMP XI.M43, "High Density Polyethylene (HDPE) Piping and Carbon Fiber Reinforced Polymer (CFRP) Repaired Piping"	No	VII.C1.AP-238 VII.C1.AP-239
D	031						
D	032						
D	032a						
D	033						
	034	BWR/PWR	Nickel-alloy, copper alloy piping, piping components exposed to raw water	Loss of material due to general (copper alloy only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, ""Open Cycle Cooling Water System""	No	VII.C1.AP-196 VII.C1.AP-206 VII.C3.AP-195 VII.C3.AP-206 VII.H2.AP-193
D	035						
D	036						

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	037	BWR/PWR	Steel piping, piping components exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, ““Open Cycle Cooling Water System”“	No	VII.C1.AP-194 VII.C3.AP-194 VII.H2.AP-194
	038	BWR/PWR	Copper alloy, steel heat exchanger components exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, ““Open Cycle Cooling Water System”“	No	VII.C1.AP-179 VII.C1.AP-183
D	039						
	040	BWR/PWR	SS piping, piping components exposed to raw water	Loss of material due to pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, ““Open Cycle Cooling Water System”“	No	VII.C1.A-54 VII.C3.A-53 VII.H2.AP-55
D	041						
	042	BWR/PWR	Copper alloy, titanium, SS heat exchanger tubes exposed to raw water, raw water (potable), treated water	Cracking due to SCC (titanium only), reduction of heat transfer due to fouling	AMP XI.M20, ““Open Cycle Cooling Water System,”“ or AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”“	No	VII.C1.AP-187 VII.C3.AP-187 VII.G.AP-187 VII.H2.AP-187

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	043	BWR/PWR	SS piping, piping components exposed to closed-cycle cooling water >60 °C (>140 °F)	Cracking due to SCC	AMP XI.M21A, ""Closed Treated Water Systems""	No	VII.C2.AP-186 VII.E3.AP-186 VII.E4.AP-186
	044	BWR/PWR	SS; steel with stainless steel cladding heat exchanger components exposed to closed-cycle cooling water >60 °C (>140 °F)	Cracking due to SCC	AMP XI.M21A, ""Closed Treated Water Systems""	No	VII.E3.AP-192
	045	BWR/PWR	Steel piping, piping components, tanks exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, ""Closed Treated Water System""	No	VII.C2.AP-202 VII.F1.AP-202 VII.F2.AP-202 VII.F3.AP-202 VII.F4.AP-202 VII.H2.AP-202
	046	BWR/PWR	Steel, copper alloy heat exchanger components, piping, piping components exposed to closed-cycle cooling water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC	AMP XI.M21A, ""Closed Treated Water Systems""	No	VII.A3.AP-189 VII.A3.AP-199 VII.A4.AP-189 VII.A4.AP-199 VII.C2.AP-189 VII.C2.AP-199 VII.E1.AP-189 VII.E1.AP-199 VII.E1.AP-203 VII.E3.AP-189 VII.E3.AP-199

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							VII.E4.AP-189 VII.E4.AP-199 VII.F1.AP-189 VII.F1.AP-199 VII.F1.AP-203 VII.F2.AP-189 VII.F2.AP-199 VII.F3.AP-189 VII.F3.AP-199 VII.F3.AP-203 VII.F4.AP-189 VII.F4.AP-199 VII.H1.AP-199 VII.H2.AP-199
	047	BWR	SS; steel with SS cladding heat exchanger components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, ““Closed Treated Water Systems”“	No	VII.E3.AP-191 VII.E4.AP-191
	048	BWR/PWR	Aluminum piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion	AMP XI.M21A, ““Closed Treated Water Systems”“	No	VII.C2.AP-254 VII.H2.AP-255
	049	BWR/PWR	SS piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, ““Closed Treated Water Systems”“	No	VII.C2.A-52

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	050	BWR/PWR	SS, copper alloy, steel heat exchanger tubes exposed to closed-cycle cooling water	Reduction of heat transfer due to fouling	AMP XI.M21A, ""Closed Treated Water Systems""	No	VII.C2.AP-188 VII.C2.AP-205 VII.E3.AP-188 VII.E4.AP-188 VII.F1.AP-204 VII.F1.AP-205 VII.F2.AP-204 VII.F2.AP-205 VII.F3.AP-204 VII.F3.AP-205 VII.F4.AP-204 VII.F4.AP-205
	051	BWR/PWR	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	AMP XI.M22, ""Boraflex Monitoring""	No	VII.A2.A-86 VII.A2.A-87
	052	BWR/PWR	Steel cranes: rails, bridges, structural members, structural components exposed to air	Loss of material due to general corrosion, wear, deformation, cracking	AMP XI.M23, ""Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems""	No	VII.B.A-07

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
D	053						
D	054						
	055	BWR/PWR	Steel piping, piping components, tanks exposed to condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.D.A-26 VII.E5.A-26 VII.F1.A-26 VII.F2.A-26 VII.F3.A-26 VII.F4.A-26 VII.H2.A-26
D	056						
	057	BWR/PWR	Elastomer fire barrier penetration seals exposed to air, condensation	Hardening, loss of strength, shrinkage due to elastomer degradation	AMP XI.M26, ““Fire Protection”“	No	VII.G.A-19
	058	BWR/PWR	Steel halon/carbon dioxide fire suppression system piping, piping components exposed to air – indoor uncontrolled, air – outdoor, condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M26, ““Fire Protection”“	No	VII.G.AP-150
	059	BWR/PWR	Steel fire rated doors exposed to air	Loss of material due to wear	AMP XI.M26, ““Fire Protection”“	No	VII.G.A-21
	060	BWR/PWR	Reinforced concrete structural fire barriers: walls, ceilings and floors exposed to air	Cracking due to chemical reaction, weathering, settlement, or	AMP XI.M26, ““Fire Protection,”“ and AMP XI.S6,	No	VII.G.A-90

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
				corrosion of reinforcement; loss of material due to delamination, exfoliation, spalling, pop out, or scaling	““Structures Monitoring”“		
D	061						
D	062						
	063	BWR/PWR	Steel fire hydrants exposed to air – outdoor, raw water, raw water (potable), treated water	Loss of material due to general, pitting, crevice corrosion; flow blockage due to fouling (raw water, raw water (potable) only)	AMP XI.M27, ““Fire Water System”“	No	VII.G.AP-149
	064	BWR/PWR	Steel, copper alloy piping, piping components exposed to raw water, treated water, raw water (potable)	Loss of material due to general (steel; copper alloy in raw water and raw water (potable) only), pitting, crevice corrosion, MIC; flow blockage due to fouling (raw water; raw water (potable) for steel only)	AMP XI.M27, ““Fire Water System”“	No	VII.G.A-33 VII.G.AP-197

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	065	BWR/PWR	Aluminum piping, piping components exposed to raw water, treated water, raw water (potable)	Loss of material due to pitting, crevice corrosion; flow blockage due to fouling (raw water only)	AMP XI.M27, ““Fire Water System”“	No	VII.G.AP-180
	066	BWR/PWR	SS piping, piping components exposed to raw water, treated water, raw water (potable)	Loss of material due to pitting, crevice corrosion, MIC; flow blockage due to fouling (raw water only)	AMP XI.M27, ““Fire Water System”“	No	VII.G.A-55
D	067						
D	068						
	069	BWR/PWR	Copper alloy piping, piping components exposed to fuel oil	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M30, ““Fuel Oil Chemistry,”“ and AMP XI.M32, ““One Time Inspection,”“ or AMP XI.M30, ““Fuel Oil Chemistry”“	No	VII.G.AP-132 VII.G.AP-132a VII.H1.AP-132 VII.H1.AP-132a VII.H2.AP-132 VII.H2.AP-132a
	070	BWR/PWR	Steel piping, piping components, tanks exposed to fuel oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M30, ““Fuel Oil Chemistry,”“ and AMP XI.M32, ““One Time Inspection,”“ or AMP XI.M30,	No	VII.H1.AP-105 VII.H1.AP-105a VII.H2.AP-105 VII.H2.AP-105a VII.G.AP-234 VII.G.AP-234a

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					““Fuel Oil Chemistry”“		
E	071	BWR/PWR	Stainless steel, aluminum, nickel-alloy piping, piping components exposed to fuel oil	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M30, ““Fuel Oil Chemistry,”“ and AMP XI.M32, ““One Time Inspection,”“ or AMP XI.M30, ““Fuel Oil Chemistry”“	No	VII.G.AP-129 VII.G.AP-129a VII.G.AP-136 VII.G.AP-136a VII.H1.AP-129 VII.H1.AP-129a VII.H1.AP-136 VII.H1.AP-136a VII.H2.AP-129 VII.H2.AP-129a VII.H2.AP-136 VII.H2.AP-136a VII.H2.A-801 VII.H2.A-802
M	072	BWR/PWR	Gray cast iron, ductile iron, malleable iron, copper alloy (>15% zinc or >8% aluminum) piping, piping components, heat exchanger components exposed to treated water, closed-cycle cooling water, soil, raw water, raw water (potable), waste water	Loss of material due to selective leaching	AMP XI.M33, ““Selective Leaching”“	No	VII.A3.AP-31 VII.A3.AP-43 VII.A4.AP-31 VII.A4.AP-32 VII.A4.AP-43 VII.C1.A-02 VII.C1.A-47 VII.C1.A-51 VII.C1.A-66 VII.C2.A-50 VII.C2.AP-31 VII.C2.AP-32

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							VII.C2.AP-43 VII.C3.A-02 VII.C3.A-47 VII.C3.A-51 VII.E1.AP-31 VII.E1.AP-43 VII.E1.AP-65 VII.E3.AP-31 VII.E3.AP-32 VII.E3.AP-43 VII.E4.AP-31 VII.E4.AP-32 VII.E4.AP-43 VII.E5.A-547 VII.E5.A-724 VII.F1.AP-31 VII.F1.AP-43 VII.F1.AP-65 VII.F2.AP-31 VII.F2.AP-43 VII.F3.A-50 VII.F3.AP-43 VII.F3.AP-65 VII.F4.AP-31 VII.F4.AP-43 VII.G.A-02 VII.G.A-47 VII.G.A-51

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							VII.G.AP-31 VII.H1.A-02 VII.H1.AP-43 VII.H2.A-02 VII.H2.A-47 VII.H2.A-51 VII.H2.AP-43
	073	BWR/PWR	Concrete, concrete cylinder piping, reinforced concrete, asbestos cement, cementitious piping, piping components exposed to air – outdoor	Cracking due to chemical reaction, weathering, or corrosion of reinforcement (reinforced concrete only); loss of material due to delamination, exfoliation, spalling, pop out, or scaling	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	No	VII.I.AP-253
D	074						
D	075						
	076	BWR/PWR	Elastomer piping, piping components, ducting, ducting components, seals exposed to air, condensation	Hardening or loss of strength due to elastomer degradation	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	No	VII.I.AP-102
D	077						

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	078	BWR/PWR	Steel external surfaces exposed to air – indoor uncontrolled, air – outdoor, condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	No	VII.I.A-77
D	079						
	080	BWR/PWR	Steel heat exchanger components, piping, piping components exposed to air – indoor uncontrolled, air – outdoor	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	No	VII.I.A-24 VII.I.AP-40 VII.I.AP-41
D	081						
	082	BWR/PWR	Elastomer, fiberglass piping, piping components, ducting, ducting components, seals exposed to air	Loss of material due to wear	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	No	VII.I.A-719 VII.I.AP-113
	083	BWR/PWR	SS diesel engine exhaust piping, piping components exposed to diesel exhaust	Cracking due to SCC	AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”“	No	VII.H2.AP-128
	085	BWR/PWR	Elastomer piping, piping components, seals exposed to air,	Hardening or loss of strength due to elastomer	AMP XI.M38, ““Inspection of Internal Surfaces in	No	VII.A3.AP-100 VII.A4.AP-101 VII.C1.AP-75

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			condensation, closed-cycle cooling water, treated borated water, treated water, raw water, raw water (potable), waste water, gas, fuel oil, lubricating oil	degradation; flow blockage due to fouling (raw water, waste water only)	Miscellaneous Piping and Ducting Components""		VII.C2.AP-259 VII.D.A-729 VII.E1.A-504 VII.E2.A-504 VII.E3.A-504 VII.E4.A-504 VII.E5.A-504 VII.E5.A-728 VII.F1.A-504 VII.F2.A-504 VII.F3.A-504 VII.F4.A-504 VII.G.A-504 VII.G.A-729 VII.G.AP-75 VII.H1.A-660 VII.H2.A-677
D	086						
	088	BWR/PWR	Steel; SS piping, piping components, diesel engine exhaust exposed to raw water (potable), diesel exhaust	Loss of material due to general (steel only), pitting, crevice corrosion, flow blockage due to fouling (steel only for raw water (potable) environment)	AMP XI.M38, ""Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components""	No	VII.E5.AP-270 VII.H2.AP-104

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	089	BWR/PWR	Steel piping, piping components exposed to condensation (internal)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M27, ““Fire Water System”“	No	VII.G.AP-143
	090	BWR/PWR	Steel ducting, ducting components (internal surfaces) exposed to condensation	Loss of material due to general, pitting, crevice corrosion, MIC (for drip pans and drain lines only)	AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”“	No	VII.F1.A-08 VII.F2.A-08 VII.F3.A-08 VII.F4.A-08
	091	BWR/PWR	Steel piping, piping components, heat exchanger components, tanks exposed to waste water	Loss of material due to general, pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”“	No	VII.E5.AP-281
D	092						
	093	BWR/PWR	Copper alloy piping, piping components exposed to raw water (potable)	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”“	No	VII.E5.AP-271
	094	BWR/PWR	SS ducting, ducting components exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, ““One Time Inspection,”“ AMP XI.M36, ““External Surfaces Monitoring of	Yes (SRP-SLR Section 3.3.2.2.4)	VII.F1.AP-99a VII.F2.AP-99a VII.F3.AP-99a VII.F4.AP-99a VII.F1.AP-99b

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					Mechanical Components,"" or AMP XI.M38, ""Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components""		VII.F2.AP-99b VII.F3.AP-99b VII.F4.AP-99b VII.F1.AP-99c VII.F2.AP-99c VII.F3.AP-99c VII.F4.AP-99c
	094a	BWR/PWR	SS ducting, ducting components exposed to air, condensation	Cracking due to SCC	AMP XI.M32, ""One Time Inspection,"" AMP XI.M36, ""External Surfaces Monitoring of Mechanical Components,"" or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Yes (SRP-SLR Section 3.3.2.2.3)	VII.F1.A-781a VII.F2.A-781a VII.F3.A-781a VII.F4.A-781a VII.F1.A-781b VII.F2.A-781b VII.F3.A-781b VII.F4.A-781b VII.F1.A-781c VII.F2.A-781c VII.F3.A-781c VII.F4.A-781c
	095	BWR/PWR	Copper alloy, stainless steel, nickel-alloy piping, piping components, heat exchanger components, tanks exposed to waste water	Loss of material due to general (copper alloy only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.E5.AP-272 VII.E5.AP-275 VII.E5.AP-276 VII.E5.AP-278 VII.E5.AP-279

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	096	BWR/PWR	Elastomer piping, piping components, seals exposed to air, raw water, raw water (potable), treated water, waste water	Loss of material due to wear; flow blockage due to fouling (raw water, waste water only)	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.C1.AP-76 VII.E5.A-550 VII.F1.AP-103 VII.F2.AP-103 VII.F3.AP-103 VII.F4.AP-103 VII.G.AP-76
	096a	BWR/PWR	Steel, aluminum, copper alloy, SS, titanium heat exchanger tubes internal to components exposed to air, condensation (external)	Reduction of heat transfer due to fouling	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.C1.A-419 VII.F1.A-419 VII.F2.A-419 VII.F3.A-419 VII.F4.A-419
	096b	BWR/PWR	Steel heat exchanger components exposed to condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, “External Surfaces Monitoring of Mechanical Components”	No	VII.C1.A-417 VII.F1.A-417 VII.F2.A-417 VII.F3.A-417 VII.F4.A-417
	097	BWR/PWR	Steel piping, piping components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, “Lubricating Oil Analysis,” and AMP XI.M32, “One Time Inspection”	No	VII.C1.AP-127 VII.C2.AP-127 VII.E1.AP-127 VII.E4.AP-127 VII.F1.AP-127 VII.F2.AP-127 VII.F3.AP-127 VII.F4.AP-127

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							VII.G.AP-127 VII.H2.AP-127
	098	BWR/PWR	Steel heat exchanger components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, “Lubricating Oil Analysis,” and AMP XI.M32, “One Time Inspection”	No	VII.H2.AP-131
	099	BWR/PWR	Copper alloy, aluminum piping, piping components exposed to lubricating oil	Loss of material due to pitting, crevice corrosion, MIC (copper alloy only)	AMP XI.M39, “Lubricating Oil Analysis,” and AMP XI.M32, “One Time Inspection”	No	VII.C1.AP-133 VII.C2.AP-133 VII.E1.AP-133 VII.E4.AP-133 VII.G.AP-133 VII.G.AP-162 VII.H2.AP-133 VII.H2.AP-162
	100	BWR/PWR	SS piping, piping components exposed to lubricating oil	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M39, “Lubricating Oil Analysis,” and AMP XI.M32, “One Time Inspection”	No	VII.C1.AP-138 VII.C2.AP-138 VII.E1.AP-138 VII.E4.AP-138 VII.G.AP-138 VII.H2.AP-138
	101	BWR/PWR	Aluminum heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	AMP XI.M39, “Lubricating Oil Analysis,” and AMP XI.M32, “One Time Inspection”	No	VII.H2.AP-154

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	102	BWR/PWR	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	AMP XI.M40, “Monitoring of Neutron-Absorbing Materials other than Boraflex”	No	VII.A2.AP-235 VII.A2.AP-236
	103	BWR/PWR	Concrete, concrete cylinder piping, reinforced concrete, asbestos cement, cementitious piping, piping components exposed to soil, concrete	Cracking due to chemical reaction, weathering, or corrosion of reinforcement (reinforced concrete only); loss of material due to delamination, exfoliation, spalling, popout, or scaling	AMP XI.M41, “Buried and Underground Piping and Tanks”	No	VII.I.AP-157
M	104	BWR/PWR	HDPE, carbon fiber reinforced polymer (CFRP), fiberglass piping, piping components exposed to soil, concrete	Cracking, blistering, loss of material due to wear, general corrosion (metal substrate), erosion, chemical attack,	AMP XI.M41, “Buried and Underground Piping and Tanks” or AMP XI.M43, “High Density	No	VII.I.AP-175 VII.I.AP-176 VII.I.AP-182

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
				exposure to temperature or moisture	Polyethylene (HDPE) Piping and Carbon Fiber Reinforced Polymer (CFRP) Repaired Piping”		
D	105						
D	106						
	107	BWR/PWR	SS, nickel-alloy piping, piping components exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, “Buried and Underground Piping and Tanks”	No	VII.I.AP-137
	108	BWR/PWR	Titanium, super austenitic, copper alloy, stainless steel, nickel-alloy piping, piping components, tanks, closure bolting exposed to soil, concrete, underground	Loss of material due to general (copper alloy only), pitting, crevice corrosion, MIC (super austenitic, copper alloy, stainless steel, nickel-alloy; soil environment only)	AMP XI.M41, “Buried and Underground Piping and Tanks”	No	VII.I.AP-171 VII.I.AP-172 VII.I.AP-174 VII.I.AP-243
	109	BWR/PWR	Steel piping, piping components, closure bolting exposed to soil, concrete, underground	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, “Buried and Underground Piping and Tanks”	No	VII.I.AP-198 VII.I.AP-241 VII.I.AP-284
D	109a						

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
E	110	BWR	SS, nickel-alloy piping, piping components ≥4 NPS exposed to treated water >93 °C (>200 °F)	Cracking due to SCC, IGSCC	AMP XI.M7, "BWR Stress Corrosion Cracking," and AMP XI.M2, "Water Chemistry"	No	VII.E4.A-61
	111	BWR/PWR	Steel structural steel exposed to air – indoor uncontrolled	Loss of material due to general, pitting, crevice corrosion	AMP XI.S6, "Structures Monitoring"	No	VII.A1.A-94
	112	BWR/PWR	Steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.3.2.2.9)	VII.J.AP-282
	113	BWR/PWR	Aluminum piping, piping components exposed to gas	None	None	No	VII.J.AP-37
M	114	BWR/PWR	Copper alloy heat exchanger components, tanks, piping, piping components exposed to air, condensation, gas	None	None	No	VII.J.AP-144 VII.J.AP-9
	115	BWR/PWR	Copper alloy, copper alloy (>8% Al) piping, piping components exposed to air with borated water leakage	None	None	No	VII.J.AP-11
	116	BWR/PWR	Galvanized steel piping, piping components	None	None	No	VII.J.AP-13

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			exposed to air – indoor uncontrolled				
	117	BWR/PWR	Glass piping elements exposed to air, lubricating oil, closed-cycle cooling water, fuel oil, raw water, treated water, treated borated water, air with borated water leakage, condensation, gas, underground	None	None	No	VII.J.AP-14 VII.J.AP-15 VII.J.AP-166 VII.J.AP-48 VII.J.AP-49 VII.J.AP-50 VII.J.AP-51 VII.J.AP-52 VII.J.AP-96 VII.J.AP-97 VII.J.AP-98
D	118						
	119	BWR/PWR	Nickel-alloy, polyvinyl chloride (PVC), glass piping, piping components exposed to air with borated water leakage, air – indoor uncontrolled, condensation, waste water, raw water (potable)	None	None	No	VII.J.AP-260 VII.J.AP-268 VII.J.AP-269 VII.J.AP-277
	120	BWR/PWR	SS piping, piping components exposed to	None	None	No	VII.J.AP-18 VII.J.AP-22

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			air with borated water leakage, gas				
	121	BWR/PWR	Steel piping, piping components exposed to air – indoor controlled, gas	None	None	No	VII.J.AP-2 VII.J.AP-6
	122	BWR/PWR	Titanium heat exchanger components, piping, piping components exposed to air – indoor uncontrolled, air – outdoor	None	None	No	VII.J.AP-151 VII.J.AP-160
	123	BWR/PWR	Titanium heat exchanger components other than tubes, piping and piping components exposed to raw water	Cracking due to SCC, flow blockage due to fouling	AMP XI.M20, “Open Cycle Cooling Water System,” or AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.C1.AP-152a VII.C3.AP-152a VII.E4.AP-152a VII.H2.AP-152a VII.C1.AP-152b VII.C1.AP-161a VII.C3.AP-161a VII.E4.AP-161a VII.H2.AP-161a VII.C1.AP-161b
	124	BWR/PWR	SS, steel (with SS or nickel-alloy cladding) spent fuel storage racks (BWR), spent fuel storage racks (PWR),	Cracking due to SCC	AMP XI.M2, “Water Chemistry,” and AMP XI.M32, “One Time Inspection”	No	VII.A2.A-96 VII.A2.A-97 VII.A3.A-56 VII.E1.A-103

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			piping, piping components exposed to treated water >60 °C (>140 °F), treated borated water >60 °C (>140 °F)				
	125	BWR/PWR	SS, steel (with SS cladding), nickel-alloy spent fuel storage racks (BWR), spent fuel storage racks (PWR), piping, piping components exposed to treated water, treated borated water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One Time Inspection"	No	VII.A2.AP-79 VII.A3.AP-79 VII.E1.AP-79 VII.A2.A-98 VII.A2.A-99
	126	BWR/PWR	Metallic piping, piping components exposed to treated water, treated borated water, raw water	Wall thinning due to erosion	AMP XI.M17, "Flow Accelerated Corrosion"	No	VII.C1.A-409 VII.E1.A-407 VII.E3.A-408
M	127	BWR/PWR	Metallic piping, piping components, tanks exposed to raw water, raw water (potable), treated water, waste water	Loss of material due to recurring internal corrosion	AMP XI.M20, "Open Cycle Cooling Water System," AMP XI.M27, "Fire Water System," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous	Yes (SRP-SLR Section 3.3.2.2.7)	VII.C1.A-400a VII.C1.A-400b VII.C3.A-400a VII.C3.A-400b VII.E5.A-400b VII.G.A-400c

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					Piping and Ducting Components”		
	128	BWR/PWR	Steel tanks (within the scope of AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”) exposed to soil, concrete, air, condensation, raw water	Loss of material due to general, pitting, crevice corrosion, MIC (soil, raw water only)	AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”	No	VII.C3.A-401 VII.E5.A-401 VII.H1.A-401
D	129						
	130	BWR/PWR	Metallic sprinklers exposed to air, condensation, raw water, raw water (potable), treated water	Loss of material due to general (where applicable), pitting, crevice corrosion, MIC (except for aluminum, and in raw water, raw water (potable), treated water only); flow blockage due to fouling	AMP XI.M27, “Fire Water System”	No	VII.G.A-403
	131	BWR/PWR	Steel, SS, copper alloy, aluminum piping, piping components exposed to air, condensation	Flow blockage due to fouling	AMP XI.M27, “Fire Water System”	No	VII.G.A-404
	132	BWR/PWR	Insulated steel, copper alloy (>15% Zn or >8%	Loss of material due to general, pitting,	AMP XI.M36, “External Surfaces	No	VII.I.A-405a VII.I.A-405b

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			Al), piping, piping components, tanks, tanks (within the scope of AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”) exposed to air, condensation	crevice corrosion (steel only); cracking due to SCC (copper alloy (>15% Zn or >8% Al) only)	Monitoring of Mechanical Components” or AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”		
M	133	BWR/PWR	HDPE, CFRP underground piping, piping components	Cracking, blistering, loss of material due to wear, general corrosion (metal substrate), erosion, chemical attack, exposure to temperature or moisture	“”AMP XI.M43, “High Density Polyethylene (HDPE) CFRP Repaired Piping”	No	VII.I.A-406 VII.I.A-420
	134	BWR/PWR	Steel, SS, copper alloy piping, piping components, and heat exchanger components exposed to raw water (for components not covered by U.S. Nuclear Regulatory Commission (NRC) Generic Letter (GL) 89-13)	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.C1.A-727

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	135	BWR/PWR	Steel, SS pump casings exposed to waste water environment	Loss of material due to general (steel only), pitting, crevice corrosion, MIC	AMP XI.M36, “External Surfaces Monitoring of Mechanical Components”	No	VII.E5.A-410 VII.E5.A-411
	136	BWR/PWR	Steel fire water storage tanks exposed to air, condensation, soil, concrete, raw water, raw water (potable), treated water	Loss of material due to general, pitting, crevice corrosion, MIC (raw water, raw water (potable), treated water, soil only)	AMP XI.M27, “Fire Water System”	No	VII.G.A-412
	137	BWR/PWR	Steel, SS, aluminum tanks (within the scope of AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”) exposed to treated water, raw water, waste water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC (steel, SS only)	AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”	No	VII.C3.A-413 VII.E5.A-413 VII.H1.A-413
M	138	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw water, raw water (potable), treated water, treated	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, or physical damage; loss of	AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”	No	VII.C1.A-416 VII.C2.A-416 VII.C3.A-416 VII.D.A-416 VII.E4.A-416 VII.E5.A-416 VII.F1.A-416 VII.F2.A-416

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			borated water, fuel oil, lubricating oil, waste water, air-dry, air, condensation	material or cracking for cementitious coatings/linings			VII.F3.A-416 VII.F4.A-416 VII.G.A-416 VII.H1.A-416 VII.H2.A-416
M	139	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw water, raw water (potable), treated water, treated borated water, fuel oil, lubricating oil, waste water, air-dry, air, condensation	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”	No	VII.C1.A-414 VII.C2.A-414 VII.C3.A-414 VII.D.A-414 VII.E4.A-414 VII.E5.A-414 VII.F1.A-414 VII.F2.A-414 VII.F3.A-414 VII.F4.A-414 VII.G.A-414 VII.H1.A-414 VII.H2.A-414
M	140	BWR/PWR	Gray cast iron, ductile iron, malleable iron piping components with internal coatings/linings exposed to closed-cycle cooling water, raw water, raw water (potable), treated water, waste water	Loss of material due to selective leaching	AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”	No	VII.C1.A-415 VII.C2.A-415 VII.C3.A-415 VII.E2.A-415 VII.E3.A-415 VII.E4.A-415 VII.E5.A-415 VII.G.A-415 VII.H1.A-415 VII.H2.A-415

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
D	141						
	142	BWR/PWR	SS, steel, nickel-alloy, copper alloy closure bolting exposed to fuel oil, lubricating oil, treated water, treated borated water, raw water, waste water	Loss of material due to general (steel; copper alloy in raw water, waste water only), pitting, crevice corrosion, MIC (raw water and waste water environments only)	AMP XI.M18, “Bolting Integrity”	No	VII.I.A-423
D	143						
	144	BWR/PWR	SS, steel, aluminum piping, piping components, tanks exposed to soil, concrete	Cracking due to SCC (steel in carbonate/bicarbonate environment only)	AMP XI.M41, “Buried and Underground Piping and Tanks”	No	VII.I.A-425
	145	BWR/PWR	SS closure bolting exposed to air, soil, concrete, underground, waste water	Cracking due to SCC	AMP XI.M18, “Bolting Integrity”	No	VII.I.A-426
	146	BWR/PWR	SS underground piping, piping components, tanks	Cracking due to SCC	AMP XI.M32, “One-Time Inspection,” AMP XI.M41, “Buried and Underground Piping and Tanks,” or AMP XI.M42, “Internal Coatings/Linings for	Yes (SRP-SLR Section 3.3.2.2.3)	VII.I.A-714a VII.I.A-714b VII.I.A-714c

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”		
	147	BWR/PWR	Nickel-alloy, nickel-alloy cladding piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, “Closed Treated Water Systems”	No	VII.C2.A-471
D	148						
	149	BWR/PWR	Fiberglass piping, piping components, ducting, ducting components exposed to air – outdoor	Cracking, blistering, loss of material due to exposure to ultraviolet light, ozone, radiation, temperature, or moisture	AMP XI.M36, “External Surfaces Monitoring of Mechanical Components”	No	VII.I.A-428
	150	BWR/PWR	Fiberglass piping, piping components, ducting, ducting components exposed to air	Cracking, blistering, loss of material due to exposure to ultraviolet light, ozone, radiation, temperature, or moisture	AMP XI.M36, “External Surfaces Monitoring of Mechanical Components”	No	VII.I.A-720
	151	BWR/PWR	SS, steel, aluminum, copper alloy, titanium heat exchanger tubes	Reduction of heat transfer due to fouling	AMP XI.M36, “External Surfaces Monitoring of	No	VII.I.A-716

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			exposed to air, condensation		Mechanical Components”		
D	153						
D	154						
	155	BWR/PWR	SS piping, piping components, and tanks exposed to waste water >60°C (>140°F)	Cracking due to SCC	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.E5.A-721
D							
	157	BWR/PWR	Steel piping, piping components, heat exchanger components exposed to air-outdoor	Loss of material due to general, pitting, crevice corrosion	AMP XI.M27, “Fire Water System,” or AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.E1.A-722 VII.E2.A-722 VII.E3.A-722 VII.E4.A-722 VII.E5.A-722 VII.F1.A-722 VII.F2.A-722 VII.F3.A-722 VII.F4.A-722 VII.G.A-722 VII.H1.A-722 VII.H2.A-722
	158	BWR/PWR	Nickel-alloy piping, piping components heat exchanger components (for components not	Loss of material due to pitting, crevice corrosion, MIC; flow	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous	No	VII.C1.A-454

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			covered by NRC GL 89-13) exposed to raw water	blockage due to fouling	Piping and Ducting Components”		
	159	BWR/PWR	Fiberglass piping, piping components, ducting, ducting components exposed to air	Loss of material due to wear	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.D.A-495 VII.E5.A-495 VII.F1.A-495 VII.F2.A-495 VII.F3.A-495 VII.F4.A-495 VII.G.A-495 VII.H1.A-495 VII.H2.A-495
	160	BWR/PWR	Copper alloy (>15% Zn or >8% Al) piping, piping components, heat exchanger components exposed to closed-cycle cooling water, raw water, waste water	Cracking due to SCC	AMP XI.M20, “Open-Cycle Cooling Water System,” AMP XI.M21A, “Closed Treated Water Systems,” or AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.C1.A-473b VII.C2.A-473a VII.E5.A-473c
	161	BWR/PWR	Copper alloy heat exchanger tubes exposed to condensation	Reduction of heat transfer due to fouling	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous	No	VII.F1.A-565 VII.F2.A-565 VII.F3.A-565 VII.F4.A-565

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					Piping and Ducting Components”		VII.G.A-565 VII.H2.A-565
D	162						
D	164						
D	165						
	166	BWR/PWR	Copper alloy piping, piping components exposed to concrete	None	None	No	VII.J.A-711
N	167	BWR/PWR	Zinc piping components exposed to air-indoor controlled, air – indoor uncontrolled	None	None	No	VII.J.A-712
	169	BWR/PWR	Steel, copper alloy piping, piping components exposed to steam	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M2, “Water Chemistry,” and AMP XI.M32, “One-Time Inspection”	No	VII.F1.A-566 VII.F2.A-566 VII.F3.A-566 VII.F4.A-566
	170	BWR/PWR	SS piping, piping components exposed to steam	Loss of material due to pitting, crevice corrosion	AMP XI.M2, “Water Chemistry,” and AMP XI.M32, “One-Time Inspection”	No	VII.F1.A-567 VII.F2.A-567 VII.F3.A-567 VII.F4.A-567
D	171						
	172	BWR/PWR	PVC piping, piping components exposed to air outdoor	Reduction in impact strength due to photolysis	AMP XI.M36, “External Surfaces Monitoring of	No	VII.C1.A-458 VII.E5.A-458 VII.G.A-458

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					Mechanical Components”		
D	173						
D	174						
M	175	BWR/PWR	Fiberglass piping, piping components, tanks exposed to raw water (for components not covered by NRC GL 89-13), raw water (potable), treated water, waste water	Cracking, blistering, loss of material due to exposure to radiation, temperature, or moisture; flow blockage due to fouling (raw water, waste water only)	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.C1.A-460 VII.E5.A-551 VII.G.A-644
	176	BWR/PWR	Fiberglass piping, piping components, tanks exposed to raw water environment (for components not covered by NRC GL 89-13), raw water (potable), treated water, waste water	Loss of material due to wear; flow blockage due to fouling (raw water, waste water only)	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.C1.A-461 VII.E5.A-552 VII.G.A-645
	177	BWR/PWR	Fiberglass piping, piping components exposed to soil	Loss of material due to wear	AMP XI.M41, “Buried and Underground Piping and Tanks”	No	VII.I.A-462

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	178	BWR/PWR	Fiberglass piping and piping components exposed to concrete	None	None	No	VII.J.A-710
	179	BWR/PWR	Masonry walls: structural fire barriers exposed to air	Cracking due to restraint shrinkage, creep, aggressive environment; loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.M26, “Fire Protection,” and AMP XI.S5, “Masonry Walls”	No	VII.G.A-626
D	180						
	181	BWR/PWR	Titanium piping, piping components exposed to condensation	None	None	No	VII.J.A-703
	182	BWR/PWR	Nonmetallic thermal insulation exposed to air, condensation	Reduced thermal insulation resistance due to moisture intrusion	AMP XI.M36, “External Surfaces Monitoring of Mechanical Components”	No	VII.I.A-704
	184	BWR/PWR	PVC piping, piping components, tanks exposed to concrete	None	None	No	VII.J.A-709
	185	BWR/PWR	Aluminum fire water storage tanks exposed to air, condensation, soil, concrete, raw water, raw	Cracking due to SCC	AMP XI.M27, “Fire Water System”	No	VII.G.A-623

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			water (potable), treated water				
	186	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation, soil, concrete, raw water, waste water	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.8)	VII.C3.A-482a VII.C3.A-482b VII.C3.A-482c VII.E5.A-482a VII.E5.A-482b VII.E5.A-482c VII.H1.A-482a VII.H1.A-482b VII.H1.A-482c
D	187						
	189	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation, raw water, raw water (potable), waste water	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting	Yes (SRP-SLR Section 3.3.2.2.8)	VII.A2.A-451a VII.A2.A-451b VII.A2.A-451c VII.A2.A-451d VII.A3.A-451a VII.A3.A-451b VII.A3.A-451c VII.A3.A-451d VII.A4.A-451a VII.A4.A-451b VII.A4.A-451c

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"		VII.A4.A-451d VII.C1.A-451a VII.C1.A-451b VII.C1.A-451c VII.C1.A-451d VII.C2.A-451a VII.C2.A-451b VII.C2.A-451c VII.C2.A-451d VII.C3.A-451a VII.C3.A-451b VII.C3.A-451c VII.C3.A-451d VII.D.A-451a VII.D.A-451b VII.D.A-451c VII.D.A-451d VII.E1.A-451a VII.E1.A-451b VII.E1.A-451c VII.E1.A-451d VII.E2.A-451a VII.E2.A-451b VII.E2.A-451c VII.E2.A-451d VII.E3.A-451a VII.E3.A-451b VII.E3.A-451c

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							VII.E3.A-451d VII.E4.A-451a VII.E4.A-451b VII.E4.A-451c VII.E4.A-451d VII.E5.A-451a VII.E5.A-451b VII.E5.A-451c VII.E5.A-451d VII.F1.A-451a VII.F1.A-451b VII.F1.A-451c VII.F1.A-451d VII.F2.A-451a VII.F2.A-451b VII.F2.A-451c VII.F2.A-451d VII.F3.A-451a VII.F3.A-451b VII.F3.A-451c VII.F3.A-451d VII.F4.A-451a VII.F4.A-451b VII.F4.A-451c VII.F4.A-451d VII.G.A-451a VII.G.A-451b VII.G.A-451c

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							VII.G.A-451d VII.H1.A-451a VII.H1.A-451b VII.H1.A-451c VII.H1.A-451d VII.H2.A-451a VII.H2.A-451b VII.H2.A-451c VII.H2.A-451d
D	190						
D	191						
	192	BWR/PWR	Aluminum underground piping, piping components, tanks	Cracking due to SCC	AMP XI.M32, “One-Time Inspection,” AMP XI.M41, “Buried and Underground Piping and Tanks,” or AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”	Yes (SRP-SLR Section 3.3.2.2.8)	VII.I.A-706a VII.I.A-706b VII.I.A-706c
	193	BWR/PWR	Steel components exposed to treated water, raw water, raw water (potable), waste water	Long-term loss of material due to general corrosion	AMP XI.M32, “One-Time Inspection”	No	VII.A3.A-439 VII.A4.A-439 VII.C1.A-532 VII.C2.A-439

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							VII.C3.A-532 VII.E1.A-439 VII.E2.A-439 VII.E3.A-439 VII.E4.A-532 VII.E5.A-785 VII.G.A-439 VII.G.A-532 VII.H2.A-439 VII.H2.A-532
M	194	BWR/PWR	PVC, CFRP piping, piping components, and tanks exposed to soil	Cracking, blistering, loss of material due to wear, general corrosion (metal substrate), erosion, chemical attack, exposure to moisture	AMP XI.M41, "Buried and Underground Piping and Tanks" or AMP XI.M43, "High Density Polyethylene (HDPE) Piping and Carbon Fiber Reinforced Polymer (CFRP) Repaired Piping"	No	VII.I.A-537 VII.I.A-538
	195	BWR/PWR	Concrete, concrete cylinder piping, reinforced concrete, asbestos cement, cementitious piping, piping components exposed to	Cracking due to chemical reaction, weathering, settlement, or corrosion of reinforcement	AMP XI.M27, "Fire Water System"	No	VII.G.A-647

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			raw water, treated water, raw water (potable)	(reinforced concrete only); loss of material due to delamination, exfoliation, spalling, popout, scaling, or cavitation; flow blockage due to fouling (raw water only)			
M	196	BWR/PWR	HDPE piping, piping components exposed to raw water, treated water, raw water (potable)	Cracking, blistering, loss of material due to exposure to radiation, temperature, or moisture; flow blockage due to fouling (raw water only)	AMP XI.M27, “Fire Water System”	No	VII.G.A-648
	197	BWR/PWR	Metallic fire water system piping, piping components, heat exchanger, heat exchanger components (any material) with only a leakage boundary (spatial) or structural integrity (attached)	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion	AMP XI.M36, “External Surfaces Monitoring of Mechanical Components”	No	VII.G.A-649

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			intended function exposed to any external environment except soil, concrete				
	198	BWR/PWR	Metallic fire water system piping, piping components, heat exchanger, heat exchanger components (any material) with only a leakage boundary (spatial) or structural integrity (attached) intended function	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion, MIC (all metallic materials except aluminum; in liquid environments only)	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.G.A-650
	199	BWR/PWR	Cranes: steel structural bolting exposed to air	Loss of preload due to self-loosening; loss of material due to general corrosion; cracking	AMP XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems"	No	VII.B.A-730
D	200						
	202	BWR/PWR	SS piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.3.2.2.9)	VII.J.AP-19

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
M	203	BWR	SS; steel with SS cladding, steel, nickel-alloy piping, piping components, heat exchanger components, tanks exposed to treated water, sodium pentaborate solution	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M2, “Water Chemistry,” and AMP XI.M32, “One Time Inspection”	No	VII.A4.AP-110 VII.A4.AP-111 VII.E2.AP-141 VII.E3.AP-110 VII.E4.AP-110
D	204						
	205	BWR/PWR	Insulated SS piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” AMP XI.M32, “One-Time Inspection,” AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” or AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”	Yes (SRP-SLR Section 3.3.2.2.3)	VII.I.A-734a VII.I.A-734b VII.I.A-734c VII.I.A-734d

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
D	206						
	207	BWR/PWR	SS, copper alloy, titanium heat exchanger tubes exposed to raw water (for components not covered by NRC GL 89-13)	Cracking due to SCC (titanium only), reduction of heat transfer due to fouling	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.C1.A-736
	208	BWR/PWR	Concrete, concrete cylinder piping, reinforced concrete, asbestos cement, cementitious piping, piping components exposed to raw water (for components not covered by NRC GL 89-13)	Cracking due to chemical reaction, weathering, settlement, or corrosion of reinforcement (reinforced concrete only); loss of material due to delamination, exfoliation, spalling, popout, scaling, or cavitation; flow blockage due to fouling	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.C1.A-737
D	209						
M	210	BWR/PWR	HDPE piping, piping components exposed to raw water (for	Cracking, blistering, loss of material due to exposure to radiation,	“”AMP XI.M43, “High Density Polyethylene (HDPE) Piping and	No	VII.C1.A-739

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			components not covered by NRC GL 89-13)	temperature, or moisture; flow blockage due to fouling	Carbon Fiber Reinforced Polymer (CFRP) Repaired Piping”		
D	211						
D	212						
D	213						
	214	BWR/PWR	Copper alloy (>15% Zn or >8% Al) piping, piping components exposed to soil	Loss of material due to selective leaching	AMP XI.M33, “Selective Leaching”	No	VII.C1.A-743 VII.C2.A-743 VII.C3.A-743 VII.D.A-743 VII.E4.A-743 VII.E5.A-743 VII.G.A-743 VII.H1.A-743 VII.H2.A-743
	215	BWR/PWR	Aluminum fire water storage tanks exposed to air, condensation, soil, concrete, raw water, raw water (potable), treated water	Loss of material due to pitting, crevice corrosion	AMP XI.M27, “Fire Water System”	No	VII.G.A-744
	216	BWR/PWR	SS fire water storage tanks exposed to air, condensation, soil, concrete	Cracking due to SCC	AMP XI.M27, “Fire Water System”	No	VII.G.A-745
D	217						

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	218	BWR/PWR	SS fire water storage tanks exposed to air, condensation, soil, concrete, raw water, raw water (potable), treated water	Loss of material due to pitting, crevice corrosion, MIC (water and soil environment only)	AMP XI.M27, “Fire Water System”	No	VII.G.A-747
	219	BWR/PWR	SS piping, piping components exposed to steam	Cracking due to SCC	AMP XI.M2, “Water Chemistry,” and AMP XI.M32, “One-Time Inspection”	No	VII.F1.A-748 VII.F2.A-748 VII.F3.A-748 VII.F4.A-748
D	220						
D	221						
	222	BWR/PWR	SS, nickel-alloy tanks exposed to air, condensation (internal/external)	Loss of material due to pitting, crevice corrosion	AMP XI.M32, “One-Time Inspection,” AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” or AMP XI.M42, “Internal	Yes (SRP-SLR Section 3.3.2.2.4)	VII.I.A-751b VII.I.A-751c VII.I.A-751d VII.I.A-751e

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”		
	223	BWR/PWR	Aluminum underground piping, piping components, tanks	Loss of material due to pitting, crevice corrosion	AMP XI.M32, “One-Time Inspection,” AMP XI.M41, “Buried and Underground Piping and Tanks,” or AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”	Yes (SRP-SLR Section 3.3.2.2.10)	VII.I.A-752a VII.I.A-752b VII.I.A-752c
D	224						
D	225						
	226	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”) exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”	No	VII.I.A-755

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	227	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”) exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” AMP XI.M32, “One-Time Inspection,” or AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”	Yes (SRP-SLR Section 3.3.2.2.10)	VII.C3.A-756a VII.C3.A-756b VII.C3.A-756c VII.E5.A-756a VII.E5.A-756b VII.E5.A-756c VII.H1.A-756a VII.H1.A-756b VII.H1.A-756c
	228	BWR/PWR	SS, nickel-alloy tanks (within the scope of AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”) exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” AMP XI.M32, “One Time Inspection,” or AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”	Yes (SRP-SLR Section 3.3.2.2.4)	VII.C3.A-757a VII.C3.A-757b VII.C3.A-757c VII.E5.A-757a VII.E5.A-757b VII.E5.A-757c VII.H1.A-757a VII.H1.A-757b VII.H1.A-757c

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	229	BWR/PWR	SS tanks (within the scope of AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”) exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil only)	AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”	No	VII.C3.A-758 VII.E5.A-758 VII.H1.A-758
	230	BWR/PWR	SS tanks (within the scope of AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”) exposed to soil, concrete	Cracking due to SCC	AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”	No	VII.C3.A-759 VII.E5.A-759 VII.H1.A-759
	231	BWR/PWR	SS tanks (within the scope of AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks”) exposed to air, condensation	Cracking due to SCC	AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” AMP XI.M32, “One-Time Inspection,” or AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”	Yes (SRP-SLR Section 3.3.2.2.3)	VII.C3.A-760a VII.C3.A-760b VII.C3.A-760c VII.E5.A-760a VII.E5.A-760b VII.E5.A-760c VII.H1.A-760a VII.H1.A-760b VII.H1.A-760c

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	232	BWR/PWR	Insulated SS, nickel-alloy piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.4)	VII.I.A-761a VII.I.A-761b VII.I.A-761c VII.I.A-761d
	233	BWR/PWR	Insulated aluminum piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical	Yes (SRP-SLR Section 3.3.2.2.8)	VII.I.A-762a VII.I.A-762b VII.I.A-762c VII.I.A-762d

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"		
	234	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.A4.A-763a VII.A4.A-763b VII.A4.A-763c VII.A4.A-763d VII.C1.A-763a VII.C1.A-763b VII.C1.A-763c VII.C1.A-763d VII.C3.A-763a VII.C3.A-763b VII.C3.A-763c VII.C3.A-763d VII.E5.A-763a VII.E5.A-763b VII.E5.A-763c VII.E5.A-763d VII.F1.A-763a VII.F1.A-763b VII.F1.A-763c VII.F1.A-763d

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							VII.F2.A-763a VII.F2.A-763b VII.F2.A-763c VII.F2.A-763d VII.F3.A-763a VII.F3.A-763b VII.F3.A-763c VII.F3.A-763d VII.F4.A-763a VII.F4.A-763b VII.F4.A-763c VII.F4.A-763d VII.H1.A-763a VII.H1.A-763b VII.H1.A-763c VII.H1.A-763d VII.H2.A-763a VII.H2.A-763b VII.H2.A-763c VII.H2.A-763d
	235	BWR/PWR	Metallic piping, piping components exposed to air-dry (internal)	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M24, “Compressed Air Monitoring”	No	VII.D.A-764
	236	BWR/PWR	Titanium heat exchanger tubes exposed to treated water	Cracking due to SCC, reduction of heat transfer due to fouling	AMP XI.M2, “Water Chemistry,” and AMP XI.M32,	No	VII.A3.A-765 VII.A4.A-765 VII.C1.A-765 VII.C3.A-765

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					“One-Time Inspection”		VII.E1.A-765 VII.E3.A-765 VII.G.A-765 VII.H2.A-765
	237	BWR/PWR	Titanium (ASTM Grades 1, 2, 7, 9, 11, or 12) heat exchanger components other than tubes, piping, piping components exposed to treated water	None	None	No	VII.J.A-766
	238	BWR/PWR	Titanium heat exchanger tubes exposed to closed-cycle cooling water	Cracking due to SCC, reduction of heat transfer due to fouling	AMP XI.M21A, “Closed Treated Water Systems”	No	VII.C2.A-767 VII.E3.A-767 VII.E4.A-767 VII.F1.A-767 VII.F2.A-767 VII.F3.A-767 VII.F4.A-767
	239	BWR/PWR	Titanium (ASTM Grades 1, 2, 7, 9, 11, or 12) heat exchanger components other than tubes, piping, piping components exposed to closed-cycle cooling water	None	None	No	VII.J.A-768
	240	BWR/PWR	Aluminum heat exchanger components exposed to waste water	Loss of material due to pitting, crevice corrosion	AMP XI.M32, “One-Time Inspection,” AMP	Yes (SRP-SLR Section 3.3.2.2.10)	VII.E5.A-769a VII.E5.A-769b

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"		VII.E5.A-769c VII.E5.A-769d
	241	BWR/PWR	SS, nickel-alloy heat exchanger components exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or	Yes (SRP-SLR Section 3.3.2.2.4)	VII.F1.A-770a VII.F1.A-770b VII.F1.A-770c VII.F1.A-770d VII.F2.A-770a VII.F2.A-770b VII.F2.A-770c VII.F2.A-770d VII.F3.A-770a VII.F3.A-770b VII.F3.A-770c VII.F3.A-770d

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”		VII.F4.A-770a VII.F4.A-770b VII.F4.A-770c VII.F4.A-770d
	242	BWR/PWR	Aluminum heat exchanger components exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, “One-Time Inspection,” AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” or AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”	Yes (SRP-SLR Section 3.3.2.2.10)	VII.F1.A-771a VII.F1.A-771b VII.F1.A-771c VII.F1.A-771d VII.F2.A-771a VII.F2.A-771b VII.F2.A-771c VII.F2.A-771d VII.F3.A-771a VII.F3.A-771b VII.F3.A-771c VII.F3.A-771d VII.F4.A-771a VII.F4.A-771b VII.F4.A-771c VII.F4.A-771d
D	243						

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	244	BWR	SS, nickel-alloy piping, piping components exposed to treated water >60 °C (>140 °F)	Cracking due to SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.E3.A-773 VII.E4.A-773
	245	BWR/PWR	Insulated aluminum piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.I.A-774a VII.I.A-774b VII.I.A-774c VII.I.A-774d
	246	BWR/PWR	SS, nickel-alloy underground piping, piping components, tanks	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M41, "Buried and Underground Piping	Yes (SRP-SLR Section 3.3.2.2.4)	VII.I.A-775a VII.I.A-775b VII.I.A-775c

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					and Tanks," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"		
	247	BWR/PWR	Aluminum piping, piping components, tanks exposed to raw water, waste water	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.C1.A-776a VII.C1.A-776b VII.C1.A-776c VII.C1.A-776d VII.C3.A-776a VII.C3.A-776b VII.C3.A-776c VII.C3.A-776d VII.E5.A-776a VII.E5.A-776b VII.E5.A-776c VII.E5.A-776d
	248	BWR/PWR	Aluminum piping, piping components, tanks	None	None	No	VII.J.A-777

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			exposed to air with borated water leakage				
	249	BWR/PWR	Steel heat exchanger tubes internal to components exposed to air outdoor, air-indoor uncontrolled, condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.C1.A-778 VII.F1.A-778 VII.F2.A-778 VII.F3.A-778 VII.F4.A-778
	250	BWR/PWR	Steel reactor coolant pump oil collection system tanks, piping, piping components exposed to lubricating oil (waste oil)	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M32, “One-Time Inspection”	No	VII.G.AP-116 VII.G.AP-117
D	251						
	252	BWR/PWR	Aluminum piping, piping components exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M41, “Buried and Underground Piping and Tanks”	No	VII.I.AP-173
M	253	BWR/PWR	PVC, CFRP piping, piping components exposed to raw water, raw water (potable), treated water, waste water	Cracking, blistering, loss of material due to wear, tearing, delamination, void, debonding, chemical attack and exposure to moisture; flow	AMP XI.M20, “Open-Cycle Cooling Water System,” AMP XI.M27, “Fire Water System,” AMP XI.M38, “Inspection of Internal Surfaces	No	VII.C1.A-787a VII.C1.A-787c VII.E5.A-787d VII.G.A-787b VII.C1.A-792

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
				blockage due to fouling, delamination, debonding, or tearing	in Miscellaneous Piping and Ducting Components," or AMP XI.M43, "High Density Polyethylene (HDPE) Piping and Carbon Fiber Reinforced Polymer (CFRP) Repaired Piping"		
	254	BWR/PWR	Aluminum heat exchanger components exposed to air, condensation	Cracking due to SCC	AMP XI.M32, "One Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components,	Yes (SRP-SLR Section 3.3.2.2.8)	VII.F1.A-788a VII.F1.A-788b VII.F1.A-788c VII.F1.A-788d VII.F2.A-788a VII.F2.A-788b VII.F2.A-788c VII.F2.A-788d VII.F3.A-788a VII.F3.A-788b VII.F3.A-788c VII.F3.A-788d VII.F4.A-788a VII.F4.A-788b VII.F4.A-788c VII.F4.A-788d

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					Heat Exchangers, and Tanks”		
M	255	BWR/PWR	Metallic fire damper housings exposed to air	Loss of material due to general, pitting, crevice corrosion; cracking due to SCC	AMP XI.M26, “Fire Protection”	No	VII.G.A-789
D	256						
	257	BWR/PWR	Steel, SS, copper alloy heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	AMP XI.M39, “Lubricating Oil Analysis,” and AMP XI.M32, “One-Time Inspection”	No	VII.C1.A-791 VII.C2.A-791 VII.C3.A-791 VII.E1.A-791 VII.E4.A-791 VII.F1.A-791 VII.F2.A-791 VII.F3.A-791 VII.F4.A-791 VII.G.A-791 VII.H2.A-791
	258	BWR/PWR	Metallic, elastomer, fiberglass, HDPE piping, piping components exposed to waste water	Flow blockage due to fouling	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.E5.A-780

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
E	259	BWR/PWR	Aluminum piping, piping components exposed to raw water	Flow blockage due to fouling	AMP XI.M20, “Open Cycle Cooling Water System,” or AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.A3.A-793 VII.A4.A-793 VII.C1.A-793a VII.C1.A-793b VII.C2.A-793 VII.C3.A-793 VII.E1.A-793 VII.E2.A-793 VII.E3.A-793 VII.E4.A-793 VII.F1.A-793 VII.F2.A-793 VII.F3.A-793 VII.F4.A-793 VII.H1.A-793 VII.H2.A-793
	260	BWR/PWR	Metallic heating, ventilation and air conditioning systems closure bolting exposed to air, condensation	Loss of material due to general (where applicable), pitting, crevice corrosion; cracking due to SCC, loss of preload	AMP XI.M36, “External Surfaces Monitoring of Mechanical Components”	No	VII.F1.A-794 VII.F2.A-794 VII.F3.A-794 VII.F4.A-794
M	261	BWR/PWR	Titanium (ASTM Grades 3, 4, or 5) heat exchanger tubes exposed to closed-cycle cooling water, raw water	Cracking due to SCC, flow blockage due to fouling	AMP XI.M20, “Open-Cycle Cooling Water System,” or AMP XI.M21A, “Closed	No	VII.C1.A-795a VII.C2.A-795b VII.C3.A-795a VII.E4.A-795a VII.H2.A-795a

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					Treated Water Systems”		
	262	BWR/PWR	Titanium piping, piping components, heat exchanger components exposed to closed-cycle cooling water, treated water	Cracking due to SCC	AMP XI.M20, “Open-Cycle Cooling Water System,” or AMP XI.M21A, “Closed Treated Water Systems,” or AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.C1.A-796a VII.C2.A-796b VII.C3.A-796a VII.E2.A-796c VII.E3.A-796c VII.E4.A-796a VII.H2.A-796a
M	263	BWR/PWR	Polymeric piping, piping components, ducting, ducting components, seals exposed to air, condensation, raw water, raw water (potable), treated water, waste water, underground, concrete, soil	Hardening or loss of strength due to polymeric degradation; loss of material due to peeling, delamination, wear; cracking or blistering due to exposure to ultraviolet light, ozone, radiation, or chemical attack; flow blockage due to	AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” or AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VII.C1.A-797b VII.C2.A-797b VII.C3.A-797b VII.D.A-797b VII.E5.A-797b VII.F1.A-797b VII.F2.A-797b VII.F3.A-797b VII.F4.A-797b VII.G.A-797b VII.H1.A-797b VII.H2.A-797b VII.I.A-797a

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
				fouling (Inspection of Internal Surfaces only)			
N	264		Steel piping, piping components, and tanks exposed to treated water, sodium pentaborate solution.	Long-term loss of material due to general corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.M32, One-Time Inspection"	No	VII.E2.A-798
N	265	BWR/PWR	Steel heat exchanger tubes exposed to fuel oil	Reduction of heat transfer due to fouling	XI.M30, "Fuel Oil Chemistry," and XI.M32, "One-Time Inspection"	No	VII.H2.A-799
N	266	BWR/PWR	Steel heat exchanger tubes exposed to fuel oil	Reduction of heat transfer due to fouling	XI.M30, "Fuel Oil Chemistry,"	No	VII.H2.A-800
N	267	BWR/PWR	Subliming compound fireproofing/fire barriers (Thermo-lag®, Darmatt™, 3M™ Interam™, and other similar materials) exposed to air	Loss of material due to abrasion, flaking, vibration; cracking/delamination due to chemical reaction, settlement; change in material properties due to gamma irradiation exposure; separation	AMP XI.M26, "Fire Protection"	No	VII.G.A-805
N	268	BWR/PWR	Cementitious coating fireproofing/fire barriers	Loss of material due to abrasion,	AMP XI.M26, "Fire Protection"	No	VII.G.A-806

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			(Pyrocrete, BIO™ K-10 Mortar, Cafecote, and other similar materials) exposed to air	exfoliation, elevated temperature, flaking, spalling; cracking/delamination due to chemical reaction, elevated temperature, settlement, vibration; change in material properties due to elevated temperature, gamma irradiation exposure; separation			
N	269	BWR/PWR	Silicate fireproofing/fire barriers (Marinite®, Kaowool™, Cerafiber®, Cera® blanket, or other similar materials) exposed to air	Loss of material due to abrasion, flaking; cracking/delamination due to settlement; change in material properties due to gamma irradiation exposure; separation	AMP XI.M26, “Fire Protection”	No	VII.G.A-807

AMP = Aging Management Program; ASME = American Society of Mechanical Engineers; BWR = boiling water reactor; CFRP = Carbon Fiber Reinforced Polymer; GL = Generic Letter; HDPE = high-density polyethylene; IGSCC = intergranular stress corrosion cracking; MIC = microbiologically-induced corrosion; NPS = nominal pipe size; NRC = U.S. Nuclear Regulatory Commission; PVC = polyvinyl chloride; PWR = pressurized water reactor; SCC = systems, structures, and components; SRP-SLR = Standard Review Plan for Review of Subsequent License Renewal Applications; SS = stainless steel; TLAA = Time-Limited Aging Analyses.

Table 3.3-2 Aging Management Review and Additional Guidance Appendices Recommended for Aging Management of Auxiliary Systems

Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report Chapter)/Aging Management Program (AMP)	Program Name
AMP XI.M1	American Society of Mechanical Engineers (ASME) Section XI Inservice Inspection, Subsections IWB, IWC, and IWD
AMP XI.M2	Water Chemistry
AMP XI.M7	Boiling water reactor (BWR) Stress Corrosion Cracking
AMP XI.M10	Boric Acid Corrosion
AMP XI.M17	Flow-accelerated Corrosion
AMP XI.M18	Bolting Integrity
AMP XI.M20	Open Cycle Cooling Water System
AMP XI.M21A	Closed Treated Water Systems
AMP XI.M22	Boraflex Monitoring
AMP XI.M23	Inspection of Overhead Heavy and Light Loads (Related to Refueling) Handling Systems
AMP XI.M24	Compressed Air Monitoring
AMP XI.M25	BWR Reactor Water Cleanup System
AMP XI.M26	Fire Protection
AMP XI.M27	Fire Water System
AMP XI.M29	Outdoor and Large Atmospheric Metallic Storage Tanks
AMP XI.M30	Fuel Oil Chemistry
AMP XI.M32	One-Time Inspection
AMP XI.M33	Selective Leaching
AMP XI.M36	External Surfaces Monitoring of Mechanical Components
AMP XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
AMP XI.M39	Lubricating Oil Analysis
AMP XI.M40	Monitoring of Neutron-Absorbing Materials Other Than Boraflex
AMP XI.M41	Buried and Underground Piping and Tanks
AMP XI.M42	Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks
AMP XI.M43	High Density Polyethylene Piping and Carbon Fiber Reinforced Polymer Repaired Piping
AMP XI.S6	Structures Monitoring
GALL-SLR Report Appendix A	Quality Assurance For Aging Management Programs
GALL-SLR Report Appendix B	Operating Experience For Aging Management Programs
SRP-SLR Appendix A	Aging Management Review—Generic (Branch Technical Position Risk-Informed, Performance-Based [RLSB-1])

AMP = Aging Management Program; ASME = American Society of Mechanical Engineers; BWR = boiling water reactor; GALL-SLR = Generic Aging Lessons Learned for Subsequent License Renewal.

3.4 Aging Management of Steam and Power Conversion System

Review Responsibilities

Primary — The branch(es) assigned responsibility by the PM for the safety review of the SLRA.

Secondary — None

3.4.1 Areas of Review

This section addresses the AMR and the associated AMPs of the steam and power conversion system. For a recent vintage plant, the information related to the steam and power conversion system is contained in Chapter 10, “Steam and Power Conversion System,” of the plant’s FSAR, consistent with the “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants” (NRC 2021-TN8013). The steam and power conversion systems contained in this review plan section are generally consistent with those contained in NUREG–0800 except for the condenser circulating water and the condensate storage systems. For older plants, the location of applicable information is plant-specific because an older plant’s FSAR may have predated NUREG–0800.

Typical steam and power conversion systems that are subject to an AMR for SLR are steam turbine, main steam, extraction steam, feedwater, condensate, steam generator blowdown, and auxiliary feedwater. This review plan section also includes SCs in nonsafety-related systems that are not connected to safety-related systems, SSCs but have a spatial relationship such that their failure could adversely impact the performance of a safety-related SSC intended function. Examples of such nonsafety-related systems may be extraction steam, plant heating steam/auxiliary boilers and hot water heating systems.

The aging management for the steam generator is reviewed following the guidance in Section 3.1 of this SRP-SLR. The aging management for portions of the BWR main steam and main feedwater systems, extending from the RV to the outermost containment isolation valve, is reviewed separately following the guidance in Section 3.1 of this SRP-SLR.

The responsible review organization is to review the following SLRA AMR and AMP items assigned to it, per SRP-SLR Section 1.2:

AMRs

- AMR results consistent with the GALL-SLR Report
- AMR results for which further evaluation is recommended
- AMR results not consistent with or not addressed in the GALL-SLR Report

AMPs

- Consistent with the GALL-SLR Report AMPs
- Plant-specific AMPs

FSAR Supplement

- The responsible review organization is to review the FSAR Supplement associated with each assigned AMP.

3.4.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the NRC regulations in 10 CFR 54.21.

3.4.2.1 Aging Management Review Results Consistent with the Generic Aging Lessons Learned for Subsequent License Renewal Report

The AMR and the AMPs applicable to the steam and power conversion system are described and evaluated in Chapter VIII of the GALL-SLR Report.

The applicant's SLRA should provide sufficient information so that the NRC reviewer is able to confirm that the specific SLRA AMR item and the associated SLRA AMP are consistent with the cited GALL-SLR Report AMR item. The reviewer should then confirm that the SLRA AMR item is consistent with the GALL-SLR Report AMR item to which it is compared.

When the applicant is crediting a different AMP than recommended in the GALL-SLR Report, the reviewer should confirm that the alternate AMP is valid to use for aging management and will be capable of managing the effects of aging as adequately as the AMP recommended by the GALL-SLR Report.

3.4.2.2 Aging Management Review Results for Which Further Evaluation Is Recommended by the Generic Aging Lessons Learned for Subsequent License Renewal Report

The basic acceptance criteria, defined in Section 3.4.2.1, need to be applied first for all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL-SLR Report AMR item to which the SLRA AMR item is compared identifies that "Further Evaluation Recommended," then additional criteria apply as identified by the GALL-SLR Report for each of the following aging effect/aging mechanism combinations. Refer to Table 3.4-1, comparing the "Further Evaluation Recommended" and the "GALL-SLR Item" column, for the AMR items that reference the following subsections.

3.4.2.2.1 Cumulative Fatigue Damage

Evaluations involving time-dependent fatigue or cyclical loading parameters may be TLAAs, as defined in 10 CFR 54.3 (TN4878). The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). This TLAA is addressed separately in SRP-SLR Section 4.3, "Metal Fatigue," or Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses." For plant-specific cumulative usage factor calculations that are based on stress-based input methods, the methods are to be appropriately defined and discussed in the applicable TLAAs.

3.4.2.2.2 Cracking Due to Stress Corrosion Cracking in Stainless Steel Alloys

Cracking due to SCC could occur in indoor or outdoor SS piping, piping components, and tanks exposed to any air, condensation, or underground environment when the component is: (i) uninsulated; (ii) insulated; (iii) in the vicinity of insulated components, or (iv) in the vicinity of potentially transportable halogens. Cracking can occur in environments containing sufficient halides (e.g., chlorides) in the presence of moisture.

Insulated SS components exposed to indoor air, outdoor air, condensation, or underground environments are susceptible to SCC if the insulation contains certain contaminants. Leakage of fluids through bolted connections (e.g., flanges, valve packing) can result in contaminants present in the insulation leaching onto the component surface or the surfaces of other components below the component. For outdoor insulated SS components, rain and changing weather conditions can result in moisture intrusion into the insulation.

Plant-specific OE and the condition of SS components are evaluated to determine if prolonged exposure to the plant-specific environments has resulted in SCC. The SCC in SS components is not an aging effect which requires management if: (i) plant-specific OE does not reveal a history of SCC and (ii) a one-time inspection demonstrates that no aging effect is occurring or apparent.

In the environment of air-indoor controlled, SCC is only expected to occur as the result of a source of moisture and halides. Inspections focus on the most susceptible locations. The applicant documents the results of the plant-specific OE review in the SLRA.

The GALL-SLR Report recommends further evaluation of SS piping, piping components, and tanks exposed to an air, condensation, or underground environment to determine whether an AMP is needed to manage the aging effect of SCC. The GALL-SLR Report AMP XI.M32, "One-Time Inspection," describes an acceptable program to demonstrate that SCC is not occurring. If SCC is occurring, the following AMPs describe acceptable programs to manage cracking due to SCC: (i) GALL-SLR Report AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," for tanks; (ii) GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," for external surfaces of piping and piping components; (iii) GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," for underground piping, piping components and tanks; and (d) GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," for internal surfaces of components that are not included in other AMPs. The timing of the one-time or periodic inspections is consistent with those recommended in the AMP selected by the applicant during the development of the SLRA. For example, one-time inspections would be conducted between the 50th and 60th year of operation, as recommended by the "Detection of Aging Effects" program element in AMP XI.M32.

The applicant may mitigate or prevent cracking due to SCC through the use of a barrier coating to isolate the component from aggressive environments. However, the applicant should identify SCC as applicable for SLR and identify the AMP that will be used to manage the integrity of the coating. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and air that contain halides. The GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," describes an acceptable program to manage the integrity of a barrier coating for internal or external coatings.

3.4.2.2.3 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and Nickel Alloys

Loss of material due to pitting and crevice corrosion could occur in indoor or outdoor SS and nickel-alloy piping, piping components, and tanks exposed to any air, condensation, or underground environment when the component is: (i) uninsulated; (ii) insulated; (iii) in the vicinity of insulated components; or (iv) in the vicinity of potentially transportable halogens. Loss of material due to pitting and crevice corrosion can occur on SS and nickel alloys in environments containing sufficient halides (e.g., chlorides) in the presence of moisture.

Insulated SS and nickel-alloy components exposed to air, condensation, or underground environments are susceptible to loss of material due to pitting or crevice corrosion if the insulation contains certain contaminants. Leakage of fluids through mechanical connections such as bolted flanges and valve packing can result in contaminants leaching onto the component surface or the surfaces of other parts below the component. For outdoor insulated SS and nickel-alloy components, rain, and changing weather conditions can result in moisture intrusion into the insulation.

Plant-specific OE and the condition of SS and nickel-alloy components are evaluated to determine if prolonged exposure to the plant-specific environments has resulted in pitting or crevice corrosion. Loss of material due to pitting and crevice corrosion is not an aging effect that requires management for SS and nickel-alloy components if: (i) plant-specific OE does not reveal a history of loss of material due to pitting or crevice corrosion; and (ii) a one-time inspection demonstrates that the aging effect is not occurring or is occurring so slowly that it will not affect the intended function of the components during the subsequent period of extended operation. The applicant documents the results of the plant-specific OE review in the SLRA.

In the environment of air-indoor controlled, pitting and crevice corrosion is only expected to occur in the presence of a source of moisture and halides. Inspections focus on the most susceptible locations.

The GALL-SLR Report recommends further evaluation of SS and nickel-alloy piping, piping components, and tanks exposed to an air, condensation, or underground environment to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion. The GALL-SLR Report AMP XI.M32, “One-Time Inspection,” describes an acceptable program to demonstrate that loss of material due to pitting and crevice corrosion is not occurring at a rate that affects the intended function of the components. If loss of material due to pitting or crevice corrosion has occurred and is sufficient to potentially affect the intended function of an SSC, the following AMPs describe acceptable programs to manage loss of material due to pitting or crevice corrosion: (i) GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” for tanks; (ii) GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” for external surfaces of piping and piping components; (iii) GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” for underground piping, piping components and tanks; and (iv) GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” for internal surfaces of components that are not included in other AMPs. The timing of the one-time or periodic inspections is consistent with that recommended in the AMP selected by the applicant during the development of the SLRA. For example, one-time inspections would be conducted between the 50th and 60th year of operation, as recommended by the “Detection of Aging Effects” program element in AMP XI.M32.

The applicant may mitigate or prevent loss of material due to pitting and crevice corrosion through the use of a barrier coating to isolate the component from aggressive environments. However, the applicant should identify loss of material as applicable for SLR and identify the AMP that will be used to manage the integrity of the coating. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and air that contain halides. GALL- SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope

Piping, Piping Components, Heat Exchangers, and Tanks," describes an acceptable program to manage the integrity of a barrier coating for internal or external coatings.

3.4.2.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in BTP IQMB-1 (Appendix Section A.2, of this SRP-SLR).

3.4.2.2.5 Ongoing Review of Operating Experience

Acceptance criteria are described in Appendix Section A.4, "Operating Experience for Aging Management Programs."

3.4.2.2.6 Loss of Material Due to Recurring Internal Corrosion

Recurring internal corrosion can result in the need to augment AMPs beyond the recommendations in the GALL-SLR Report. During the search of plant-specific OE conducted during the SLRA development, recurring internal corrosion can be identified by the number of occurrences of aging effects and the extent of degradation at each localized corrosion site. This further evaluation item is applicable if the search of plant-specific OE reveals repetitive occurrences. The criteria for recurrence is: (i) a 10 year search of plant-specific OE reveals the aging effect has occurred in three or more refueling outage cycles; or (ii) a 5 year search of plant-specific OE reveals the aging effect has occurred in two or more refueling outage cycles and resulted in the component either not meeting plant-specific acceptance criteria or experiencing a reduction in wall thickness greater than 50 percent (regardless of the minimum wall thickness).

The GALL-SLR Report recommends that GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," be evaluated for inclusion of augmented requirements to ensure the adequate management of any recurring aging effect(s). Alternatively, a plant-specific AMP may be proposed. Potential augmented requirements include: (i) alternative examination methods (e.g., volumetric versus external visual), (ii) augmented inspections (e.g., a greater number of locations, additional locations based on risk insights based on susceptibility to aging effect and consequences of failure, a greater frequency of inspections), and (iii) additional trending parameters and decision points for implementing in more frequent inspections.

The applicant states: (i) why the program's examination methods will be sufficient to detect the recurring aging effect before affecting the ability of a component to perform its intended function, (ii) the basis for the adequacy of augmented or lack of augmented inspections, (iii)) the trend of which parameters will be followed as well as the decision points where increased inspections would be implemented (e.g., the extent of degradation at individual corrosion sites, the rate of degradation change), (iv) how inspections of components that are not easily accessed (i.e., buried, underground) will be conducted, and (v) how leaks in any involved buried or underground components will be identified.

Plant-specific OE examples should be evaluated to determine if the chosen AMP should be augmented even if the thresholds for significance of aging effect or frequency of occurrence of aging effect have not been exceeded. For example, during a 10 year search of plant-specific OE, two instances of a 360º 30 percent wall loss occurred at copper alloy to steel joints. Neither the significance of the aging effect nor the frequency of occurrence of aging effect threshold has been exceeded. Nevertheless, the OE should be evaluated to determine if the AMP that is proposed to manage the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of inspections) to provide reasonable assurance that the CLB intended functions of the component will be met throughout the subsequent period of extended operation. While recurring internal corrosion is not as likely in environments other than raw water and waste water (e.g., treated water), the aging effect should be addressed in a similar manner.

3.4.2.2.7 Cracking Due to Stress Corrosion Cracking in Aluminum Alloys

The SCC is a form of environmentally assisted cracking which is known to occur in high and moderate strength aluminum alloys. The three conditions necessary for SCC to occur in a component are a sustained tensile stress, aggressive environment, and material with a susceptible microstructure. Cracking due to SCC can be mitigated by eliminating one of the three necessary conditions. For the purposes of SLR, acceptance criteria for this further evaluation are provided for demonstrating that the specific material is not susceptible to SCC or the ambient environment is not aggressive in nature. Cracking due to SCC is an aging effect which requires management unless it is demonstrated by the applicant that one of the two necessary conditions discussed below is absent.

<u>Susceptible Material</u>: If the material is not susceptible to SCC, then cracking is not an aging effect that requires management. The microstructure of an aluminum alloy, of which alloy composition is only one factor, that determines whether the alloy is susceptible to SCC. Therefore, determining susceptibility based on alloy composition alone is not adequate to conclude whether a particular material is susceptible to SCC. The temper type, condition, and product form of the alloy is considered when assessing if a material is susceptible to SCC. Aluminum alloys that are susceptible to SCC include:

- 2xxx series alloys in the F, W, Ox, T3x, T4x, or T6x temper;
- 5xxx series alloys with a magnesium content of 3.5 wt% or greater;
- 6xxx series alloys in the F temper;
- 7xxx series alloys in the F, T5x, or T6x temper;
- 2xx.x and 7xx.x series alloys;
- 3xx.x series alloys that contain copper; and
- 5xx.x series alloys with a magnesium content of greater than 8 wt%.

The material is evaluated to verify that it is not susceptible to SCC and that the basis used to make the determination is technically substantiated. Tempers have been specifically developed to improve the SCC resistance for some aluminum alloys. Aluminum alloy and temper combination which are not susceptible to SCC when used in piping, piping component, and tank applications include 1xxx series, 3xxx series, 6061-T6x, 6063-T6, and 5454-x. If it is determined that a material is not susceptible to SCC, the SLRA provides the components/locations where it is used, alloy composition, temper or condition, and product form. For tempers not addressed above, the basis used to determine that the alloy is not susceptible and technical information substantiating the basis is added to the SLRA.

<u>Aggressive Environment</u>: If the environment to which an aluminum alloy is exposed is not aggressive, such as dry gas or treated water, then cracking due to SCC will not occur and it is not an aging effect which requires management. Aggressive environments that are known to result in cracking due to SCC of susceptible aluminum alloys include the presence of aqueous

solutions, air, condensation, and underground locations that contain halides (e.g., chloride). Halide concentrations should be considered high enough to facilitate SCC of aluminum alloys in uncontrolled or untreated aqueous solutions and air, such as raw water, waste water, condensation, underground locations, and outdoor air, unless demonstrated otherwise.

Halides could be present on the surface of the aluminum material if the component is encapsulated in a material such as insulation layer or concrete. In a controlled or uncontrolled indoor air, condensation, or underground environment, sufficient halide concentrations to cause SCC could be present due to secondary sources such as leakage from nearby components (e.g., leakage from insulated flanged connections or valve packing). If an aluminum component is exposed to a halide-free indoor air environment, not encapsulated in materials containing halides, and the exposure to secondary sources of moisture or halides is precluded, cracking due to SCC is not expected to occur. The plant-specific configuration can be used to demonstrate that exposure to halides will not occur. If it is determined that SCC will not occur because the environment is not aggressive, the SLRA provides the components and locations exposed to the environment, description of the environment, basis used to determine the environment is not aggressive, and technical information substantiating the basis. The GALL-SLR Report AMP XI.M32, “One-Time Inspection,” and a review of plant-specific OE describe an acceptable means to confirm the absence of moisture or halides within the proximity of the aluminum component.

If the environment potentially contains halides, GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” describes an acceptable program to manage cracking due to SCC of aluminum tanks. The GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” describes an acceptable program to manage cracking due to SCC of aluminum piping and piping components. The GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” describes an acceptable program to manage cracking due to SCC of aluminum piping and tanks which are buried or underground. The GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” describes an acceptable program to manage cracking due to SCC of aluminum components that are not included in other AMPs.

The applicant may mitigate or prevent cracking due to SCC through the use of a barrier coating to isolate the component from aggressive environments. However, the applicant should identify SCC as applicable for SLR and identify the AMP that will be used to manage the integrity of the coating. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and air that contain halides. GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” describes an acceptable program to manage the integrity of a barrier coating for internal or external coatings.

3.4.2.2.8 Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to Stress Corrosion Cracking

Loss of material due to general (steel only), crevice, or pitting corrosion and cracking due to SCC (SS only) can occur in steel and SS piping and piping components exposed to concrete. Concrete provides a highly alkaline environment that can mitigate the effects of loss of material for steel piping, thereby significantly reducing the corrosion rate. However, if water intrudes through the concrete, the pH can be reduced and ions that promote loss of material such as chlorides, which can penetrate the protective oxide layer created in the highly alkaline environment, can reach the surface of the metal. Carbonation can reduce the pH within concrete. The rate of carbonation is reduced by using concrete with a low water-to-cement ratio and low permeability. Concrete with low permeability also reduces the potential for penetration of water. Adequate air entrainment improves the ability of the concrete to resist freezing and thawing cycles and therefore reduces the potential for cracking and intrusion of water. Cracking due to SCC, as well as pitting and crevice corrosion can occur due to halides present in the water that penetrate the surface of the metal.

If the following conditions are met, loss of material is not considered to be an applicable aging effect for steel: (i) 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; (ii) plant-specific OE indicates no degradation of the concrete that could lead to penetration of water to the metal surface; and (iii) the piping is not potentially exposed to groundwater. For SS components loss of material and cracking due to SCC are not considered to be applicable aging effects as long as the piping is not potentially exposed to groundwater. Where these conditions are not met, loss of material due to general (steel only), crevice, or pitting corrosion, and cracking due to SCC (SS only) are identified as applicable aging effects. GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” describes an acceptable program to manage these aging effects.

3.4.2.2.9 Loss of Material Due to Pitting and Crevice Corrosion in Aluminum Alloys

Loss of material due to pitting and crevice corrosion could occur in aluminum piping, piping components, and tanks exposed to an air, condensation, underground, raw water, or waste water environment for a sufficient duration of time. Environments that can result in pitting and/or crevice corrosion of aluminum alloys are those that contain halides (e.g., chloride) in the presence of moisture. The moisture level and halide concentration in atmospheric and uncontrolled air greatly depend on geographical location and site-specific conditions. Moisture level and halide concentration should be considered high enough to facilitate pitting and/or crevice corrosion of aluminum alloys in atmospheric and uncontrolled air, unless demonstrated otherwise. The periodic introduction of moisture or halides into an environment from secondary sources should also be considered. Leakage of fluids from mechanical connections (e.g., insulated bolted flanges and valve packing); onto a component in indoor controlled air is an example of a secondary source that should be considered. Halide concentrations should be considered high enough to facilitate loss of material of aluminum alloys in untreated aqueous solutions, unless demonstrated otherwise. Plant-specific OE and the condition of aluminum alloy components are evaluated to determine if prolonged exposure to the plant-specific air, condensation, underground, or water environments has resulted in pitting or crevice corrosion. Loss of material due to pitting and crevice corrosion is not an aging effect which requires management for aluminum alloys if: (i) plant-specific OE does not reveal a history of loss of material due to pitting or crevice corrosion and (ii) a one-time inspection demonstrates that the aging effect is not occurring or is occurring so slowly that it will not affect the intended function of the components. <u>Alternatively, loss of material due to pitting and crevice corrosion need not be managed if the type of aluminum is not susceptible to cracking and plant-specific operating experience does not reveal any issues related to loss of material due to pitting or crevice corrosion</u>. The applicant documents the results of the plant-specific OE review in the SLRA.

In the environment of air-indoor controlled, pitting and crevice corrosion is only expected to occur in the presence of a source of moisture and halides. Alloy susceptibility may be considered when reviewing OE and interpreting inspection results. Inspections focus on the most susceptible alloys and locations.

The GALL-SLR Report recommends the further evaluation of aluminum piping, piping components, and tanks exposed to an air, condensation, or underground environment to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion. The GALL-SLR Report AMP XI.M32, “One-Time Inspection,” describes an acceptable program to demonstrate that the aging effect of loss of material due to pitting and crevice corrosion is not occurring at a rate that will affect the intended function of the components. If loss of material due to pitting or crevice corrosion has occurred and is sufficient to potentially affect the intended function of an SSC, the following AMPs describe acceptable programs to manage loss of material due to pitting and crevice corrosion: (i) GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” for tanks; (ii) GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” for external surfaces of piping and piping components; (iii) GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” for underground piping, piping components and tanks; and (iv) GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” for internal surfaces of components that are not included in other AMPs. The timing of the one-time or periodic inspections is consistent with that recommended in the AMP selected by the applicant during the development of the SLRA. For example, one-time inspections would be conducted between the 50th and 60th year of operation, as recommended by the “detection of aging effects” program element in AMP XI.M32.

The applicant may mitigate or prevent the loss of material due to pitting and crevice corrosion through the use of a barrier coating to isolate the component from aggressive environments. However, the applicant should identify loss of material as applicable for SLR and identify the AMP that will be used to manage the integrity of the coating. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and air that contain halides. The GALL- SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” or equivalent program, describes an acceptable program to manage the integrity of a barrier coating for internal or external coatings.

3.4.2.3 Aging Management Review Results Not Consistent With or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report

Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.4.2.4 Aging Management Programs

For those AMPs that will be used for aging management and are based on the program elements of an AMP in the GALL-SLR Report, the NRC reviewer performs an audit of AMPs credited in the SLRA to confirm consistency with the GALL-SLR Report AMPs identified in Chapters X and XI.

If the applicant identifies an exception to any of the program elements of the cited GALL-SLR Report AMP, the SLRA AMP should include a basis demonstrating how the criteria of 10 CFR 54.21(a)(3) (TN4878) would still be met. The NRC reviewer should then confirm that the SLRA AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the SLRA AMP, the reviewer identifies a difference between the SLRA AMP and the GALL-SLR Report AMP that should have been identified as an exception to the GALL-SLR Report AMP, the difference should be reviewed and dispositioned appropriately. The reviewer should document the disposition of all SLRA-defined exceptions and NRC staff-identified differences.

The SLRA should identify any enhancements that are needed to permit an existing SLRA AMP to be declared consistent with the GALL-SLR Report AMP to which the SLRA AMP is compared. The reviewer is to confirm that the enhancement, when implemented, would allow the existing SLRA AMP to be consistent with the GALL-SLR Report AMP and also that the applicant has a commitment in the FSAR Supplement to implement the enhancement prior to the subsequent period of extended operation. The reviewer should document the disposition of all enhancements.

If the applicant chooses to use a plant-specific program that is not a GALL-SLR Report AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix 0 of this SRP-SLR).

3.4.2.5 Final Safety Analysis Report Supplement

The summary description of the programs and activities for managing the effects of aging for the subsequent period of extended operation in the FSAR Supplement should be sufficiently comprehensive that later changes can be controlled by 10 CFR 50.59 (TN249). The description should contain information associated with the bases for determining that aging effects will be managed during the subsequent period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the subsequent period of extended operation. Table X-01 and Table XI-01 of the GALL-SLR Report provide examples of the type of information to be included in the FSAR Supplement. Table 3.4-2 lists the programs that are applicable for this SRP-SLR section.

3.4.3 Review Procedures

For each area of review, the following review procedures discussed below are to be followed.

3.4.3.1 Aging Management Review Results Consistent With the Generic Aging Lessons Learned for Subsequent License Renewal Report

The applicant may reference the GALL-SLR Report in its SLRA, as appropriate, and demonstrate that the AMRs and AMPs at its facility are consistent with those reviewed and approved in the GALL-SLR Report. The reviewer should not conduct a re-review of the substance of the matters described in the GALL-SLR Report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL-SLR Report, the reviewer should find acceptable the applicant’s reference to the GALL-SLR Report in its SLRA. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms that the applicable aging effects have been addressed based on the NRC staff’s review of industry and plant-specific OE.

Furthermore, the reviewer should confirm that the applicant has addressed OE identified after the issuance of the GALL-SLR Report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the steam and power conversion system components that are contained in the GALL-SLR Report as applicable to its plant.

3.4.3.2 Aging Management Review Results for Which Further Evaluation is Recommended by the Generic Aging Lessons Learned for Subsequent License Renewal Report

The basic review procedures defined in Section 3.4.3.1 need to be applied first for all of the AMRs and AMPs provided in this section. In addition, if the GALL-SLR Report AMR item to which the SLRA AMR item is compared identifies that “Further Evaluation Recommended,” then additional criteria apply as identified by the GALL-SLR Report for each of the following aging effect/aging mechanism combinations. Refer to Table 3.4-1 for the item references for the following sections.

3.4.3.2.1 Cumulative Fatigue Damage

Evaluations involving time-dependent fatigue or cyclical loading parameters may be TLAAs, as defined in 10 CFR 54.3 (TN4878). TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1).

The staff reviews the information on a case-by-case basis consistent with the review procedures in SRP-SLR Section 4.3 or 4.7 (as applicable) to determine whether the applicant has provided a sufficient basis for dispositioning the TLAAs in accordance with the acceptance criteria in 10 CFR 54.21(c)(1)(i), (ii), or (iii). This includes staff’s review of those cumulative usage factor analyses that qualify as TLAAs and are based on plant-specific, methods utilized for stress-based calculations methods

3.4.3.2.2 Cracking Due to Stress Corrosion Cracking in Stainless Steel Alloys

The GALL-SLR Report recommends further evaluation to manage cracking due to SCC in SS piping, piping components, and tanks exposed to air and underground environments containing sufficient halides (e.g., chlorides) and in which condensation is possible. The possibility of cracking also extends to components exposed to air which has recently been introduced into buildings (i.e., components near intake vents) or where the component is in the vicinity of insulated components.

The reviewer independently verifies the sufficiency of the applicant’s evaluation of plant-specific OE. If the review of plant-specific OE reveals SCC in SS alloys, the reviewer determines whether an adequate program is credited to manage the aging effect. If the review of plant-specific OE reveals that SCC is not applicable, the reviewer verifies that the GALL-SLR Report AMP XI.M32, “One-Time Inspection,” is cited for all applicable AMR line items.

An applicant may refine its OE search, and subsequent one-time inspections, by binning plant-specific environments into subcategories. For example, the OE search could be based on two environments including outdoor air and indoor air. The results could be that SCC has occurred in the outdoor air environment but not the indoor air environment. The applicant could further categorize the indoor air locations as those where leakage could impinge on the SS component’s surface (e.g., leakage from mechanical connections) and those where there is no potential for leakage. When the applicant chooses to conduct its OE search in this manner, the reviewer should also confirm that the applicant has adequately addressed the potential for the periodic introduction of either moisture or halides from secondary sources. Secondary sources of moisture or halides should be considered for all environments including indoor conditioned air. Typical secondary sources of moisture or halides include: leakage from mechanical connections; leakage into vaults; insulation containing halides; and outdoor air intrusion. Grouping of environments consistent with that described in the detection of aging effects program element of GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” is appropriate.

If the applicant uses a barrier coating to mitigate or prevent cracking due to SCC, the reviewer verifies that loss of coating integrity is being managed for the associated components with a program equivalent to the GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks.”

3.4.3.2.3 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and Nickel Alloys

The GALL-SLR Report recommends further evaluation to manage loss of material due to pitting and crevice corrosion of SS and nickel-alloy piping and piping components exposed to any air, condensation, or underground environment, when the component is: (i) uninsulated; (ii) insulated; (iii) in the vicinity of insulated components where the presence of sufficient halides (e.g., chlorides) and moisture is possible; or (iv) in the vicinity of potentially transportable halogens. The possibility of pitting and crevice corrosion also extends to indoor components located in close proximity to sources of outdoor air (e.g., components near intake vents).

The reviewer independently verifies the sufficiency of the applicant’s evaluation of plant-specific OE. If the review of plant-specific OE reveals loss of material due to pitting or crevice corrosion in SS and nickel alloys, the reviewer determines whether an adequate program is credited to manage the aging effect. If the review of plant-specific OE reveals that loss of material due to pitting and crevice corrosion is not applicable, the reviewer verifies that GALL-SLR Report AMP XI.M32, “One-Time Inspection,” is cited for all applicable AMR line items.

An applicant may refine its OE search, and subsequent one-time inspections, by binning plant-specific environments into subcategories. For example, the OE search could be based on two environments including outdoor air and indoor air. The results could be that loss of material due to pitting and crevice corrosion has occurred in the outdoor air environment but not the indoor air environment. The applicant could further categorize the indoor air locations as those where leakage could impinge on the SS or nickel-alloy component’s surface (e.g., leakage from mechanical connections) and those where there is no potential for leakage. When the applicant chooses to conduct its OE search in this manner, the reviewer should also confirm that the applicant has adequately addressed the potential for the periodic introduction of either moisture or halides from secondary sources. Secondary sources of moisture or halides should be considered for all environments including indoor conditioned air. Typical secondary sources of moisture or halides include: leakage from mechanical connections; leakage into vaults; insulation containing halides; and outdoor air intrusion. Grouping of environments consistent with that described in the detection of aging effects program element of GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” is appropriate.

If the applicant uses a barrier coating to mitigate or prevent the loss of material due to pitting and crevice corrosion, the reviewer verifies that loss of coating integrity is being managed for the associated components with a program equivalent to the GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks.”

3.4.3.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

The applicant's AMPs for SLR should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered by 10 CFR Part 50 (TN249), Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an AMP for SLR. Nevertheless, the applicant has the option to expand the scope of its 10 CFR Part 50, Appendix B program to include these components and address these program elements. If the applicant chooses this option, the reviewer confirms that the applicant has documented such a commitment in the FSAR Supplement. An example description is in Appendix A of the GALL-SLR Report. If the applicant chooses alternative means, the branch responsible for QA should be requested to review the applicant's proposal on a case-by-case basis.

3.4.3.2.5 Ongoing Review of Operating Experience

The applicant's AMPs should contain the element of OE. The reviewer verifies that the applicant has appropriate programs or processes for the ongoing review of both plant-specific and industry OE concerning age-related degradation and aging management. Such reviews are used to make sure that the AMPs are effective in managing the aging effects for which they are created. The AMPs are either enhanced or new AMPs are developed, as appropriate, when it is determined through the evaluation of the OE that the effects of aging may not be adequately managed. Additional information is in Appendix Section A.4, "Operating Experience for Aging Management Programs" of this SRP-SLR.

In addition, the reviewer confirms that the applicant has provided an appropriate summary description of these activities in the FSAR Supplement. The GALL-SLR Report provides examples of the type of information to be included in the FSAR Supplement.

3.4.3.2.6 Loss of Material Due to Recurring Internal Corrosion

The GALL-SLR Report recommends further evaluation to manage recurring internal corrosion aging effects. The reviewer conducts an independent review of plant-specific OE to determine whether the plant is currently experiencing recurring internal corrosion. This further evaluation item is applicable if the search of plant-specific OE reveals repetitive occurrences. The criteria for recurrence is: (i) a 10 year search of plant-specific OE reveals the aging effect has occurred in three or more refueling outage cycles; or (b) a 5 year search of plant-specific OE reveals the aging effect has occurred in two or more refueling outage cycles as a result of which the component either did not meet plant-specific acceptance criteria or experienced a reduction in wall thickness greater than 50 percent (regardless of the minimum wall thickness).

The reviewer should evaluate plant-specific OE examples to determine if the chosen AMP should be augmented. For example, during a 10 year search of plant-specific OE, two instances of a 360º 30 percent wall loss occurred at copper alloy to steel joints. Neither the significance of the aging effect nor the frequency of occurrence of aging effect threshold has been exceeded. Nevertheless, the OE should be evaluated to determine if the AMP that is proposed to manage the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of inspections) to provide reasonable assurance that the CLB intended functions of the component will be met throughout the subsequent period of extended operation.

The reviewer determines whether a proposed program is adequate to manage recurring internal corrosion by evaluating the proposed AMP against the criteria in SRP-SLR Section 3.4.2.2.6.

3.4.3.2.7 Cracking Due to Stress Corrosion Cracking in Aluminum Alloys

The GALL-SLR Report recommends the further evaluation of aluminum components (i.e., piping, piping components, and tanks) exposed to air, condensation, underground, or aqueous solutions that contain halides to manage cracking due to SCC. The reviewer must first determine if cracking due to SCC is applicable and requires aging management. Cracking is to be considered applicable unless it is demonstrated that one of the two acceptance criteria are met by demonstrating that an aggressive environment is not present or the specific material is not susceptible, as discussed in Section 3.4.2.2.7. Additionally, guidance is also provided on the review of the third condition necessary for SCC to occur, a sustained tensile stress. Each of three conditions is evaluated based on the review procedures below.

If the material used to fabricate the component being evaluated is not susceptible to SCC then cracking due to SCC is not an aging effect that requires management. When determining if an aluminum alloy is susceptible to SCC the reviewer is to verify the materials: (i) alloy composition, (ii) condition or temper, and (iii) product form. Additionally, if the material was produced using a process specifically developed to provide a SCC resistant microstructure then the reviewer will consider the effects of this processing in the review. Once the material information has been established the reviewer is to evaluate the technical justification used to substantiate that the material is not susceptible to SCC when exposed to an aggressive environment and sustained tensile stress. The reviewer will evaluate all documentation and references used by the applicant as part of a technical justification.

If the environment to which an aluminum alloy is exposed is not aggressive, such as dry gas, or treated water, then cracking due to SCC is not an aging effect that requires management. The environments cited in the AMR line items in the GALL-SLR Report that reference this further evaluation are considered to be aggressive and potentially containing halide concentrations that facilitate SCC of aluminum alloys. The reviewer is to verify that components are not also periodically exposed to nontypical environments that would be categorized as aggressive, such as secondary sources of moisture or halides, including outdoor air which has recently been introduced into a building and the leakage/seepage of untreated aqueous solutions into a building or underground vault. Controlled indoor air is not considered aggressive unless secondary sources of moisture or halides are present. When applicable, the staff reviews the basis for the applicant’s claim that the plant configuration precludes the potential presence of secondary sources of moisture or halides. Using information provided by the applicant, the reviewer will also evaluate the chemical composition of applicable encapsulating materials (e.g., concrete, insulation) for halides.

If the applicant uses a barrier coating to mitigate or prevent cracking due to SCC, the reviewer verifies that loss of coating integrity is being managed for the associated components with a program equivalent to the GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks.”

If the sustained tensile stress being experienced by a component is below the SCC threshold value, then cracking is not an aging effect that requires management. Many aluminum alloys do not have a true SCC threshold stress, although a practical SCC threshold value can be determined based on the material, service environment, and duration of intended function. The basis for the SCC threshold value is to be evaluated to determine its applicability. The magnitude of the maximum tensile service stress (applied and residual) experienced by the component is to be evaluated to verify that the stress levels are bounded by the SCC threshold value.

The information necessary to determine if SCC is applicable based on the sustained service stress is often not readily available. The SCC threshold stress level is dependent on both the alloy (e.g., chemical composition, processing history, and microstructure) and service environment. Furthermore, the magnitude and state of the residual stress sustained by a component is typically not fully characterized. The reviewer must determine the adequacy of both the SCC threshold value being used by the applicant and the magnitude of the tensile stress being experienced by the component. The evaluation of the SCC threshold value includes the verification that the: (i) test method used to establish the threshold value is standardized and recognized by the industry, (ii) data are statistically significant or conservative, and (iii) data are for a relevant alloy, temper, product form, and environment. The evaluation of the tensile stress being experienced by the component includes the verification that the stress analysis accounts for: (i) all applied and residual stresses and (ii) stress riser that can initiate SCC cracks, such as corrosion pits and fabrication defects.

Documentation that may assist the reviewer in determining if cracking due to SCC is applicable and requires aging management include: (i) component drawings, (ii) applicable codes or specifications used in the design, fabrication, and installation of the component, (iii) material specific material certification data and lot release data, (iv) maintenance records, and (v) plant-specific OE.

If it is determined that cracking due to SCC is applicable, the reviewer is to evaluate the applicants proposed AMP to ensure that cracking is adequately managed so that the component's intended functions will be maintained consistent with the CLB for the subsequent period of extended operation. The GALL-SLR Report AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," describes an acceptable program to manage cracking due to SCC of aluminum in tanks. The GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," describes an acceptable program to manage cracking due to SCC of aluminum piping and piping components. The GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," describes an acceptable program to manage cracking due to SCC of aluminum piping and tanks which are buried or underground. The GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components" describes an acceptable program to manage cracking due to SCC of aluminum components that are not included in other AMPs.

3.4.3.2.8 Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to Stress Corrosion Cracking

The GALL-SLR Report recommends that for steel piping and piping components exposed to concrete, if the following conditions are met, loss of material is not considered to be an applicable aging effect for steel: (i) 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; (ii) plant-specific OE indicates no degradation of the concrete that could lead to penetration of water to the metal surface; and (iii) the piping is not potentially exposed to groundwater. For SS piping and piping components, loss of material and cracking due to SCC are not considered to be applicable aging effects as long as the piping is not potentially exposed to groundwater. Where these conditions are not met, loss of material due to general (steel only), crevice or pitting corrosion and cracking due to SCC (SS only) are identified as applicable aging effects. The GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," describes an acceptable program to manage these aging effects.

The reviewer verifies that the concrete was specified to meet ACI 318 or ACI 349 (low water-to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG–1557. The reviewer should evaluate plant -specific OE to determine whether concrete degradation sufficient to allow water intrusion has occurred.

3.4.3.2.9 Loss of Material Due to Pitting and Crevice Corrosion in Aluminum Alloys

The GALL-SLR Report recommends a further evaluation to determine whether an AMP is needed to manage loss of material due to pitting and crevice corrosion of aluminum piping, piping components, and tanks exposed to an air, condensation, underground, raw water, or waste water environment. The reviewer is to conduct an independent assessment of plant-specific OE during the AMP audit to confirm that the applicant's evaluation of its OE is adequate.

The reviewer is to confirm that the applicant has adequately addressed the potential for the periodic introduction of either moisture or halides from secondary sources. Secondary sources of moisture or halides should be considered for all environments including indoor conditioned air. Typical secondary sources of moisture or halides include: leakage from mechanical connections; leakage into vaults; insulation containing halides; and outdoor air intrusion. Grouping of environments consistent with that found in the GALL-SLR Report Section IX.D is appropriate.

The grouping of OE search results based on environmental factors or plant configuration may be appropriate. The reviewer is to verify that the considerations given to groupings based on environmental factors and/or plant configuration have a substantiated technical basis. Components in the vicinity of secondary sources of moisture or halides may be treated as a separate population when performing inspections and interpreting results due to plant-specific configurations.

The grouping of alloys based on relative susceptibility to loss of material may also be appropriate. The reviewer is to verify that the considerations given to alloy susceptibility and/or grouping have a substantiated technical basis. The high-strength heat treatable aluminum alloys (2xxx and 7xxx series) may be treated as a separate population when performing inspections and interpreting results due to their relatively lower corrosion resistance. The relative susceptibility of moderate and lower strength alloys varies based on composition (primarily wt% copper, magnesium, and iron) and temper designation.

The reviewer is to determine whether an adequate program is credited to manage the aging effect if the OE reveals that loss of material is applicable or the applicant elects to manage loss of material due to pitting or crevice corrosion. The reviewer is to verify that the SLRA cites the use of GALL-SLR Report AMP XI.M32, "One-Time Inspection," for all aluminum piping, piping components, and tanks exposed to air, condensation, or underground environments when confirming that the aging effect is not applicable based on the OE evaluation.

If the applicant uses a barrier coating to mitigate or prevent the loss of material due to pitting and crevice corrosion, the reviewer verifies that loss of coating integrity is being managed for the associated components with a program equivalent to the GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks."

3.4.3.3 Aging Management Review Results Not Consistent With or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report

The reviewer should confirm that the applicant, in its SLRA, has identified applicable aging effects, listed the appropriate combination of materials and environments, and has credited AMPs that will adequately manage the aging effects. The AMP credited by the applicant could be an AMP that is described and evaluated in the GALL-SLR Report or a plant-specific program. The review procedures are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.4.3.4 Aging Management Programs

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR Report AMP. If the applicant identifies, in the SLRA AMP, an exception to any of the program elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3) (TN4878). If the reviewer identifies a difference, not identified by the SLRA, between the SLRA AMP and the GALL-SLR Report AMP with which the SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions, or differences. The AMPs evaluated in the GALL-SLR Report pertinent to the steam and power conversion system are summarized in Table 3.4-1 of this SRP-SLR. The “GALL-SLR Item” column identifies the AMR item numbers in the GALL-SLR Report, Chapter VIII, presenting detailed information summarized by this row.

If the applicant chooses to use a plant-specific program that is not a GALL-SLR Report AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix 0 of this SRP-SLR).

3.4.3.5 Final Safety Analysis Report Supplement

The reviewer confirms that the applicant has provided in the FSAR Supplement information equivalent to that provided in GALL-SLR Table X-01 and Table XI-01 for aging management of the steam and power conversion systems. Table 3.4-2 lists the AMPs that are applicable for this SRP-SLR Section. The reviewer also confirms that the applicant has provided information equivalent to that in GALL-SLR Table X-01 and Table XI-01 and Section 3.4.3.3 of this SRP-SLR, “Aging Management Review Results Not Consistent With or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report.”

The NRC staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursuant to 10 CFR 50.71(e)(4) (TN249). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR Supplement before the license is renewed, no condition will be necessary.

An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to make sure that the applicant will complete these activities no later than the committed date.

3.4.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of this section, then an evaluation finding similar to the following text should be included in the NRC staff's SER:

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has demonstrated that the aging effects associated with the steam and power conversion system components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the subsequent period of extended operation, as required by 10 CFR 54.21(a)(3) (TN4878).
>
> The NRC staff also reviewed the applicable FSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the steam and power conversion system, as required by 10 CFR 54.21(d).

3.4.5 Implementation

Except for cases in which the applicant proposes an alternative method for complying with specified portions of NRC regulations, the NRC staff members follow the methods described herein in their evaluation of conformance with NRC regulations. The staff evaluates these alternatives and finds them acceptable if the staff determines that the alternatives provide reasonable assurance that the component's intended functions will be maintained.

3.4.6 References

1. NRC. NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." Agencywide Documents Access and Management System (ADAMS) Accession No. ML070630046. Washington, DC: U.S. Nuclear Regulatory Commission. March 2007. NRC 2021-TN8013

2. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54– The License Renewal Rule." Revision 6. ADAMS Accession No. ML051860406. Washington, DC: Nuclear Energy Institute. June 2005.

3. NRC. NUREG–1557, "Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal." Washington, DC: U.S. Nuclear Regulatory Commission. October 1996.

4. ACI. ACI Standard 318-95, "Building Code Requirements for Reinforced Concrete and Commentary." Farmington Hills, Michigan: American Concrete Institute. 1995.

5. ACI. ACI Standard 349 85, "Code Requirements for Nuclear Safety-Related Concrete Structures." Farmington Hills, Michigan: American Concrete Institute. 1985.

6. ANSI. ANSI Standard H35.1/H35.1M, "Alloy and Temper Designation Systems for Aluminum." New York, New York: American National Standards Institute, Inc. 2013.

7. ASM. *Corrosion of Aluminum and Aluminum Alloys*. J. R. Davis, ed. Materials Park, Ohio: ASM International. 1999.

8. NRL. *Stress-Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys*. B. F. Brown, ed. Washington, DC: Naval Research Laboratory. 1972.

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	001	Boiling water reactor (BWR)/pressurized water reactor (PWR)	Steel piping, piping components exposed to any environment	Cumulative fatigue damage due to fatigue	TLAA, Standard Review Plan for Review of Subsequent License Renewal (SRP-SLR) Section 4.3 ““Metal Fatigue”“	Yes (SRP-SLR Section 3.4.2.2.1)	VIII.B1.S-08 VIII.B2.S-08 VIII.D1.S-11 VIII.D2.S-11 VIII.G.S-11
	002	BWR/PWR	Stainless steel (SS) piping, piping components, tanks exposed to air, condensation	Cracking due to stress corrosion cracking (SCC)	AMP XI.M32, ““One Time Inspection,”“ AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components,”“ AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,”“ or AMP XI.M42, ““Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	Yes (SRP-SLR Section 3.4.2.2.2)	VIII.A.SP-118a VIII.A.SP-118b VIII.A.SP-118c VIII.A.SP-118d VIII.B1.SP-118a VIII.B1.SP-118b VIII.B1.SP-118c VIII.B1.SP-118d VIII.B2.SP-118a VIII.B2.SP-118b VIII.B2.SP-118c VIII.B2.SP-118d VIII.C.SP-118a VIII.C.SP-118b VIII.C.SP-118c VIII.C.SP-118d VIII.D1.SP-118a VIII.D1.SP-118b VIII.D1.SP-118c VIII.D1.SP-118d VIII.D2.SP-118a VIII.D2.SP-118b VIII.D2.SP-118c VIII.D2.SP-118d

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
							VIII.E.SP-118a VIII.E.SP-118b VIII.E.SP-118c VIII.E.SP-118d VIII.F.SP-118a VIII.F.SP-118b VIII.F.SP-118c VIII.F.SP-118d VIII.G.SP-118a VIII.G.SP-118b VIII.G.SP-118c VIII.G.SP-118d
	003	BWR/PWR	Stainless steel, nickel-alloy piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, ““One-Time Inspection,”“ AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components,”“ AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,”“ or AMP XI.M42, ““Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	Yes (SRP-SLR Section 3.4.2.2.3)	VIII.A.SP-127a VIII.A.SP-127b VIII.A.SP-127c VIII.A.SP-127d VIII.B1.SP-127a VIII.B1.SP-127b VIII.B1.SP-127c VIII.B1.SP-127d VIII.B2.SP-127a VIII.B2.SP-127b VIII.B2.SP-127c VIII.B2.SP-127d VIII.C.SP-127a VIII.C.SP-127b VIII.C.SP-127c VIII.C.SP-127d VIII.D1.SP-127a VIII.D1.SP-127b VIII.D1.SP-127c

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
							VIII.D1.SP-127d VIII.D2.SP-127a VIII.D2.SP-127b VIII.D2.SP-127c VIII.D2.SP-127d VIII.E.SP-127a VIII.E.SP-127b VIII.E.SP-127c VIII.E.SP-127d VIII.F.SP-127a VIII.F.SP-127b VIII.F.SP-127c VIII.F.SP-127d VIII.G.SP-127a VIII.G.SP-127b VIII.G.SP-127c VIII.G.SP-127d
	004	PWR	Steel external surfaces exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, ““Boric Acid Corrosion”“	No	VIII.H.S-30
	005	BWR/PWR	Steel piping, piping components exposed to steam, treated water	Wall thinning due to flow-accelerated corrosion	AMP XI.M17, ““Flow Accelerated Corrosion”“	No	VIII.A.S-15 VIII.B1.S-15 VIII.B2.S-15 VIII.C.S-15 VIII.D1.S-16 VIII.D2.S-16 VIII.E.S-16 VIII.F.S-16 VIII.G.S-16

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	006	BWR/PWR	Metallic closure bolting exposed to any environment, soil, underground	Loss of preload due to thermal effects, gasket creep, self-loosening	AMP XI.M18, ““Bolting Integrity”“	No	VIII.H.SP-142
	007	BWR/PWR	High-strength steel closure bolting exposed to air, soil, underground	Cracking due to SCC; cyclic loading	AMP XI.M18, ““Bolting Integrity”“	No	VIII.H.S-03
D	008						
	009	BWR/PWR	Steel, stainless steel, nickel-alloy closure bolting exposed to air-indoor uncontrolled, air outdoor, condensation	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M18, ““Bolting Integrity”“	No	VIII.H.S-02
D	010						
	011	BWR/PWR	Stainless steel piping, piping components, tanks, heat exchanger components exposed to steam, treated water >60 °C (>140 °F)	Cracking due to SCC	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	VIII.A.SP-98 VIII.B1.SP-88 VIII.B1.SP-98 VIII.B2.SP-98 VIII.C.SP-88 VIII.D1.SP-88 VIII.E.SP-88 VIII.E.SP-97 VIII.F.SP-85 VIII.F.SP-88 VIII.G.SP-88

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	012	BWR/PWR	Steel tanks exposed to treated water	Loss of material due to general, pitting, crevice corrosion, microbiologically influenced corrosion (MIC)	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	VIII.E.SP-75 VIII.G.SP-75
D	013						
	014	BWR/PWR	Steel piping, piping components exposed to steam, treated water	Loss of material due to general, pitting, crevice corrosion, MIC (treated water only)	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	VIII.A.SP-71 VIII.B1.SP-71 VIII.B1.SP-74 VIII.B2.SP-160 VIII.B2.SP-73 VIII.C.SP-71 VIII.C.SP-73 VIII.D1.SP-74 VIII.D2.SP-73 VIII.E.SP-73 VIII.F.SP-74 VIII.G.SP-74
	015	BWR/PWR	Steel heat exchanger components exposed to treated water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	VIII.E.SP-77
	016	BWR/PWR	Copper alloy, aluminum piping, piping components exposed to treated water, treated borated water	Loss of material due to pitting, crevice corrosion, MIC (copper alloy only)	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	VIII.A.SP-101 VIII.D1.SP-90 VIII.D2.SP-90 VIII.E.SP-90 VIII.F.SP-101

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
							VIII.F.SP-90 VIII.G.SP-90
D	017						
	018	BWR/PWR	Copper alloy, stainless steel heat exchanger tubes exposed to treated water	Reduction of heat transfer due to fouling	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	VIII.E.SP-100 VIII.E.SP-96 VIII.F.SP-96 VIII.F.SP-100 VIII.G.SP-100
	019	BWR/PWR	Stainless steel, steel heat exchanger components exposed to raw water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, ““Open Cycle Cooling Water System”“	No	VIII.E.SP-117 VIII.E.SP-146 VIII.F.SP-146 VIII.F.SP-117 VIII.G.SP-117 VIII.G.SP-146
	020	BWR/PWR	Copper alloy, stainless steel piping, piping components exposed to raw water	Loss of material due to general (copper alloy only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, ““Open Cycle Cooling Water System”“	No	VIII.A.SP-31 VIII.E.SP-31 VIII.E.SP-36 VIII.F.SP-31 VIII.F.SP-36 VIII.G.SP-31 VIII.G.SP-36
D	021						
	022	BWR/PWR	Stainless steel, copper alloy, steel heat exchanger tubes exposed to raw water	Reduction of heat transfer due to fouling	AMP XI.M20, “Open Cycle Cooling Water System”	No	VIII.E.S-28 VIII.E.SP-56 VIII.F.S-28 VIII.G.S-27 VIII.G.S-28 VIII.G.SP-56

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	023	BWR/PWR	Stainless steel piping, piping components exposed to closed-cycle cooling water >60 °C (>140 °F)	Cracking due to SCC	AMP XI.M21A, ""Closed Treated Water Systems"""	No	VIII.E.SP-54 VIII.F.SP-54 VIII.G.SP-54
D	024						
	025	BWR/PWR	Steel heat exchanger components exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, ""Closed Treated Water Systems"""	No	VIII.A.S-23 VIII.E.S-23 VIII.F.S-23 VIII.G.S-23
	026	BWR/PWR	Stainless steel heat exchanger components, piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, ""Closed Treated Water Systems"""	No	VIII.E.S-25 VIII.E.SP-39 VIII.F.S-25 VIII.F.SP-39 VIII.G.S-25 VIII.G.SP-39
	027	BWR/PWR	Copper alloy piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, ""Closed Treated Water Systems"""	No	VIII.E.SP-8 VIII.F.SP-8 VIII.G.SP-8
	028	BWR/PWR	Steel, stainless steel, copper alloy heat exchanger tubes exposed to closed-cycle cooling water	Reduction of heat transfer due to fouling	AMP XI.M21A, ""Closed Treated Water Systems"""	No	VIII.A.SP-64 VIII.E.SP-41 VIII.E.SP-57 VIII.E.SP-64 VIII.F.SP-41 VIII.F.SP-64

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
							VIII.G.SP-41 VIII.G.SP-64
D	029						
	030	BWR/PWR	Steel tanks (within the scope of AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks”“) exposed to soil, concrete, air, condensation	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks”“	No	VIII.E.SP-115 VIII.G.SP-116
D	031						
M	032	BWR/PWR	Gray cast iron, ductile iron, malleable iron piping, piping components exposed to soil	Loss of material due to selective leaching	AMP XI.M33, ““Selective Leaching”“	No	VIII.E.SP-26 VIII.G.SP-26
	033	BWR/PWR	Gray cast iron, ductile iron, malleable iron, copper alloy (>15% Zn or >8% Al) piping, piping components exposed to treated water, raw water, closed-cycle cooling water	Loss of material due to selective leaching	AMP XI.M33, ““Selective Leaching”“	No	VIII.A.SP-27 VIII.A.SP-28 VIII.A.SP-30 VIII.E.SP-27 VIII.E.SP-29 VIII.E.SP-30 VIII.E.SP-55 VIII.F.SP-27 VIII.F.SP-29 VIII.F.SP-30 VIII.F.SP-55

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
							VIII.G.SP-27 VIII.G.SP-28 VIII.G.SP-29 VIII.G.SP-30 VIII.G.SP-55
	034	BWR/PWR	Steel external surfaces exposed to air – indoor uncontrolled, air – outdoor, condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	No	VIII.H.S-29
E	035	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, ““One-Time Inspection,”“ AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components,”“ AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,”“or AMP XI.M42, ““Internal Coatings/Linings for InScope Piping, Piping Components, Heat Exchangers, and Tanks”“	Yes (SRP-SLR Section 3.4.2.2.9)	VIII.E.SP-147a VIII.E.SP-147b VIII.E.SP-147c VIII.E.SP-147d VIII.G.SP-147a VIII.G.SP-147b VIII.G.SP-147c VIII.G.SP-147d

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	036	BWR/PWR	Steel piping, piping components exposed to air – outdoor	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, ""Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components""	No	VIII.B1.SP-59 VIII.E.SP-59 VIII.G.SP-59
	037	BWR/PWR	Steel piping, piping components exposed to condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.E.SP-60 VIII.G.SP-60
	038	PWR	Steel piping, piping components exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open Cycle Cooling Water System"	No	VIII.G.SP-136
D	039						
	040	BWR/PWR	Steel piping, piping components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, ""Lubricating Oil Analysis,"" and AMP XI.M32, ""One-Time Inspection""	No	VIII.A.SP-91 VIII.D1.SP-91 VIII.D2.SP-91 VIII.E.SP-91 VIII.G.SP-91
	041	PWR	Steel heat exchanger components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, ""Lubricating Oil Analysis,"" and AMP XI.M32, ""One-Time Inspection""	No	VIII.G.SP-76

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	042	PWR	Aluminum piping, piping components exposed to lubricating oil	Loss of material due to pitting, crevice corrosion	AMP XI.M39, ""Lubricating Oil Analysis,"" and AMP XI.M32, ""One-Time Inspection""	No	VIII.G.SP-114
	043	BWR/PWR	Copper alloy piping, piping components exposed to lubricating oil	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M39, ""Lubricating Oil Analysis,"" and AMP XI.M32, ""One-Time Inspection""	No	VIII.A.SP-92 VIII.D1.SP-92 VIII.D2.SP-92 VIII.E.SP-92 VIII.G.SP-92
	044	BWR/PWR	Stainless steel piping, piping components, heat exchanger components exposed to lubricating oil	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M39, ""Lubricating Oil Analysis,"" and AMP XI.M32, ""One Time Inspection""	No	VIII.A.SP-95 VIII.D1.SP-95 VIII.D2.SP-95 VIII.E.SP-95 VIII.G.SP-79 VIII.G.SP-95
	045	BWR/PWR	Aluminum heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	AMP XI.M39, ""Lubricating Oil Analysis,"" and AMP XI.M32, ""One-Time Inspection""	No	VIII.E.SP-113 VIII.G.SP-113
	046	PWR	Stainless steel, steel, copper alloy heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	AMP XI.M39, ""Lubricating Oil Analysis,"" and AMP XI.M32,	No	VIII.G.SP-102 VIII.G.SP-103 VIII.G.SP-99

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
					““One-Time Inspection”“		
	047	BWR/PWR	Stainless steel piping, piping components, tanks, closure bolting exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, ““Buried and Underground Piping and Tanks”“	No	VIII.H.SP-145
	048	BWR/PWR	Nickel-alloy piping, piping components, tanks, closure bolting exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, ““Buried and Underground Piping and Tanks”“	No	VIII.H.SP-143
D	049						
	050	BWR/PWR	Steel piping, piping components, tanks, closure bolting exposed to soil, concrete, underground	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, ““Buried and Underground Piping and Tanks”“	No	VIII.H.SP-141 VIII.H.SP-161
D	050a						
	051	BWR/PWR	Steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.4.2.2.8)	VIII.I.SP-154
	052	BWR/PWR	Aluminum piping, piping components exposed to gas	None	None	No	VIII.I.SP-23

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	053	BWR/PWR	Copper alloy, copper alloy (>8% Al) piping, piping components exposed to air with borated water leakage	None	None	No	VIII.I.SP-104
	054	BWR/PWR	Copper alloy piping, piping components exposed to air, condensation, gas	None	None	No	VIII.I.SP-6
	055	BWR/PWR	Glass piping elements exposed to lubricating oil, air, condensation, raw water, treated water, air with borated water leakage, gas, closed-cycle cooling water	None	None	No	VIII.I.SP-10 VIII.I.SP-33 VIII.I.SP-34 VIII.I.SP-35 VIII.I.SP-67 VIII.I.SP-68 VIII.I.SP-69 VIII.I.SP-70
	056	BWR/PWR	Nickel-alloy piping, piping components exposed to air with borated water leakage	None	None	No	VIII.I.SP-148
	057	BWR/PWR	Polyvinyl chloride (PVC) piping, piping components	None	None	No	VIII.I.SP-152 VIII.I.SP-153

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			exposed to air – indoor uncontrolled, condensation				
	058	BWR/PWR	Stainless steel piping, piping components exposed to gas	None	None	No	VIII.I.SP-15
	059	BWR/PWR	Steel piping, piping components exposed to air – indoor controlled, gas	None	None	No	VIII.I.SP-1 VIII.I.SP-4
E	060	BWR/PWR	Metallic piping, piping components exposed to steam, treated water	Wall thinning due to erosion	AMP XI.M17, ““Flow Accelerated Corrosion”“	No	VIII.A.S-408 VIII.B1.S-408 VIII.B2.S-408 VIII.C.S-408 VIII.D1.S-408 VIII.D2.S-408 VIII.G.S-408
E	061	BWR/PWR	Metallic piping, piping components, tanks exposed to raw water, waste water	Loss of material due to recurring internal corrosion	AMP XI.M20, ““Open Cycle Cooling Water System,”“ or AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”“	Yes (SRP-SLR Section 3.4.2.2.6)	VIII.A.S-400a VIII.A.S-400b VIII.D1.S-400b VIII.D2.S-400b VIII.E.S-400a VIII.E.S-400b VIII.F.S-400a VIII.F.S-400b VIII.G.S-400a VIII.G.S-400b

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	062	BWR/PWR	Steel, stainless steel or aluminum tanks (within the scope of AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks”“) exposed to treated water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC (steel, stainless steel only)	AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks”“	No	VIII.E.S-405 VIII.G.S-405
	063	BWR/PWR	Insulated steel, copper alloy (>15% Zn or >8% Al), piping, piping components, tanks, tanks (within the scope of AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks”“) exposed to air, condensation	Loss of material due to general, pitting, crevice corrosion (steel only); cracking due to SCC (copper alloy (>15% Zn or >8% Al) only)	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“ or AMP XI.M29, ““Outdoor and Large Atmospheric Metallic Storage Tanks”“	No	VIII.H.S-402a VIII.H.S-402b
	064	BWR/PWR	Nonmetallic thermal insulation exposed to air, condensation	Reduced thermal insulation resistance due to moisture intrusion	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	No	VIII.H.S-403
D	065						

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	066	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, lubricating oil	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, or physical damage; loss of material or cracking for cementitious coatings/linings	AMP XI.M42, ““Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	No	VIII.E.S-401 VIII.F.S-401 VIII.G.S-401
	067	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M42, ““Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	No	VIII.E.S-414 VIII.F.S-414 VIII.G.S-414
M	068	BWR/PWR	Gray cast iron, ductile iron, malleable iron piping, piping components with internal coatings/linings exposed to closed-cycle cooling	Loss of material due to selective leaching	AMP XI.M42, ““Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	No	VIII.E.S-415 VIII.F.S-415 VIII.G.S-415

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			water, raw water, treated water, waste water				
D	069						
	070	BWR/PWR	Stainless steel, steel, nickel-alloy, copper alloy closure bolting exposed to lubricating oil, treated water, treated borated water, raw water, waste water	Loss of material due to general (steel; copper alloy in raw water, waste water only), pitting, crevice corrosion, MIC (raw water, waste water environments only)	AMP XI.M18, ““Bolting Integrity”“	No	VIII.H.S-418
D	071						
	072	BWR/PWR	Stainless steel, steel, aluminum piping, piping components, tanks exposed to soil, concrete	Cracking due to SCC (steel in carbonate/bicarbonate environment only)	AMP XI.M41, ““Buried and Underground Piping and Tanks”“	No	VIII.H.S-420
	073	BWR/PWR	Stainless steel closure bolting exposed to air, soil, concrete, underground, waste water	Cracking due to SCC	AMP XI.M18, ““Bolting Integrity”“	No	VIII.H.S-421
	074	BWR/PWR	Stainless steel underground	Cracking due to SCC	AMP XI.M32, ““One-Time Inspection,”“ AMP XI.M41,	Yes (SRP-SLR Section 3.4.2.2.2)	VIII.H.S-425a VIII.H.S-425b VIII.H.S-425c

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			piping, piping components, tanks		““Buried and Underground Piping and Tanks,”“ or AMP XI.M42, ““Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”“		
	075	BWR/PWR	Stainless steel, steel, aluminum, copper alloy, titanium heat exchanger tubes exposed to air, condensation	Reduction of heat transfer due to fouling	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	No	VIII.H.S-426
	077	BWR/PWR	Elastomer piping, piping components, seals exposed to air, condensation	Hardening or loss of strength due to elastomer degradation	AMP XI.M36, ““External Surfaces Monitoring of Mechanical Components”“	No	VIII.H.S-428
	078	BWR/PWR	Elastomer piping, piping components, seals exposed to air, condensation	Hardening or loss of strength due to elastomer degradation	AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”“	No	VIII.D1.S-429 VIII.D2.S-429 VIII.E.S-429 VIII.G.S-429
D	080						

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	081	BWR/PWR	Steel components exposed to treated water, raw water	Long-term loss of material due to general corrosion	AMP XI.M32, ““One-Time Inspection”“	No	VIII.A.S-432 VIII.D1.S-432 VIII.D2.S-432 VIII.E.S-432 VIII.F.S-432 VIII.G.S-432
	082	BWR/PWR	Stainless steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.4.2.2.8)	VIII.I.SP-13
	083	BWR/PWR	Stainless steel, nickel-alloy tanks exposed to treated water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	VIII.E.SP-162 VIII.G.SP-162
	084	BWR/PWR	Stainless steel, nickel-alloy piping, piping components exposed to steam	Loss of material due to pitting, crevice corrosion	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	VIII.A.SP-155 VIII.B1.SP-155 VIII.B2.SP-155 VIII.B1.SP-157
	085	BWR/PWR	Stainless steel, nickel-alloy piping, piping components, PWR heat exchanger components exposed to treated water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M2, ““Water Chemistry,”“ and AMP XI.M32, ““One-Time Inspection”“	No	VIII.B1.SP-87 VIII.C.SP-87 VIII.D1.SP-87 VIII.D2.SP-87 VIII.E.SP-80 VIII.E.SP-87 VIII.F.SP-80 VIII.F.SP-87 VIII.G.SP-87

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	086	BWR/PWR	Stainless steel, steel, aluminum, copper alloy, titanium heat exchanger tubes internal to components exposed to air, condensation	Reduction of heat transfer due to fouling	AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”“	No	VIII.E.S-433 VIII.G.S-433
D	088						
	089	BWR/PWR	Steel, stainless steel, copper alloy piping, piping components exposed to raw water (for components not covered by U.S. Nuclear Regulatory Commission [NRC] Generic Letters [GL] 89-13)	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M38, ““nspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”“	No	VIII.A.S-436 VIII.E.S-436 VIII.F.S-436 VIII.G.S-436
	090	BWR/PWR	Steel, stainless steel, copper alloy heat exchanger tubes exposed to raw water (for components not covered by NRC GL 89-13)	Reduction of heat transfer due to fouling	AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”“	No	VIII.E.S-437 VIII.F.S-437 VIII.G.S-437

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	091	BWR/PWR	Steel, stainless steel, copper alloy heat exchanger components exposed to raw water (for components not covered by NRC GL 89-13)	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M38, ““Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”“	No	VIII.E.S-438 VIII.F.S-438 VIII.G.S-438
	092	BWR/PWR	Copper alloy (>15% Zn or >8% Al) piping, piping components exposed to soil	Loss of material due to selective leaching	AMP XI.M33, ““Selective Leaching”“	No	VIII.D1.S-439 VIII.D2.S-439 VIII.E.S-439 VIII.F.S-439 VIII.G.S-439
D	093						
	094	BWR/PWR	Aluminum underground piping, piping components, tanks	Loss of material due to pitting, crevice corrosion	AMP XI.M32, ““One-Time Inspection,”“ AMP XI.M41, ““Buried and Underground Piping and Tanks,”“ or AMP XI.M42, ““Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”“	Yes (SRP-SLR Section 3.4.2.2.9)	VIII.H.S-442a VIII.H.S-442b VIII.H.S-442c

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	095	BWR/PWR	Stainless steel, nickel-alloy underground piping, piping components, tanks	Loss of material due to pitting, crevice corrosion	AMP XI.M32, ""One-Time Inspection,"" AMP XI.M41, ""Buried and Underground Piping and Tanks,"" or AMP XI.M42, ""Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks""	Yes (SRP-SLR Section 3.4.2.2.3)	VIII.H.S-443a VIII.H.S-443b VIII.H.S-443c
	096	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks"") exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks""	No	VIII.E.S-444 VIII.G.S-444
	097	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks"") exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, ""Outdoor and Large Atmospheric Metallic Storage Tanks,"" AMP XI.M32, ""One-Time Inspection,"" or AMP XI.M42, ""Internal Coatings/Linings for In-Scope Piping, Piping Components,	Yes (SRP-SLR Section 3.4.2.2.9)	VIII.E.S-445a VIII.E.S-445b VIII.E.S-445c VIII.G.S-445a VIII.G.S-445b VIII.G.S-445c

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
					Heat Exchangers, and Tanks""		
	098	BWR/PWR	Stainless steel, nickel-alloy tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.3)	VIII.E.S-446a VIII.E.S-446b VIII.E.S-446c VIII.G.S-446a VIII.G.S-446b VIII.G.S-446c
	099	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil only)	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	VIII.E.S-447 VIII.G.S-447
	100	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time	Yes (SRP-SLR Section 3.4.2.2.2)	VIII.E.S-448a VIII.E.S-448b VIII.E.S-448c VIII.G.S-448a VIII.G.S-448b VIII.G.S-448c

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			Metallic Storage Tanks") exposed to air, condensation		Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"		
	101	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, concrete	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	VIII.E.S-449 VIII.G.S-449
	102	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation, soil, concrete, raw water, waste water	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.7)	VIII.E.S-450a VIII.E.S-450b VIII.E.S-450c VIII.G.S-450a VIII.G.S-450b VIII.G.S-450c

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	103	BWR/PWR	Insulated stainless steel, nickel-alloy piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.3)	VIII.H.S-451a VIII.H.S-451b VIII.H.S-451c VIII.H.S-451d
	104	BWR/PWR	Insulated stainless steel piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42,	Yes (SRP-SLR Section 3.4.2.2.2)	VIII.H.S-452a VIII.H.S-452b VIII.H.S-452c VIII.H.S-452d

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
					"Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"		
	105	BWR/PWR	Insulated aluminum piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.7)	VIII.H.S-453a VIII.H.S-453b VIII.H.S-453c VIII.H.S-453d
	106	BWR/PWR	Copper alloy (>15% Zn or >8% Al) piping, piping components exposed to air, condensation	Cracking due to SCC	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-454

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	107	BWR/PWR	Copper alloy (>15% Zn or >8% Al) tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-455
D	108						
	109	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation, raw water, waste water	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.7)	VIII.D1.S-457b VIII.D1.S-457d VIII.D1.S-457e VIII.D2.S-457b VIII.D2.S-457d VIII.D2.S-457e VIII.E.S-457b VIII.E.S-457d VIII.E.S-457e VIII.F.S-457b VIII.F.S-457d VIII.F.S-457e VIII.G.S-457b VIII.G.S-457d VIII.G.S-457e VIII.H.S-457c
D	110						
D	111						
	112	BWR/PWR	Aluminum underground	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP	Yes (SRP-SLR Section 3.4.2.2.7)	VIII.H.S-460a VIII.H.S-460b VIII.H.S-460c

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
			piping, piping components, tanks		XI.M41, “Buried and Underground Piping and Tanks,” or AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks”		
D	113						
	114	BWR/PWR	Titanium heat exchanger tubes exposed to treated water	Cracking due to SCC, reduction of heat transfer due to fouling	AMP XI.M2, “Water Chemistry,” and AMP XI.M32, “One-Time Inspection”	No	VIII.E.S-462 VIII.F.S-462 VIII.G.S-462
	115	BWR/PWR	Titanium (ASTM Grades 1, 2, 7, 9, 11, or 12) heat exchanger components other than tubes, piping, piping components exposed to treated water	None	None	No	VIII.I.S-463
	116	BWR/PWR	Titanium heat exchanger tubes exposed to closed-cycle cooling water	Cracking due to SCC, reduction of heat transfer due to fouling	AMP XI.M21A, “Closed Treated Water Systems”	No	VIII.A.S-464 VIII.E.S-464 VIII.F.S-464 VIII.G.S-464

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	117	BWR/PWR	Aluminum piping, piping components, tanks exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.H.S-466
D	118						
	119	BWR/PWR	Insulated aluminum piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.9)	VIII.H.S-468a VIII.H.S-468b VIII.H.S-468c VIII.H.S-468d
	120	BWR/PWR	Aluminum piping, piping components, tanks exposed to raw water, waste water	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time	Yes (SRP-SLR Section 3.4.2.2.9)	VIII.E.S-469a VIII.E.S-469b VIII.E.S-469c VIII.E.S-469d VIII.E.S-469e

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
					Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"		
D	121						
	122	BWR/PWR	Elastomer piping, piping components, seals exposed to air	Loss of material due to wear	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-471
	123	BWR/PWR	Elastomer piping, piping components, seals exposed to air	Loss of material due to wear	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.D1.S-472 VIII.D2.S-472 VIII.E.S-472 VIII.G.S-472

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	124	BWR/PWR	PVC piping, piping components, tanks exposed to concrete	None	None	No	VIII.I.S-473
M	125	BWR/PWR	PVC, carbon fiber reinforced polymer (CFRP) piping, piping components, tanks exposed to soil	Cracking, blistering, loss of material due to wear, tearing, delamination, void, debonding, chemical attack and exposure to moisture; flow blockage due to fouling, delamination, debonding, or tearing	AMP XI.M41, “Buried and Underground Piping and Tanks” or AMP XI.M43, “High Density Polyethylene (HDPE) Piping and Carbon Fiber Reinforced Polymer (CFRP) Repaired Piping”	No	VIII.H.S-474 VIII.H.S-484
	126	BWR/PWR	Titanium (ASTM Grades 1, 2, 7, 9, 11, or 12) heat exchanger components other than tubes, piping, piping components exposed to closed-cycle cooling water	None	None	No	VIII.I.S-465
	127	BWR/PWR	Aluminum piping, piping components, tanks exposed to air with borated water leakage	None	None	No	VIII.I.S-475

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	128	BWR/PWR	Copper alloy piping, piping components exposed to concrete	None	None	No	VIII.I.S-476
	129	BWR/PWR	Copper alloy piping, piping components exposed to soil, underground	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, “Buried and Underground Piping and Tanks”	No	VIII.H.S-477
	130	BWR/PWR	Titanium piping, piping components, heat exchanger components other than tubes exposed to raw water	Cracking due to SCC, flow blockage due to fouling	AMP XI.M20, “Open-Cycle Cooling Water System,” or AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VIII.A.S-478a VIII.A.S-478b VIII.D1.S-478a VIII.D1.S-478b VIII.D2.S-478a VIII.D2.S-478b VIII.E.S-478a VIII.E.S-478b VIII.F.S-478a VIII.F.S-478b VIII.G.S-478a VIII.G.S-478b
	131	PWR	Copper alloy (>15% Zn) piping, piping components exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, “Boric Acid Corrosion”	No	VIII.H.S-479

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
	132	PWR	Stainless steel piping, piping components, tanks exposed to air with borated water leakage	None	None	No	VIII.I.S-480
	133	BWR/PWR	Aluminum piping, piping components exposed to raw water	Flow blockage due to fouling	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VIII.D1.S-481 VIII.D2.S-481 VIII.E.S-481 VIII.F.S-481 VIII.G.S-481
	134	BWR/PWR	Titanium (ASTM Grades 3, 4, or 5) heat exchanger tubes exposed to raw water	Cracking due to SCC, flow blockage due to fouling	AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VIII.D1.S-482 VIII.D2.S-482 VIII.E.S-482 VIII.F.S-482
	135	BWR/PWR	Polymeric piping, piping components, ducting, ducting components, seals exposed to air, condensation, raw water, raw water (potable), treated water, waste water, underground, concrete, soil	Hardening or loss of strength due to polymeric degradation; loss of material due to peeling, delamination, wear; cracking or blistering due to exposure to ultraviolet light, ozone, radiation, or chemical attack; flow blockage due to fouling. (Inspection of	AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” or AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”	No	VIII.D1.S-483b VIII.D2.S-483b VIII.E.S-483b VIII.F.S-483b VIII.G.S-483b VIII.H.S-483a

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the Generic Aging Lessons Learned for Subsequent License Renewal Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal Item
				Internal Surfaces only)			

AMP = Aging Management Program; ASTM = ASTM International; BWR = boiling water reactor; CFRP = carbon fiber reinforced polymer; GL = Generic Letter; HDPE = High Density Polyethylene; MIC = microbiologically influenced corrosion; NRC = U.S. Nuclear Regulatory Commission; PVC = polyvinyl chloride; PWR = pressurized water reactor; SCC = stress corrosion cracking; SRP-SLR = Standard Review Plan for Review of Subsequent License Renewal; SS = stainless steel; TLAA = Time-Limited Aging Analyses.

Table 3.4-2 Aging Management Programs and Additional Guidance Appendices Recommended for Aging Management of Steam and Power Conversion System

Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report Chapter/ Aging Management Program (AMP)	Program Name
AMP XI.M2	Water Chemistry
AMP XI.M10	Boric Acid Corrosion
AMP XI.M17	Flow-Accelerated Corrosion
AMP XI.M18	Bolting Integrity
AMP XI.M20	Open-Cycle Cooling Water System
AMP XI.M21A	Closed Treated Water Systems
AMP XI.M29	Outdoor and Large Atmospheric Metallic Storage Tanks
AMP XI.M32	One-Time Inspection
AMP XI.M33	Selective Leaching
AMP XI.M36	External Surfaces Monitoring of Mechanical Components
AMP XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
AMP XI.M39	Lubricating Oil Analysis
AMP XI.M41	Buried and Underground Piping and Tanks
AMP XI.M42	Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks
AMP XI.M43	High Density Polyethylene Piping and Carbon Fiber Reinforced Polymer Repaired Piping
GALL-SLR Report Appendix A	Quality assurance for aging management programs
GALL-SLR Report Appendix B	Operating experience for aging management programs
SRP-SLR Appendix A.1	Aging Management Review—Generic (Branch Technical Position RLSB-1)

AMP = Aging Management Program; GALL-SLR = Generic Aging Lessons Learned for Subsequent License Renewal.

3.5 Aging Management of Containments, Structures, and Component Supports

Review Responsibilities

Primary — The branch(es) assigned responsibility by the PM for the safety review of the SLRA.

Secondary — None

3.5.1 Areas of Review

This section addresses the AMR and the associated AMPs for containments, SC supports. For a recent vintage plant, the information related to containments, supports is contained in Chapter 3, "Design of Structures, Components, Equipment, and Systems," of the plant's FSAR, consistent with the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NRC 2021-TN8013). For older vintage plants, the location of applicable information is plant-specific because an older plant's FSAR may have predated NUREG–0800. The scope of this section is containment structures, and safety-related and other SC supports.

The PWR containment structures consist of concrete (reinforced or prestressed) and steel containments. The BWR containment structures consist of Mark I, Mark II, and Mark III steel and concrete (reinforced or prestressed) containments.

The safety-related structures (other than containments) are organized into nine groups:

- Group 1: BWR reactor building, PWR shield building, control room/building
- Group 2: BWR reactor building with steel superstructure
- Group 3: Auxiliary building, diesel generator building, radioactive waste building, turbine building, switchgear room, yard structures (auxiliary feedwater pump house, utility/piping tunnels, security lighting poles, manholes, duct banks), SBO structures (transmission towers, startup transformer circuit breaker foundation, electrical enclosure)
- Group 4: containment internal structures, excluding refueling canal
- Group 5: fuel storage facility, refueling canal
- Group 6: water-control structures (e.g., intake structure, cooling tower, and spray pond)
- Group 7: concrete tanks and missile barriers
- Group 8: steel tank foundations and missile barriers
- Group 9: BWR unit vent stack.

The component supports are organized into seven groups:

- Group B1.1: Supports for ASME Code Class 1 piping and components
- Group B1.2: Supports for ASME Class 2 and 3 piping and components
- Group B1.3: Supports for ASME Class MC components
- Group B2: Supports for cable tray, conduit, heating, ventilation, and air conditioning ducts, TubeTrack®, instrument tubing, non-ASME piping and components

- Group B3: Anchorage of racks, panels, cabinets, and enclosures for electrical equipment and instrumentation
- Group B4: Supports for miscellaneous equipment (e.g., emergency diesel generator, heating, ventilation, and air conditioning components)
- Group B5: Supports for miscellaneous structures (e.g., platforms, pipe whip restraints, jet impingement shields, masonry walls).

The responsible review organization is to review the following SLRA AMR and AMP items assigned to it, per SRP-SLR Section 1.2, for review:

<u>AMRs</u>

- AMR results consistent with the GALL-SLR Report
- AMR results for which further evaluation is recommended
- AMR results that are not consistent with or not addressed in the GALL-SLR Report

<u>AMPs</u>

- Consistent with GALL-SLR Report AMPs
- Plant-specific AMPs

<u>FSAR Supplement</u>

- The responsible review organization is to review the FSAR Supplement associated with each assigned AMP.

3.5.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the NRC regulations in 10 CFR 54.21.

3.5.2.1 Aging Management Review Results Consistent With the Generic Aging Lessons Learned for Subsequent License Renewal Report

The AMRs and the AMPs applicable to structures and component supports are described and evaluated in Chapters II and III of the GALL-SLR Report.

The applicant’s SLRA should provide sufficient information so that the reviewer is able to confirm that the specific SLRA AMR item and the associated SLRA AMP are consistent with the cited GALL-SLR Report AMR item. The reviewer should then confirm that the SLRA AMR item is consistent with the GALL-SLR Report AMR item to which it is compared.

When the applicant is crediting a different AMP than recommended in the GALL-SLR Report, the reviewer should confirm that the alternate AMP is valid to use for aging management and will be capable of managing the effects of aging as adequately as the AMP recommended by the GALL-SLR Report.

3.5.2.2 Aging Management Review Results for Which Further Evaluation is Recommended by the Generic Aging Lessons Learned for Subsequent License Renewal Report

The basic acceptance criteria defined in Section 3.5.2.1 need to be applied first for all of the AMRs and AMPs as part of this section. In addition, if the GALL-SLR Report AMR item to which the SLRA AMR item is compared identifies that "Further Evaluation Recommended," then additional criteria apply for each of the following aging effect/aging mechanism combinations. Refer to Table 3.5-1, comparing the "Further Evaluation Recommended" column and the "GALL-SLR Item" column, for the AMR items that reference the following subsections.

3.5.2.2.1 Pressurized Water Reactor and Boiling Water Reactor 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 Code 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 dewatering system to lower the site groundwater level. If the plant's CLB credits a dewatering system to control settlement, further evaluation is recommended to verify the continued functionality of the dewatering system during the subsequent period of extended operation.

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 (TN249) and ASME Code 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 Code Section III, Division 2, specifies the concrete temperature limits for normal operation or any other long-term period. Further evaluation is recommended to determine the need for a plant-specific AMP or plant-specific enhancements to ASME Code Section XI Subsection IWL and/or Structures Monitoring AMPs, essential to manage these aging effects for portions of the concrete containment components that exceed 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 BTP RLSB-1, "Aging Management Review – Generic, July 2017" (Appendix Section A.1 of this SRP-SLR).

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 Code Section XI, Subsection IWE, and 10 CFR Part 50 (TN249), Appendix J AMPs, to manage this aging effect. Further evaluation of plant-specific programs is recommended to manage this aging effect if corrosion is indicated from the IWE examinations. Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

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 Code Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J, to manage this aging effect. If corrosion is significant, recoating of the torus is recommended. Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

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 Code Section XI, Subsection IWE to manage this aging effect. Further evaluation of plant-specific programs is recommended to manage this aging effect if corrosion is significant. Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

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 TLAA as defined in 10 CFR 54.3 (TN4878). The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed in Section 4.5, “Concrete Containment Unbonded Tendon Pre-stress Analysis,” and/or Section 4.7 “Other Plant Specific Time-Limited Aging Analyses,” of this SRP-SLR.

3.5.2.2.1.5 *Cumulative Fatigue Damage*

Evaluations involving time-dependent fatigue, cyclical loading, or cyclical displacement of metal liner, metal plates, suppression pool steel shells (including welded joints) and penetrations (including personnel airlock, equipment hatch, CRD hatch, 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 may be TLAAs as defined in 10 CFR 54.3. The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The evaluation of this TLAA is addressed in Section 4.6, “Containment Liner Plates, Metal Containments, and Penetrations Fatigue Analysis,” and for cases of plant-specific components, in Section 4.7 “Other Plant Specific Time-Limited Aging Analyses,” of this SRP-SLR. For plant-specific cumulative usage factor calculations, the method used is appropriately defined and discussed in the applicable TLAAs.

For the above-stated containment pressure-retaining components (corresponding to Table 3.5-1, Items 027 and 040) subject to cyclic loading for which no CLB fatigue analysis exists at the time of an SLRA submittal, a plant-specific further evaluation may be performed to demonstrate that cracking due to cyclic loading is an aging effect that does not require aging management for the component. As one acceptable approach, the aging effect does not require aging management actions if the further evaluation demonstrates that the six criteria for cyclic loading in paragraph NE-3222.4(d) (NE-3221.5[d] in 1980 and later code editions), “Analysis for Cyclic Operation, Vessels Not Requiring Analysis for Cyclic Service,” of ASME Code, Section III, Division 1 (1974 edition or later edition incorporated by reference in 10 CFR 50.55a[a][i]), that provide for a waiver from detailed fatigue analysis are satisfied for applicable component materials through the end of the subsequent period of extended operation. The option to perform a fatigue waiver analysis to address the aging effect of cracking due to cyclic loading, for specific containment metallic components, is in lieu of performing supplemental surface examinations or performing or crediting an appropriate

10 CFR Part 50, Appendix J, leak-rate test discussed in GALL-SLR Report AMP XI.S1, "ASME Section XI, Subsection IWE."

3.5.2.2.1.6 *Cracking Due to Stress Corrosion Cracking*

The SCC of SS penetration sleeves, penetration bellows, vent line bellows, suppression chamber shell (interior surface), and dissimilar metal welds could occur in PWR and/or BWR containments. The existing program relies on ASME Code Section XI, Subsection IWE and 10 CFR Part 50 (TN249), Appendix J, to manage this aging effect. Further evaluation, including consideration of SCC susceptibility and applicable OE related to detection and additional appropriate examinations/evaluations implemented to detect this aging effect for these SS components and dissimilar metal welds is recommended.

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. Further evaluation is recommended of this aging effect to determine the need for a plant-specific AMP or plant-specific enhancements to ASME Code Section XI, Subsection IWL, and/or Structures Monitoring AMPs, to manage these aging effects for plants located in moderate to severe weathering conditions. Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

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-SLR Report recommends further evaluation to determine the need for a plant-specific AMP or plant-specific enhancements to ASME Code Section XI, Subsection IWL, and/or Structures Monitoring AMPs to manage this aging effect. Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

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. Further evaluation is recommended if leaching is observed in accessible areas that impact intended functions, to determine the need for a plant-specific AMP or plant-specific enhancements to ASME Code Section XI, Subsection IWL and/or Structures Monitoring AMPs, essential to manage these aging effects. Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

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. Further evaluation of inaccessible areas of these groups of structures for plants located in moderate to severe weathering conditions is recommended to determine the need for a plant-specific AMP or plant-specific enhancements to Structures Monitoring AMP, to manage these aging

effects. Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

2. Cracking due to expansion and reaction with aggregates could occur in inaccessible concrete areas for Groups 1–5 and 7–9 structures. Further evaluation of inaccessible areas of these groups of structures is recommended to determine the need for a plant-specific AMP or plant-specific enhancements to Structures Monitoring AMP, to manage this aging effect. Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

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 dewatering system to lower the site groundwater level. If the plant's CLB credits a dewatering system, verification is recommended of the continued functionality of the dewatering system during the subsequent period of extended operation. No further evaluation is recommended if this activity is included in the scope of the applicant's structures monitoring program.

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. Further evaluation is recommended to determine the need for a plant-specific AMP or plant-specific enhancements to Structures Monitoring AMP to manage these aging effects if leaching is observed in accessible areas that impact intended functions. Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

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, "Code Requirements for Nuclear Safety-Related Concrete Structures," 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). Further evaluation is recommended to determine the need for a plant-specific AMP or plant-specific enhancements to Structures Monitoring AMP, to manage these aging effects 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 BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.5.2.2.2.3 Aging Management of Inaccessible Areas for Group 6 Structures

Further evaluation is recommended 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-SLR Report, AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants," or Federal Energy Regulatory Commission (FERC)/U.S. 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. Further evaluation is recommended to determine the need for a plant-specific AMP or plant-specific enhancements to Structures Monitoring AMP to manage these aging effects for inaccessible areas for plants located in moderate to severe weathering conditions. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

2. Cracking due to expansion and reaction with aggregates could occur in inaccessible concrete areas of Group 6 structures. Further evaluation is recommended to determine the need for a plant-specific AMP or plant-specific enhancements to Structures Monitoring AMP, to manage this aging effect. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

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. Further evaluation is recommended to determine the need for a plant-specific AMP or plant-specific enhancements to Structures Monitoring AMP, to manage these aging effects if leaching is observed in accessible areas that impact intended functions. Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

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 SCC and loss of material due to pitting and crevice corrosion could occur in: (i) Group 7 and 8 SS tank liners exposed to standing water and (ii) SS and aluminum alloy support members, welds, bolted connections, or support anchorage to building structure exposed to air or condensation (see SRP-SLR Sections 3.2.2.2.2, 3.2.2.2.4, 3.2.2.2.8, and 3.2.2.2.10 for background information).

For Group 7 and 8 SS tank liners exposed to standing water, further evaluation is recommended of plant-specific programs to manage these aging effects. The acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

For SS and aluminum alloy support members, welds, bolted connections, support anchorage to building structure exposed to air or condensation, the plant-specific OE and condition of the SS and aluminum alloy components are evaluated to determine if the plant-specific air or condensation environments are aggressive enough to result in loss of material or cracking after prolonged exposure. The aging effects of loss of material and cracking in SS and aluminum alloy components is not applicable and does not require management if: (i) the plant specific OE does not reveal a history of pitting or crevice corrosion or cracking and (ii) a one-time inspection demonstrates that the aging effects are not occurring or that an aging effect is occurring so slowly that it will not affect the intended function of the components during the subsequent period of extended operation. The applicant documents the results of the plant-specific OE review in the SLRA. Visual inspections conducted in accordance with GALL-SLR Report AMP XI.M32, “One-Time Inspection,” are an acceptable method to demonstrate that the aging effects are not occurring at a rate that affects the intended function of the components. One-time inspections are conducted between the 50th and 60th year of operation, as recommended by the “Detection of Aging Effects“ program element in AMP XI.M32. If loss of material or cracking has occurred and is sufficient to potentially affect the intended function of SS or aluminum alloy support members, welds, bolted connections, or support anchorage to building structure, either: (a) enhancing the applicable AMP (i.e., GALL-SLR Report AMP XI.S3, “ASME Section XI, Subsection IWF," or AMP XI.S6, "Structures Monitoring"), (b) conducting a representative sample inspection consistent with GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or (c) developing a plant-specific AMP are acceptable programs to manage loss of material or cracking (as applicable). Tempers have been specifically developed to improve the SCC resistance for some aluminum alloys. Aluminum alloy and temper combinations which are not susceptible to SCC when used in structural support applications include 1xxx series, 3xxx series, 6061-T6x, 6063-T6, and 5454-x. For these alloys and tempers, the susceptibility of cracking due to SCC is not applicable. If these alloys or tempers have been used, the SLRA states the specific alloy or temper used for the applicable in scope components.

3.5.2.2.2.5 Cumulative Fatigue Damage

Evaluations involving time-dependent fatigue, cyclical loading, or cyclical displacement of component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports are TLAAs as defined in 10 CFR 54.3 (TN4878) only if a CLB fatigue analysis exists. The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed in Section 4.3, "Metal Fatigue," and/or Section 4.7, "Other Plant Specific Time-Limited Aging Analyses," of this SRP-SLR. For plant-specific cumulative usage factor calculations, the method used is appropriately defined and discussed in the applicable TLAAs.

3.5.2.2.2.6 Reduction of Strength and Mechanical Properties of Concrete Due to Irradiation

Reduction of strength, loss of mechanical properties, and cracking due to irradiation could occur in PWR and BWR Group 4 concrete structures that are exposed to high levels of neutron and gamma radiation. These structures include the reactor (primary/biological) shield wall, the sacrificial shield wall, and the RV support/pedestal structure. Data related to the effects and significance of neutron and gamma radiation on concrete mechanical and physical properties is limited, especially for conditions (dose, temperature, etc.) representative of light-water reactor (LWR) plants. However, based on literature review of existing research, radiation fluence limits of 1×10^{19} neutrons/cm^2 neutron radiation and 1×10^8 Gray (1×10^{10} rad) gamma dose are considered conservative radiation exposure levels beyond which concrete material properties may begin to degrade markedly (Ref. 17, 18, 19).

Further evaluation is recommended to determine the need for a plant-specific AMP or plant-specific enhancements to selected existing AMPs to manage the aging effects of irradiation if the estimated (calculated) fluence levels or irradiation dose received by any portion of the concrete from neutron (fluence cutoff energy $E > 0.1$ MeV) or gamma radiation exceeds the respective threshold level during the subsequent period of extended operation that could affect intended functions. Higher fluence or dose levels may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and/or loss of mechanical properties of concrete from those fluence levels, at or above the operating temperature experienced by the concrete, and the effects are applied to the design calculations. Supporting calculations/analyses, test data, and other technical basis are provided to estimate and evaluate fluence levels and the plant-specific program. The acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.5.2.2.2.7 Loss of Material, and/or Changes in Material Properties Due to Weathering, Chemical Degradation, Insect Infestation, Repeated Wetting and Drying, or Fungal Decay

Loss of material and/or changes in material properties due to weathering, chemical degradation, insect infestation, repeated wetting and drying, or fungal decay could occur in standing wooden poles. Their vulnerability to decay is generally dependent on geographical location and site-specific characteristics and conditions. Factors affecting the service life of the wooden poles are the species of wood, type and thoroughness of treatment, geographical location, and soil conditions.

Further evaluation is recommended to determine the plant-specific AMP or plant-specific enhancements to an existing AMP(s) required to manage the effects of aging for wooden poles during the subsequent period of extended operation. A plant-specific AMP or plant-specific enhancements to an existing AMP(s) is acceptable if visual inspections are supplemented with appropriate additional examination methods or techniques, at a frequency capable of detecting the presence and extent of aging effects that are expected in portions of wooden poles that are below-grade and/or internally before there is a loss of intended function. This should account for the decay/deterioration expected to occur at the site based on geographical location and site-specific characteristics and conditions. The plant-specific AMP or plant-specific enhancements to an existing AMP(s), should provide appropriate acceptance criteria and corrective actions, consistent with industry guidelines. The acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.5.2.2.2.8 Combined Effects of Aging Associated with Irradiation of RV Steel Structural Support Components and Loss of Function of Other RV Structural Support Components That are Not Concrete

Combined effects of aging associated with neutron radiation exposure could occur in the RV structural support assembly components and materials in BWRs and PWRs. The steel components of the RV structural support assembly (including associated weldments and bolted connections) are made of ferritic carbon or low alloy steels, and the combined effects of aging for these steel components include, but are not limited to, reduction in fracture toughness, loss of material, loss of preload, and distortion that could result in loss of intended function. Examples of RV steel structural support components are RV steel girder and column supports, RV steel support skirt, and neutron shield tanks. For nonconcrete, nonmetallic materials (e.g., Lubrite® lubricant) and nonconcrete, nonferrous materials (e.g., manganese bronze alloy) associated with the RV structural support assembly, effects of aging due to radiation exposure could also result in loss of intended function. Further evaluation of the RV structural support assembly as a whole is recommended to determine the need for a plant-specific AMP or plant-specific enhancements to selected GALL-SLR AMPs to manage combined effects of aging, such that intended function(s) of the RV structural support assembly as a whole is maintained consistent with the CLB for the subsequent period of extended operation (SPEO).

The acceptance criteria for a plant-specific AMP or enhancements to GALL-SLR AMPs for ongoing management of potential combined effects of aging are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR). The combined effects of aging associated with irradiation (i.e., reduction in fracture toughness, loss of material, loss of preload, and distortion) in the RV structural support assembly components may be addressed by analysis or by augmented ongoing examinations and inspections for the effects of aging, as needed, or a combination of these, during the SPEO. Any analysis should include conservatisms in the technical basis (or bases) that account for uncertainties in the evaluation parameters (e.g., fluence, initial nil-ductility temperature, and fracture toughness).

Prior to any analysis, evaluation of the physical conditions through physical examination of the RV structural supports is essential for assessing whether the structural integrity of the RV structural support assembly (other than concrete) is affected by potential combined effects of radiation exposure that include reduction in fracture toughness, corrosive environment (boric acid), temperature, cyclic loading, and applied stresses (including weld residual and/or fabrication stresses). Inservice inspection for flaws in portion of support beams embedded in the concrete biological shield wall may be unattainable; however, inspection records indicating distortions may shed light on the likelihood of significant flaws that may have developed inside the concrete. One or more existing AMPs (e.g., ASME Section XI, Subsection IWF AMP, Boric Acid AMP) may be credited for this physical examination. Following the physical examination, NUREG-1509, "Radiation Effects on Reactor Pressure Vessel Supports," (Ref. 26) provides one acceptable methodology (with the exception of the structural consequence analysis approach in Section 4.5 of the report) for evaluating the RV steel structural support assembly for reduction in fracture toughness due to irradiation embrittlement during the SPEO. An initial screening methodology in NUREG-1509 (Section 4.2) provides one acceptable method for initial assessment for the potential for irradiation embrittlement of the RV steel support system components based on the plant-specific reactor support configuration, plant-specific materials, and plant-specific state of stress. If irradiation embrittlement is a possibility based on this initial screening, an evaluation of the RV steel structural support assembly for a reduction in fracture toughness can be based on a fracture mechanics analysis or a transition temperature analysis (relative to the lowest operating or service temperature of the RV steel structural support component), such as those outlined in Section 4.3 of NUREG-1509, or an accurate analysis such as that outlined Section 4.4 of NUREG-1509. Applications that rely on the use of NUREG-1509 generic nil-ductility transition temperature (NDTT) values in lieu of those from plant-specific materials testing need to include additional justification that the NUREG-1509 generic NDTT values are representative of the plant-specific materials of the RV steel structural support assembly components; these applications will be reviewed on a case-by-case basis. In such a case, applicants can use a bounding approach in their fracture analysis, selecting the most conservative values from available data and references, other further evaluation methodologies, including augmented inspections and examinations.

In the event the applicant pursues augmented ongoing examinations and inspections as needed from one or more GALL-SLR AMPs that help detect the effects of aging for the RV structural support assembly components, including but not limited to cracking, loss of material, loss of preload, and permanent distortion, the details of these augmented ongoing examinations and inspections need to be provided as part for this further evaluation so that the effects of aging are adequately managed consistent with 10 CFR 54.21(a)(3) and that the intended function(s) remain consistent with the CLB for the SPEO.

A plant-specific AMP or plant-specific enhancements to selected GALL-SLR AMPs may not be necessary for the RV steel structural support components if either the initial screening criteria (such as those in Section 4.2.4 of NUREG-1509) or the evaluation criteria (such as those in Section 4.3 or Section 4.4 of NUREG-1509) are satisfied based on plant-specific evaluations. For the radiation exposure criterion in Section 4.2.4 of NUREG-1509, the plant-specific radiation exposure level at a specific location in the RV steel structural supports can be considered low if the radiation exposure damage level is 2×10^{-5} displacements per atom (dpa) or less, consistent with the upper-bound embrittlement shift curve specified in Figure 3-1 of NUREG-1509 and considering an energy spectrum of $E > 0.1$ MeV. The ASTM International Standard E693-17 (Ref. 28) provides a methodology for calculating damage (i.e., dpa) for iron and ferritic low alloy steels.

The radiation exposure evaluation of the RV structural support assembly as a whole should be for an energy spectrum of E > 0.1 MeV and use conservative assumptions to estimate the levels of neutron fluence exposure to calculate the projected dpa damage for the SPEO. Evaluation methodologies that have been endorsed by the NRC may be used, but justifications should be provided for their applicability beyond the basis for qualification and approval (e.g., differences in areas of exposure and location(s) for which a methodology was benchmarked against). For evaluation methodologies not previously reviewed or endorsed by the NRC, the applicant provides a detailed description of the analysis methodology and how it was qualified to determine its adequacy for use.

Based on the results of the radiation exposure evaluation, the applicant evaluates the structural integrity of the RV steel structural support components for a reduction in fracture toughness if the radiation exposure damage level exceeds 2×10^{-5} dpa. Additionally, the applicant considers effects of aging associated with irradiation working in synergy with reduction in fracture toughness of the RV steel structural support components such that these components will maintain their intended function(s) consistent with the CLB through the SPEO. The structural integrity evaluation should include all RV structural support design basis load combinations in the UFSAR. The irradiation embrittlement predictions of the RV steel structural support assembly components consider their chemical composition to determine the influence of alloying elements, such as copper, nickel, and phosphorous, on reduction in fracture toughness. For nonconcrete, nonmetallic, nonferrous components and/or materials, the applicant provides supporting technical information and data used to determine their integrity against loss of intended function as a result of radiation exposure and to determine the need for a plant-specific AMP or enhancements to selected GALL-SLR AMPs to manage the combined effects of aging associated with irradiation during the SPEO.

Risk-informed, performance-based (RIPB) principles can be used in the evaluation of the RV steel structural support assemblies with safety being the ultimate objective to maintain RV support intended function consistent with the CLB during the SPEO. RIPB relies on damage tolerance and performance outcomes based on CLB engineering loading demand parameters for events of defined magnitude with uncertainty estimates. This means the applicant ensures that after examination or inspection the results are assessed and uncertainty in the evaluation parameters (e.g., fluence, initial nil-ductility temperature, fracture toughness) are incorporated, margins remain in load-bearing capacity in the RV steel structural support assembly system, such that if performance criteria are not met a safety concern will not develop during the SPEO. Applicants using RIPB principles need data to support their determination of reasonable assurance that the RV steel structural support assembly system will fulfill its intended function through the end of the SPEO. Thus, assumptions in the RIPB evaluation of the RV steel structural support assemblies reflect in situ conditions for material, environment, and component behavior subject to noted uncertainties. The RIPB methodology could be fulfilled, for example, by a combination of ongoing inspections and fracture mechanics with adjustment to uncertainties involved in estimation of damage tolerance. Damage tolerance is a method of assessing the ability of a RV steel structural support assembly component to perform its intended function in the presence of a defect, damage, or flaw. Specifically, damage tolerance is assessing how damage to an RV steel structural support assembly component is tolerated when it fails and evaluating the subsequent redistribution of loads within the RV steel structural support assembly.

3.5.2.2.3 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in BTP IQMB-1 (Appendix Section A.2 of this SRP-SLR).

3.5.2.2.4 Ongoing Review of Operating Experience

Acceptance criteria are described in Appendix Section A.4, “Operating Experience for Aging Management Programs.”

3.5.2.3 Aging Management Review Results Not Consistent with or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report

Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.5.2.4 Aging Management Programs

For those AMPs that will be used for aging management and are based on the program elements of an AMP in the GALL-SLR Report, the NRC reviewer performs an audit of AMPs credited in the SLRA to confirm consistency with the GALL-SLR Report AMPs identified in Chapter X, “Aging Management Programs That May Be Used to Demonstrate Acceptability of Time-Limited Aging Analyses in Accordance With 10 CFR 54.21(c)(1)(iii) (TN4878),” and Chapter XI, “Chapter XI—Aging Management Programs.”

If the applicant identifies an exception to any of the program elements of the cited GALL-SLR Report AMP, the SLRA AMP should include a basis demonstrating how the criteria of 10 CFR 54.21(a)(3) would still be met. The NRC reviewer should then confirm that the SLRA AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the SLRA AMP, the reviewer identifies a difference from the GALL-SLR Report AMP that should have been identified as an exception to the GALL-SLR Report AMP, this difference should be reviewed and dispositioned appropriately. The reviewer should document the disposition of all SLRA-defined exceptions and NRC staff-identified differences.

The SLRA should identify any enhancements that are needed to permit an existing SLRA AMP to be declared consistent with the GALL-SLR Report AMP to which the SLRA AMP is compared. The reviewer is to confirm that the enhancement, when implemented, would allow the existing SLRA AMP to be consistent with the GALL-SLR Report AMP and that the applicant has a commitment in the FSAR Supplement to implement the enhancement prior to the subsequent period of extended operation. The reviewer should document the disposition of all enhancements.

If the applicant chooses to use a plant-specific program that is not a GALL-SLR Report AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix 0 of this SRP-SLR).

3.5.2.5 Final Safety Analysis Report Supplement

The summary description of the programs and activities for managing the effects of aging for the subsequent period of extended operation in the FSAR Supplement should be sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59 (TN249). The description should contain information associated with the bases for determining that aging effects are managed during the subsequent period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the subsequent period of extended operation. Table X-01 and Table XI-01 of the GALL-SLR Report provide examples of the type of information to be included in the FSAR Supplement. Table 3.5-2 lists the programs that are applicable for this SRP-SLR section.

3.5.3 Review Procedures

For each area of review, the review procedures below are to be followed.

3.5.3.1 Aging Management Review Results Consistent With the Generic Aging Lessons Learned for Subsequent License Renewal Report

The applicant may reference the GALL-SLR Report in its SLRA, as appropriate, and demonstrate that the AMRs and AMPs at its facility are consistent with those reviewed and approved in the GALL-SLR Report. The reviewer should not conduct a review of the substance of the matters described in the GALL-SLR Report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL-SLR Report, the reviewer should find acceptable the applicant's reference to GALL-SLR in its SLRA. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms that the applicable aging effects have been addressed based on the staff's review of industry and plant-specific OE.

Furthermore, the reviewer should confirm that the applicant has addressed OE identified after the issuance of the GALL-SLR Report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the SC supports that are contained in the GALL-SLR Report as applicable to its plant.

3.5.3.2 Aging Management Review Results for Which Further Evaluation Is Recommended by the Generic Aging Lessons Learned for Subsequent License Renewal Report

The basic review procedures defined in Section 3.5.3.1 need to be applied first for all of the AMRs and AMPs provided in this section. In addition, if the GALL-SLR AMR item to which the SLRA AMR item is compared identifies that further evaluation is recommended, then additional criteria apply for each of the following aging effect/aging mechanism combinations.

3.5.3.2.1 Pressurized Water Reactor and Boiling Water Reactor Containments

3.5.3.2.1.1 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

Further evaluation of aging management is recommended for: (i) cracking and distortion due to increases in component stress level from settlement for PWR and BWR concrete and steel containments and (ii) reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundations for all types of PWR and BWR containments if a dewatering system is relied upon to control settlement. The reviewer evaluates and confirms that, if the applicant credits a dewatering system in its CLB, the applicant has committed to monitor the functionality of the dewatering system under the applicant's ASME Code Section XI, Subsection IWL or the structures monitoring program. If not, the reviewer evaluates the plant-specific program for monitoring the dewatering system during the subsequent period of extended operation.

3.5.3.2.1.2 *Reduction of Strength and Modulus Due to Elevated Temperature*

Further evaluation of programs to manage reduction of strength and modulus of concrete due to elevated temperatures for PWR and BWR concrete and steel containments is recommended. The implementation of ASME Code Section XI, Subsection IWL examinations and 10 CFR 50.55a (TN249) would not be able to detect the reduction of concrete strength and modulus due to elevated temperature and also notes that no mandated aging management exists for managing this aging effect.

A plant-specific evaluation should be performed if any portion of the concrete containment components exceeds specified temperature limits (i.e., general 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 reviewer evaluates and confirms that the applicant's discussion in the renewal application indicates that the affected PWR and BWR containment components are not exposed to a temperature that exceeds the temperature limits. If active cooling is relied upon to maintain acceptable temperatures, then the reviewer makes sure that the aging effects associated with the cooling system are being properly managed or temperatures are being monitored to identify a problem with the cooling system. If the temperature exceeds the limits, the reviewer reviews the technical basis (i.e., tests and/or calculations) provided by the applicant to justify the higher temperature. Otherwise, the reviewer evaluates the applicant's proposed plant-specific AMP or plant-specific enhancements to ASME Code Section XI, Subsection IWL and/or Structures Monitoring AMPs, needed to manage these aging effects. Plant-specific evaluations verify that, where appropriate, an effective enhanced inspection program has been developed and implemented, to make sure that reduction of strength and modulus of elasticity due to elevated temperatures are adequately managed during the subsequent period of extended operation.

3.5.3.2.1.3 *Loss of Material Due to General, Pitting, and Crevice Corrosion*

1. The GALL-SLR Report identifies programs to manage loss of material due to general, pitting, and crevice corrosion in accessible and inaccessible areas of the steel elements in drywell and torus or the steel liner and integral attachments for all types of PWR and BWR containments. The AMP consists of ASME Code Section XI, Subsection IWE, and 10 CFR Part 50 (TN249), Appendix J, leak tests. Subsection IWE exempts from examination portions of the containments that are inaccessible, such as embedded or inaccessible portions of steel liners and steel elements in drywell and torus, and integral attachments.

   To cover the inaccessible areas, 10 CFR 50.55a(b)(2)(ix) requires that the applicant evaluate 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. In addition, further evaluation of plant-specific programs to manage the aging effects for inaccessible areas is recommended if the following cannot be satisfied: (i) concrete meeting the requirements of ACI 318 or ACI 349 (low water-to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG–1557 and the guidance of ACI 201.2R, as applicable, was used for the containment concrete in contact with the embedded containment shell or liner; (ii) the moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Code Section XI, Subsection IWE requirements; (iii) the concrete is monitored to make sure that it is free of penetrating cracks that provide a path for water seepage into the surface of the containment shell or liner; and (iv) borated water spills and water ponding on the concrete floor are common and when detected are cleaned up or diverted to a sump in a timely manner. The OE has identified significant corrosion in some plants. If any of the above conditions cannot be satisfied, then a plant-specific AMP for corrosion is necessary. The reviewer reviews the applicant's proposed AMP to confirm that, where appropriate, an effective inspection program has been developed and implemented to ensure that the aging effects in inaccessible areas are adequately managed.

2. The GALL-SLR Report identifies programs to manage loss of material due to general, pitting, and crevice corrosion in steel torus shell of Mark I containments. The AMP consists of ASME Code Section XI, Subsection IWE, and 10 CFR Part 50 (TN249), Appendix J, leak tests. In addition, further evaluation is recommended of plant-specific programs to manage the aging effects if corrosion is significant. Further evaluation of torus shell corrosion is warranted as a result of industry-wide OE that identified a number of incidences of torus corrosion. The reviewer evaluates the applicant's proposed AMP to confirm that, where appropriate, an effective inspection program has been developed and implemented to ensure that the aging effects are adequately managed. A plant-specific program may include the recoating of the torus, if necessary.

3. The GALL-SLR Report identifies programs to manage loss of material due to general, pitting, and crevice corrosion in steel torus ring girders and downcomers of Mark I containments, suppression chambers and downcomers of Mark II containments, and interior surface of suppression chamber shell of Mark III containments. GALL-SLR Report AMP XI.S1, "ASME Section XI, Subsection IWE," is recommended for aging management. In addition, further evaluation of plant-specific programs is recommended to manage the aging effects if plant OE identified significant corrosion of the torus ring girders, downcomers and suppression chambers.

<u>3.5.3.2.1.4</u> *<u>Loss of Prestress Due to Relaxation, Shrinkage, Creep, and Elevated Temperature</u>*

Loss of prestress is a TLAA as defined in 10 CFR 54.3 (TN4878). The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed in Section 4.5, "Concrete Containment Unbonded Tendon Prestress Analysis," or Section 4.7, "Other Plant Specific Time-Limited Aging Analyses," of this SRP-SLR.

The staff reviews the information on a case-by-case basis consistent with the review procedures in SRP-SLR Sections 4.5 and/or 4.7 (as applicable) to determine whether the applicant has provided a sufficient basis for dispositioning the TLAAs in accordance with the acceptance criteria in 10 CFR 54.21(c)(1)(i), (ii), or (iii).

<u>3.5.3.2.1.5</u> *<u>Cumulative Fatigue Damage</u>*

Evaluations involving time-dependent fatigue, cyclical loading, or cyclical displacement included in the CLB for the metal liner, metal plates, suppression pool steel shells (including welded joints) and penetrations (including personnel airlock, equipment hatch, CRD hatch, 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 (TN4878). The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed in Section 4.6, "Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analysis," and for cases of plant-specific components, in Section 4.7, "Other Plant Specific Time-Limited Aging Analyses," of this SRP-SLR.

The staff reviews the information on a case-by-case basis consistent with the review procedures in SRP-SLR Sections 4.6 or 4.7 (as applicable) to determine whether the applicant has provided a sufficient basis for dispositioning the TLAAs in accordance with the acceptance criteria in 10 CFR 54.21(c)(1)(i), (ii), or (iii). This includes staff's review of those cumulative usage factor analyses that qualify as TLAAs based on plant-specific calculation methods.

For specific containment metallic components (corresponding to Table 3.5.1, Items 027 and 040) for which no CLB fatigue analysis exists at the time of SLRA submittal, the applicant may perform a fatigue waiver analysis in accordance with the ASME Code to demonstrate that the fatigue aging effect do not require aging management. The reviewer verifies that the number of cycles for applicable cyclic loads has been adequately accounted for, the appropriate environment and material property inputs are used, and the acceptance criteria in paragraph NE-3222.4(d) (NE-3221.5(d) in 1980 and later code editions) of ASME Code, Section III, Division 1 (1974 edition or later edition incorporated by reference in 10 CFR 50.55a(a)(i])), that provide for a waiver of detailed fatigue analysis are satisfied through the end of the subsequent period of extended operation. The staff reviews any other justification provided on a case-by-case basis.

3.5.3.2.1.6 *Cracking Due to Stress Corrosion Cracking*

Further evaluation is recommended of programs to manage cracking due to SCC in SS penetration sleeves, penetration bellows, vent line bellows, suppression chamber shell (interior surface), and dissimilar metal welds in PWR and/or BWR containments. Transgranular stress corrosion cracking is a concern for dissimilar metal welds. In the case of bellows assemblies, SCC may cause aging effects particularly if the material is not shielded from a corrosive environment. Containment ISI IWE and leak rate testing may not be sufficient to detect cracks, especially for dissimilar metal welds. Additional appropriate examinations to detect SCC in the listed SS components and dissimilar metal welds, considering SCC susceptibility and applicable OE (e.g., cracking of two-ply bellows) related to detection, are recommended to address this issue. The reviewer assesses and evaluates the applicant's proposed programs to confirm that adequate inspection methods will be implemented to ensure that cracks are detected.

3.5.3.2.1.7 *Loss of Material (Scaling, Spalling) and Cracking Due to Freeze-Thaw*

Further evaluation is recommended of programs to manage loss of material (scaling, spalling) and cracking due to freeze-thaw for concrete elements of PWR and BWR containments. Containment ISI Subsection IWL may not be sufficient for plants located in moderate to severe weathering conditions. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch per year [day-in/yr]) (NUREG–1557). The weathering index for the continental United States is shown in ASTM C33-90, “Standard Specification for Concrete Aggregates,” Figure 1. A plant-specific AMP or plant-specific enhancements to ASME Code Section XI, Subsection IWL and/or Structures Monitoring AMPs, needed to manage this aging effect are not required if documented evidence confirms that the existing concrete had air content of 3%-8% (including tolerance) and subsequent inspection of accessible areas did not exhibit degradation related to freeze thaw. Such inspections are considered a part of the evaluation. The reviewer reviews and confirms that the applicant has satisfied the recommendations for inaccessible concrete. Otherwise, the reviewer reviews the applicant's proposed plant-specific AMP, or plant-specific enhancements to ASME Code Section XI, Subsection IWL and/or Structures Monitoring AMPs, needed to manage these aging effects. Plant-specific evaluations verify that, where appropriate, an effective enhanced inspection program has been developed and implemented to ensure that loss of material (scaling, spalling) and cracking due to freeze thaw in inaccessible areas for plants located in moderate to severe weathering conditions are adequately managed during the subsequent period of extended operation.

3.5.3.2.1.8 Cracking Due to Expansion from Reaction with Aggregates

Further evaluation is recommended of programs to manage cracking due to expansion from reaction with aggregates in inaccessible areas of concrete elements of PWR and BWR concrete and steel containments. Either a plant-specific AMP, or plant-specific enhancement(s) to ASME Code Section XI, Subsection IWL and/or Structures Monitoring AMP is necessary to manage this aging effect if: (i) reactivity tests or petrographic examinations of concrete samples identify reaction with aggregates, or (ii) accessible concrete exhibits visual indications of aggregate reactions, such as “map” or “patterned” cracking, alkali silica gel, exudations, surface staining, expansion causing structural deformation, relative movement or displacement, or misalignment/distortion of attached components. The reviewer confirms that the applicant has not identified one of the above conditions. Otherwise, the reviewer evaluates the applicant’s proposed plant-specific AMP or plant-specific enhancements to ASME Code Section XI, Subsection IWL and/or Structures Monitoring AMP, needed to manage this aging effect. Plant-specific evaluations verify that, where appropriate, an effective enhanced inspection program has been developed and implemented to make sure that cracking due to expansion from reaction with aggregates in inaccessible areas is adequately managed during the subsequent period of extended operation.

3.5.3.2.1.9 Increase in Porosity and Permeability Due to Leaching Of Calcium Hydroxide and Carbonation

Further evaluation of programs to manage increase in porosity and permeability due to leaching of calcium hydroxide and carbonation in inaccessible areas of PWR and BWR concrete and steel containments is recommended. A plant-specific AMP is not required, even if reinforced concrete is exposed to flowing water if: (i) there is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (ii) evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas is not significant and has no impact on the intended function of the concrete structure. The reviewer confirms that the applicant has satisfied these conditions. Otherwise, the reviewer assesses the applicant’s proposed plant-specific AMP, or plant-specific enhancement(s) to ASME Code Section XI, Subsection IWL and/or Structures Monitoring AMP, needed to manage these aging effects. Plant-specific evaluations verify that, where appropriate, an effective enhanced inspection program has been developed and implemented to ensure that increases in porosity and permeability due to leaching in inaccessible areas are adequately managed during the subsequent period of extended operation.

3.5.3.2.2 Safety-Related and Other Structures, and Component Supports

3.5.3.2.2.1 Aging Management of Inaccessible Areas

1. Further evaluation is recommended of programs to manage loss of material (spalling, scaling) and cracking due to freeze-thaw in below-grade inaccessible concrete areas of Groups 1–3, 5, and 7–9 structures. Structure monitoring programs may not be sufficient for plants located in moderate to severe weathering conditions. Further evaluation for plants that are located in moderate to severe weathering conditions (weathering index >100 day-in/yr) (NUREG–1557) is required. The weathering index for the continental United States is shown in ASTM C33-90, Figure 1. A plant-specific program is not required if documented

evidence confirms that the existing concrete had air content of 3–8 percent and subsequent inspection did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. The reviewer confirms that the applicant has satisfied these conditions. Otherwise, the reviewer evaluates the applicant’s proposed plant-specific AMP or plant-specific enhancements to structures monitoring AMPs needed to manage these aging effects. Plant-specific evaluations verify that, where appropriate, an effective enhanced inspection program has been developed and implemented to ensure that loss of material (spalling, scaling) and cracking due to freeze-thaw in inaccessible areas for plants located in moderate to severe weathering conditions are adequately managed during the subsequent period of extended operation.’

2. Further evaluation is recommended to determine if a plant-specific program is required to manage cracking due to expansion from reaction with aggregates in inaccessible concrete areas of Groups 1–5 and 7–9 structures. A plant-specific evaluation or program is required if: (i) reactivity tests or petrographic examinations of concrete samples identify reaction with aggregates, or (ii) accessible concrete exhibits visual indications of aggregate reactions, such as “map” or “patterned” cracking, alkali silica gel exudations, surface staining, expansion causing structural deformation, relative movement or displacement, or misalignment/distortion of attached components. The reviewer confirms that the applicant has not identified any of the above conditions. Otherwise, the reviewer evaluates the applicant’s proposed AMP or plant-specific enhancements to structures monitoring AMPs needed to manage this aging effect. Plant-specific evaluations verify that, where appropriate, an effective enhanced inspection program has been developed and implemented to ensure that cracking due to expansion from reaction with aggregates in inaccessible concrete areas is adequately managed during the subsequent period of extended operation.’

3. Further evaluation of aging management is recommended for: (i) cracking and distortion due to increased stress levels from settlement for inaccessible concrete areas of structures for all Groups and (ii) reduction of foundation strength, and cracking due to differential settlement and erosion of porous concrete subfoundations for inaccessible concrete areas of Groups 1–3, and 5–9 structures if a dewatering system is relied upon to manage the aging effect. The reviewer confirms that, if the applicant’s plant credits a dewatering system in its CLB, the applicant has committed to monitor the functionality of the dewatering system under the applicant’s structures monitoring program. If not, the reviewer reviews and evaluates the plant-specific program for monitoring the dewatering system during the subsequent period of extended operation.

4. Further evaluation of programs to manage increase in porosity and permeability due to leaching of calcium hydroxide and carbonation in below-grade inaccessible concrete areas of Groups 1–5, and 7–9 structures is recommended. A plant-specific AMP is not required for the reinforced concrete exposed to flowing water if: (i) there is evidence in the accessible areas that the flowing water has not caused leaching of calcium hydroxide and carbonation or (ii) evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure. The reviewer confirms that the applicant has satisfied these conditions. Otherwise, the reviewer evaluates the applicant’s proposed plant-specific AMP or plant-specific enhancements to Structures Monitoring AMP needed to manage these aging effects. Plant-specific evaluations verify that, where appropriate, an effective enhanced inspection program has been developed and implemented to make sure that increases in porosity and permeability due to leaching of calcium hydroxide and carbonation in inaccessible areas are adequately managed during the subsequent period of extended operation.’

3.5.3.2.2.2 Reduction of Strength and Modulus Due to Elevated Temperature

Further evaluation of programs to manage reduction of strength and modulus of concrete structures due to elevated temperatures for PWR and BWR safety-related and other structures is recommended.

A plant-specific evaluation should be performed if any portion of the concrete Groups 1–5 structures exceeds specified temperature limits (i.e., general 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 reviewer evaluates and confirms that the applicant's discussion in the renewal application indicates that the affected Groups 1–5 structures are not exposed to temperature that exceeds the temperature limits. If active cooling is relied upon to maintain acceptable temperatures, then the reviewer makes sure that the aging effects associated with the cooling system are being properly managed or temperatures are being monitored to identify a problem with the cooling system. If the limits are exceeded, the reviewer reviews the technical basis (i.e., tests and/or calculations) provided by the applicant to justify the higher temperature. Otherwise the reviewer reviews the applicant's proposed plant-specific AMP or plant-specific enhancements to the Structures Monitoring AMP needed to manage these aging effects. Plant-specific evaluations verify that, where appropriate, an effective enhanced inspection program has been developed and implemented, to ensure that reduction of strength and modulus of concrete structures due to elevated temperatures are adequately managed during the subsequent period of extended operation.'

3.5.3.2.2.3 Aging Management of Inaccessible Areas for Group 6 Structures

Further evaluation is recommended 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 GALL-SLR Report AMP XI.S7, or FERC/U.S. 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. Further evaluation for plants that are located in moderate to severe weathering conditions (weathering index >100 day-in/yr) (NUREG–1557, Ref. 15) is needed. The weathering index for the continental U.S. is shown in ASTM C33-90, Figure 1. A plant-specific program is not required if documented evidence confirms that the existing concrete had air content of 3–8 percent and subsequent inspection of accessible areas did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. The reviewer evaluates and confirms that the applicant has satisfied these conditions. Otherwise, the reviewer assesses the applicant's proposed plant-specific AMP or plant-specific enhancements to the Structures Monitoring AMP essential to manage these aging effects. Plant-specific evaluations verify that, where appropriate, an effective enhanced inspection program has been developed and implemented, to make sure that loss of material (spalling, scaling) and cracking due to freeze-thaw in inaccessible areas for plants located in moderate to severe weathering conditions are adequately managed during the subsequent period of extended operation.'

2. Cracking due to expansion from reaction with aggregates could occur in inaccessible concrete areas of Group 6 structures. Further evaluation is recommended to determine if a plant-specific program is required to manage the aging effect. A plant-specific evaluation or

program is required if: (i) reactivity tests or petrographic examinations of concrete samples identify reaction with aggregates, or (ii) accessible concrete exhibits visual indications of aggregate reactions, such as “map” or “patterned” cracking, alkali silica gel exudations, surface staining, expansion causing structural deformation, relative movement or displacement, or misalignment/distortion of attached components. The reviewer confirms that the applicant has not identified any of the above conditions. Otherwise, the reviewer evaluates the applicant’s proposed plant-specific AMP, or plant-specific enhancements to the Structures Monitoring AMP, needed to manage this aging effect. Plant-specific evaluations verify that, where appropriate, an effective enhanced inspection program has been developed and implemented to make sure that cracking due to expansion from reaction with aggregates is adequately managed during the subsequent period of extended operation. Otherwise, the reviewer evaluates the applicant’s proposed AMP or plant-specific evaluation to verify that, an effective evaluation or inspection program has been developed and implemented to ensure that the aging effect will be adequately managed.

3. Increase in porosity and permeability due to leaching of calcium hydroxide and carbonation could occur in below-grade inaccessible concrete areas of Group 6 structures. Further evaluation is recommended to determine if a plant-specific program is required to manage the aging effect. A plant-specific program is not required for the reinforced structures exposed to flowing water if: (i) there is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (ii) evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure. The reviewer confirms that the applicant has satisfied these conditions. Otherwise, the reviewer evaluates the applicant’s proposed AMP or plant-specific enhancements to the Structures Monitoring AMP needed manage this aging effect. Plant-specific evaluations verify that, where appropriate, an effective enhanced inspection program has been developed and implemented to make sure that porosity and permeability due to leaching of calcium hydroxide and carbonation in inaccessible areas are adequately managed during the subsequent period of extended operation.’

3.5.3.2.2.4 *Cracking Due to Stress Corrosion Cracking and Loss of Material Due to Pitting and Crevice Corrosion*

Further evaluation of plant-specific programs to manage cracking due to SCC and loss of material due to pitting and crevice corrosion for SS tank liners exposed to standing water is recommended. The reviewer evaluates the applicant’s proposed AMP on a case-by-case basis to make sure that the intended functions will be maintained during the subsequent period of extended operation.

The GALL-SLR Report recommends further evaluation to manage loss of material due to pitting and crevice corrosion and cracking due to SCC in SS and aluminum alloy support members; welds; bolted connections; or support anchorage to building structure exposed to any air, condensation, or underground environment where the presence of sufficient halides (e.g., chlorides) and moisture is possible; or in the vicinity of potentially transportable halogens. The possibility of these aging effects also extends to indoor components located in close proximity to sources of outdoor air (e.g., components near intake vents).

The reviewer independently verifies the sufficiency of the applicant’s evaluation of plant-specific OE. If the review of plant-specific OE reveals loss of material due to pitting or crevice corrosion or cracking due to SCC in SS or aluminum alloys, the reviewer determines whether an adequate program is credited to manage the aging effect. If the review of plant-specific OE reveals that loss of material due to pitting and crevice corrosion and cracking due to SCC is not applicable, the reviewer verifies that AMP XI.M32, “One-Time Inspection,” is cited for all applicable AMR line items.

An applicant may refine its OE search, and subsequent one-time inspections, by binning plant-specific environments into subcategories. For example, the OE search could be based on two environments including outdoor air and indoor air. The results could be that loss of material or cracking has occurred in the outdoor air environment but not the indoor air environment. The applicant could further categorize the indoor air locations as those where leakage could impinge on a component’s surface (e.g., leakage from mechanical connections) and those where there is no potential for leakage. When the applicant chooses to conduct its OE search in this manner, the reviewer is to also confirm that the applicant has adequately addressed the potential for the periodic introduction of either moisture or halides from secondary sources. Secondary sources of moisture or halides should be considered for all environments including indoor conditioned air. Typical secondary sources of moisture or halides include: leakage from mechanical connections; leakage into vaults; insulation containing halides; and outdoor air intrusion. Grouping of environments consistent with that described in the detection of aging effects program element of GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” is appropriate.

3.5.3.2.2.5 Cumulative Fatigue Damage

Evaluations involving time-dependent fatigue, cyclical loading, or cyclical displacement of support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports are TLAAs as defined in 10 CFR 54.3 (TN4878) only if a CLB fatigue analysis exists. The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed in Section 4.3, “Metal Fatigue,” and/or Section 4.7, “Other Plant Specific Time Limited Aging Analyses,” of this SRP-SLR.

The staff reviews the information on a case-by-case basis consistent with the review procedures in SRP-SLR Sections 4.3 and/or 4.7 (as applicable) to determine whether the applicant has provided a sufficient basis for dispositioning the TLAAs in accordance with the acceptance criteria in 10 CFR 54.21(c)(1)(i), (ii), or (iii). This includes staff’s review of those cumulative usage factor analyses that qualify as TLAAs based on plant-specific calculation methods.

3.5.3.2.2.6 Reduction of Strength and Mechanical Properties of Concrete Due to Irradiation

Further evaluation is recommended of a plant-specific AMP or plant-specific enhancements to selected AMPs to manage reduction of strength, loss of mechanical properties, and cracking of concrete due to irradiation in PWR and BWR Group 4 concrete structures, exposed to high levels of neutron and gamma radiation. These structures include the reactor (primary/biological) shield wall, the sacrificial shield wall, and the RV support/pedestal structure. The irradiation mechanism consists of radiation interactions with the material and heating due to absorption of radiation energy at the operating temperature experienced by the concrete. The intensity of radiation is typically characterized by the measure of its field or fluence. Both neutron and gamma radiation produce internal heating from absorption of radiation energy and, at high fluence levels, changes in microstructure and certain mechanical properties of concrete (e.g., compressive strength, tensile strength, modulus of elasticity) from radiation interactions with the material. Limited data are available in the open literature related to the effects and significance of radiation fluences (neutron and gamma radiation) on intended functions of concrete structures, especially for conditions (dose, temperature, etc.) representative of existing LWR plants. However, based on literature review of existing research, fluence limits of 1×10^{19} neutrons/cm^2 neutron radiation and 1×10^8 Gray (1×10^{10} rad) gamma dose are considered conservative radiation exposure levels beyond which concrete material properties may begin to degrade markedly.

Plant-specific calculations/analyses should be performed to identify the neutron (fluence cutoff energy $E > 0.1$ MeV) and gamma fields that develop in any portion of the concrete structures of interest at 80 years of operation and compare them to the above threshold limits. The impact of any plant-specific OE of concrete irradiation effects on intended functions are evaluated. The reviewer evaluates these analyses, OE and supporting technical basis (e.g., calculations, test data, plant-specific evaluations) on a case-by-case basis. Higher fluence or dose levels may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and/or change in mechanical properties of concrete, if any, from those fluence levels and the effects are applied to the design calculations. The reviewer confirms that the applicant's discussion in the SLRA indicates that the affected PWR and BWR concrete components are not exposed to neutron and gamma radiation fluence levels that exceed the threshold limits, or are otherwise evaluated, for example, the concrete is primarily for shielding and non-structural. The reviewer also confirms that the impact of any plant-specific OE of concrete irradiation degradation on intended functions is addressed. If the limits are exceeded, the technical basis (i.e., tests and/or calculations or evaluations) provided by the applicant to justify higher fluence or dose limits is reviewed. Otherwise, the applicant's proposed plant-specific AMP or plant-specific enhancements to selected AMPs and the supporting technical basis is reviewed to ensure that the effects of irradiation on the concrete components will be adequately managed during the subsequent period of extended operation.

3.5.3.2.2.7 *Loss of Material, and/or Changes in Material Properties Due to Weathering, Chemical Degradation, Insect Infestation, Repeated Wetting and Drying, or Fungal Decay*

Further evaluation is recommended of programs to manage loss of material and/or changes in material properties due to weathering, chemical degradation, insect infestation, repeated wetting and drying, or fungal decay for standing wooden poles. Considering the geographical location and site-specific characteristics and conditions, the reviewer evaluates: (i) the methods or techniques that will be used to effectively detect the aging effects in wooden poles and (ii) the established inspection frequency based on the decay/deterioration that is expected to occur at the plant site, the acceptance criteria, and corrective actions. The reviewer reviews the applicant's plant-specific evaluation and proposed plant-specific AMP or plant-specific enhancements to an existing AMP(s) to verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that the effects of aging for wooden poles are adequately managed.

Most decay in wooden poles occurs underground and/or internally. If an applicant selects to use an existing AMP(s) that normally relies on visual inspections to manage aging effects, the visual inspections need to be supplemented with additional methods or techniques capable of detecting the aging effects in wooden poles before there is a loss of intended function. An acceptable inspection frequency for wooden poles should appropriately account for the decay or deterioration expected to occur at the site based on its geographical location and should be consistent with industry guidelines. The U.S. Department of Agriculture, Rural Utilities Service Bulletin 1730B-121 "Wood Pole Inspection and Maintenance" is an acceptable industry guideline that can be used to determine the decay severity zone applicable to the site and to establish an adequate inspection program, including inspection methods, frequency, acceptance criteria and corrective actions.

3.5.3.2.2.8 Combined Effects of Aging Associated with Irradiation of RV Steel Structural Support Components and Loss of Function of Other RV Structural Support Components That are Not Concrete

Combined effects of aging associated with neutron radiation exposure could occur in the RV structural support assembly components and materials in BWRs and PWRs. The steel components of the RV structural support assembly (including associated weldments and bolted connections) are made of ferritic carbon or low alloy steels, and the combined effects of aging for these steel components include but are not limited to reduction in fracture toughness, loss of material, loss of preload, and distortion that could result in loss of intended function. Examples of RV steel structural support components are RV steel girder and column supports, RV steel support skirts, and neutron shield tanks. For nonconcrete nonmetallic materials (e.g., Lubrite® lubricant) and nonconcrete nonferrous materials (e.g., manganese bronze alloy) associated with the RV structural support assembly, effects of aging could also result in loss of intended function. Further evaluation of the RV structural support assembly as a whole is recommended to determine the need for a plant-specific AMP or plant-specific enhancements to selected GALL-SLR AMPs to manage the combined effects of aging. If a plant-specific AMP or enhancements to existing GALL-SLR AMPs to manage the combined effects of aging are determined to be necessary, the reviewer confirms that the acceptance criteria for the AMP elements described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR) are followed. Otherwise, the reviewer evaluates the adequacy of the applicant's evaluation of the RV structural support assembly that determined that a plant-specific AMP or enhancements to selected GALL-SLR AMPs is/are not necessary, such that intended function(s) of the RV structural support assembly as a whole is/are maintained consistent with the CLB for the SPEO.

The reviewer confirms that the applicant addressed combined effects of aging associated with irradiation (i.e., reduction in fracture toughness, loss of material, loss of function, loss of preload, and distortion) in the RV structural support assembly as a whole by analysis, testing, or a combination of these, and by ongoing aging management examinations and inspections for the SPEO. The reviewer confirms that prior to any analysis, the applicant included one or more evaluations of the physical conditions through physical examination of the RV structural supports to assess whether the structural integrity of the RV structural support assembly (other than concrete) is affected by potential combined effects of radiation, corrosive environment (boric acid), temperature, cyclic loading, and applied stresses (including weld residual and/or fabrication stresses). Existing plant-specific AMPs (such as the ASME Section XI, Subsection IWF AMP) may be credited for this physical examination. Following the physical examination, NUREG-1509, "Radiation Effects on Reactor Pressure Vessel Supports," (Ref. 26) provides one acceptable methodology (with the exception of the structural consequence analysis approach in Section 4.5 of the report) for evaluating the RV steel structural support components for reduction in fracture toughness due to irradiation embrittlement during the SPEO. If the initial screening criteria (Section 4.2.4) are not satisfied, the reviewer confirms that the applicant performed a plant-specific fracture mechanics analysis or a plant-specific transition temperature analysis (relative to the lowest operating or service temperature of the RV steel structural support component) per Section 4.3 or an accurate analysis per Section 4.4. The reviewer makes sure that there are sufficient conservatisms in the performed analysis (e.g., conservatism in neutron exposure levels, applied stresses, fracture toughness values) to account for uncertainties in these evaluation parameters. The reviewer also asertains that there are sufficient conservatisms in any structural integrity evaluations performed for the associated nonconcrete, nonmetallic, nonferrous components and/or materials. The reviewer ascertains that applications that rely on the use of NUREG-1509 generic NDTT values in lieu of those from plant-specific materials testing included additional justification that the NUREG-1509 generic

NDTT values are representative of the plant-specific materials of the RV steel structural support assembly components.

The reviewer is encouraged to use risk-informed decision-making in the safety determinations in this further evaluation of the RV steel structural support assemblies, particularly where an applicant used RIPB principles. For such a case, the reviewer assesses whether the applicant provided an efficient, effective approach in determining structural stability of the RV steel structural support assemblies so that their intended function(s) are maintained consistent with the CLB during the SPEO. The reviewer further assesses whether the applicant's use of RIPB principles is based on a well-defined system that clearly links tolerable risk, design basis loads, and tolerable performance. If the applicant decides to pursue the RIPB methodology using augmented examinations combined with the fracture mechanics methodology, the reviewer evaluates the procedures established for such augmented examinations in support of damage tolerance evaluation. It should be noted that the ultimate objective of the reviewer regardless of the applicant's evaluation methodology is to determine whether there is reasonable assurance that intended function(s) of RV steel structural support assemblies anchored to the concrete remain consistent with the CLB during the SPEO.

Reliance on piping for RV support during the SPEO is outside the scope of this further evaluation. For applicants intending to continue relying on piping to support their RVs during the SPEO, this should be made clear in the CLB, and all associated CLB analyses must be updated through the end of the SPEO and submitted for review and approval with the application.

A plant-specific AMP or plant-specific enhancements to selected GALL-SLR AMPs may not be necessary for the RV steel structural support components if either the initial screening criteria (such as those in Section 4.2.4 of NUREG-1509) or the evaluation criteria (such as those in Section 4.3 or Section 4.4 of NUREG-1509) are satisfied based on plant-specific evaluations; or based on other applicant-proposed methodology for technical evaluation of the condition of the RV structural support assembly as a whole as documented in the CLB. For the radiation exposure criterion in Section 4.2.4 of NUREG-1509 for initial screening, the reviewer compares the plant-specific radiation exposure level at the RV steel structural support components against the damage criterion of 2×10^{-5} dpa, which is based on the upper-bound embrittlement shift curve in Figure 3-1 of NUREG-1509. If the radiation exposure level is greater than 2×10^{-5} dpa, and if a fracture mechanics analysis is used, the reviewer evaluates the plant-specific analysis. If the applicant opted to follow NUREG-1509 guidance, the reviewer evaluates the analysis based on the approach in Figure 4-3, "Fracture Mechanics Approach," of NUREG-1509. If the fracture mechanics analysis methodology in nonmandatory Appendix A of the ASME Code, Section XI (Ref. 27) is used as recommended in NUREG-1509, the reviewer verifies the consistency of the applicant's evaluation approach with that for which the ASME Code, Section XI, Appendix A methodology was intended (i.e., vessels). If a transition temperature analysis is used, the reviewer evaluates the plant-specific analysis. If the applicant opted to follow NUREG-1509 guidance, the reviewer evaluates the analysis based on the process shown in Figure 4-4, "Transition Temperature Approach," of NUREG-1509. For the damage (i.e., dpa) estimation, the reviewer evaluates the plant-specific estimates with the methodology in ASTM E693-17 (Ref. 28) for a neutron energy spectrum of $E > 0.1$ MeV. For related nonconcrete, nonmetallic, nonferrous components and/or materials, the reviewer evaluates on a case-by-case basis that the applicant provided adequate technical information and data used to determine the material(s)' integrity against loss of intended function as a result of radiation exposure and to determine the need for a plant-specific AMP or enhancements to selected GALL-SLR AMPs as suggested in NUREG-2192 (Appendix Section A.1 of this SRP-SLR) guidance to manage the combined effects of aging during the SPEO.

The reviewer confirms that the applicant's technical evaluation conservatively estimated the neutron radiation exposure values incident on the RV steel structural support components and the corresponding dpa estimates for the SPEO. The reviewer further confirms that the evaluation demonstrated that the RV steel structural support components and related nonconcrete, nonmetallic, nonferrous components and/or materials noted above remain capable of performing their intended function consistent with the CLB through the SPEO. The reviewer confirms that the applicant's further evaluation included sufficient justification that demonstrated that appropriate methodologies and conservative assumptions were used for neutron fluence and dpa estimates projected to the end of the SPEO. The damage parameter dpa for each RV steel support component includes neutrons of energy spectrum E > 0.1 MeV (i.e., embrittlement predictions should include damage from neutrons of energy spectrum E > 0.1 MeV) and a consideration of alloying elements, such as copper, nickel, and phosphorous, which can increase the rate of irradiation embrittlement. In summary, the reviewer confirms that the evaluation considered the material properties and chemical composition of the steel components (e.g., initial nil-ductility temperature, type of steel, alloying element, weld material) and the lowest service (operating) temperature to which the components is exposed.

The reviewer confirms that any structural integrity evaluation (such as an evaluation performed with the fracture mechanics approach recommended in NUREG-1509) of the RV steel structural support components and related nonconcrete, nonmetallic, nonferrous components and/or materials included all design basis loading combinations referenced in the CLB. The reviewer also confirms that each applicant's further evaluation includes: (i) a review of the current as-found physical condition of the RV structural support assembly as a whole and in particular of the steel structural components, which includes a review of plant-specific OE to date of the assembly and/or components for evaluation of potential degradation due to irradiation embrittlement and other aging effects acting in concert; (ii) the effects of observed signs of damage or degradation (including but not limited to corrosion, cracks, or permanent distortion) and potential future degradations projected to the end of the SPEO; (iii) an explanation of how credit is taken for ongoing examinations and inspections against loss of intended function for the RV structural support assembly as a whole; and (iv) identification and consideration of all relevant AMR line items. This last item should typically be based on detailed physical examinations and inspections (to the extent possible) particularly for the RV steel structural support components. If degradation is detected, its documentation in inspection reports can serve as the basis for the evaluation, including risk-informed decisions regarding further actions or when an examination is not feasible. For that case, the reviewer confirms that assumptions of potential degradation through the end of the SPEO were adequately justified, or appropriate monitoring actions were proposed to manage the effects of aging consistent with the assumptions.

3.5.3.2.3 Quality Assurance for Aging Management of Nonsafety-Related Components

The applicant's AMP for SLR should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered by 10 CFR Part 50 (TN249), Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an AMR for SLR. Nevertheless, an applicant has the option to expand the scope of its 10 CFR Part 50 Appendix B program to include these components and address these program elements. If the applicant chooses this option, the reviewer verifies that the applicant has documented such a commitment in the FSAR Supplement. If the applicant chooses alternative means, the branch responsible for quality assurance should be requested to review the applicant's proposal on a case-by-case basis.

3.5.3.2.4 Ongoing Review of Operating Experience

The applicant's AMPs should contain the elements of OE. The reviewer verifies that the applicant has appropriate programs or processes for the ongoing review of both plant-specific and industry OE concerning age-related degradation and aging management. Such reviews are used to make sure that the AMPs are effective in managing the aging effects for which they are created. The AMPs are either enhanced or new AMPs are developed, as appropriate, when it is determined through the evaluation of the OE that the effects of aging may not be adequately managed. Additional information is in Appendix Section A.4, "Operating Experience for Aging Management Programs" of this SRP-SLR. In addition, the reviewer confirms that the applicant has provided an appropriate summary description of these activities in the FSAR Supplement.

3.5.3.3 Aging Management Review Results Not Consistent with or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report

The reviewer should confirm that the applicant, in their SLRA, has identified applicable aging effects, listed the appropriate combination of materials and environments, and credited AMPs that will adequately manage the aging effects. The AMP credited by the applicant could be an AMP that is described and evaluated in the GALL-SLR Report or a plant-specific program. The review procedures are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.5.3.4 Aging Management Programs

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR Report AMP. If the applicant identifies, in the SLRA AMP, an exception to any of the program elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3) (TN4878). If the reviewer identifies a difference, not identified by the SLRA, between the SLRA AMP and the GALL-SLR Report AMP, with which the SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions, or differences. The AMPs evaluated in the GALL-SLR Report pertinent to the containments, structures, and component supports are summarized in Table 3.5-1 of this SRP-SLR. The "GALL-SLR Item" column identifies the AMR item numbers in the GALL-SLR Report, Chapters II and III, presenting detailed information summarized by this row.

If the applicant chooses to use a plant-specific program that is not a GALL-SLR Report AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix 0 of this SRP-SLR).

3.5.3.5 Final Safety Analysis Report Supplement

The reviewer confirms that the applicant has provided in its FSAR Supplement information equivalent to that provided in GALL-SLR Table X-01 and Table XI-01 for aging management of the containments, structures, and component supports. Table 3.5-2 lists the AMPs that are applicable for this SRP-SLR Section. The reviewer also confirms that the applicant has provided information equivalent to that in GALL-SLR Table X-01 and Table XI-01 and Section 3.5.3.3 of this SRP-SLR, “Aging Management Review Results Not Consistent with or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report.”

The NRC staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursuant to 10 CFR 50.71(e)(4) (TN249). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR Supplement before the license is renewed, no condition will be necessary.

An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to make sure that the applicant will complete these activities no later than the committed date.

3.5.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of this section, then an evaluation finding similar to the following text should be included in the NRC staff’s SER:

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has demonstrated that the aging effects associated with the containments, structures, and component supports components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the subsequent period of extended operation, as required by 10 CFR 54.21(a)(3) (TN4878).
>
> The NRC staff also reviewed the applicable FSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the containments, structures, and component supports, as required by 10 CFR 54.21(d).

3.5.5 Implementation

Except for cases in which the applicant proposes an alternative method for complying with specified portions of NRC regulations, the NRC staff members follow the methods described herein in their evaluation of conformance with NRC regulations. The staff evaluates these alternatives and finds them acceptable if the staff determines that the alternatives provide reasonable assurance that the component’s intended functions will be maintained.

3.5.6 References

1. 10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016. 10 CFR Part 50-TN249

2. 10 CFR 50.55a, “Codes and Standards.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

3. 10 CFR 50.59, “Changes, Tests, and Experiments.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

4. 10 CFR Part 50, Appendix J, “Primary Reactor Containment Leakage Testing for Water Cooled Power Reactors.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

5. 10 CFR 50.71, “Maintenance of Record, Making of Reports.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

6. 10 CFR 50.65, “Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

7. 10 CFR 54.4, “Scope.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016. 10 CFR Part 54-TN4878

8. NRC. Regulatory Guide 1.127, “Inspection of Water-Control Structures Associated with Nuclear Power Plants.” Revision 1. Agencywide Documents Access and Management System (ADAMS) Accession No. ML003739392. Washington, DC: U.S. Nuclear Regulatory Commission. March 1978.

9. NEI. NEI 95-10, “Industry Guideline for Implementing the Requirements of

10. 10 CFR Part 54–The License Renewal Rule.” Revision 6. ADAMS Accession No. ML051860406. Washington, DC: Nuclear Energy Institute. June 2005.

11. ASME Code, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components,” Subsection IWL, “Requirements for Class CC Concrete Components of Light-Water Cooled Power Plants.” New York, New York: The American Society of Mechanical Engineers. 2008.

12. ASME Code, Section XI, “”Subsection IWE, “Requirements for Class MC and Metallic Liners of Class CC Components of Light-Water Cooled Power Plants.” New York, New York: The American Society of Mechanical Engineers. 2008.

13. ASME Code, Section XI, “”Subsection IWF, “Requirements for Class 1, 2, 3, and MC Component Supports of Light-Water Cooled Power Plants.” New York, New York: The American Society of Mechanical Engineers. 2008.

14. NEI. NUMARC 93-01, “Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants.” Revision 2. ADAMS Accession No. ML11116A198. Washington, DC: Nuclear Energy Institute. April 1996.

15. NRC. Regulatory Guide 1.160, “Monitoring the Effectiveness of Maintenance at Nuclear Power Plants.” Revision 2. Agencywide Documents Access and Management System (ADAMS) Accession No. ML003761662. Washington, DC: U.S. Nuclear Regulatory Commission. March 31 1997.

16. NUREG–1557, “Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Report addressing License Renewal.” Washington, DC: U.S. Nuclear Regulatory Commission. October 1996.

17. ACI. ACI Standard 318, “Building Code Requirements for Reinforced Concrete and Commentary.” Farmington Hills, Michigan: American Concrete Institute. 1995.

18. Hilsdorf, H.K., J. Kropp, and H.J. Koch. “The Effects of Nuclear Radiation on the Mechanical Properties of Concrete.” ACI SP 55-10. pp 223-251. Farmington Hills, Michigan: American Concrete Institute. 1978.

19. NRC. NUREG/CR–7171, “A Review of the Effects of Radiation on Microstructure and Properties of Concretes Used in Nuclear Power Plants.” ADAMS Accession No. ML13325B077. Washington, DC: U.S. Nuclear Regulatory Commission. November 2013.

20. Field, K.G., Y. Le Pape, and I. Remec. “Perspectives on Radiation Effects in Concrete for Nuclear Power Plants–Part I: Quantification of Radiation Exposure and Radiation Effects.” Nuclear Engineering and Design. Vol 285. pp 126–143. February 2015.

21. ACI. ACI Standard 349 85, “Code Requirements for Nuclear Safety-Related Concrete Structures.” Farmington Hills, Michigan: American Concrete Institute. 1985.

22. ASME. ASME Code, Section III, “Rules for Construction of Nuclear Facility Components,” Division 1 – Subsection NE, “Class MC Components.” New York, New York: The American Society of Mechanical Engineers. 1974 edition or later edition incorporated by reference in 10 CFR 50.55a(a)(i) as applicable

23. U.S. Department of Agriculture, “Wood Pole Inspection and Maintenance,” Rural Utility Service (RUS) Bulletin 1730B-121, August 13, 2013.

24. U.S. Department of Agriculture Report, “Durability of Preservative-Treated Wood Utility Poles in Guam,” May 1986.

25. Morrell, J. Jeffrey, “Estimated Service Life of Wood Poles,” Technical Bulletin No. 16-U-101, North American Wood Pole Council, Oregon State University, February 2016.

26. NUREG-1509, “Radiation Effects on Reactor Pressure Vessel Supports,” U.S. Nuclear Regulatory Commission, Washington DC, May 1996.

27. ASME Code, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components,” Nonmandatory Appendix A, “Analytical Evaluation of Flaws,” New York, New York: The American Society of Mechanical Engineers, 1989 Edition up to 2020 Edition incorporated by reference in 10 CFR 50.55a.

28. ASTM E693-17, “Standard Practice for Characterizing Neutron Exposures in Iron and Low Alloy Steels in Terms of Displacement Per Atom (DPA),” ASTM International.

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	001	Boiling water reactor (BWR)/ Presurized water reactor (PWR)	Concrete: dome; wall; basemat; ring girders; buttresses, concrete elements, all	Cracking and distortion due to increased stress levels from settlement	AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring"	Yes (Standard Review Plan for Review of Subsequent License Renewal [SRP-SLR] Section 3.5.2.2.1.1)	II.A1.CP-101 II.A2.CP-69 II.B1.2.CP-105 II.B2.2.CP-105 II.B3.1.CP-69 II.B3.2.CP-105
	002	BWR/PWR	Concrete: foundation; subfoundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.1.1)	II.A1.C-07 II.A2.C-07 II.B1.2.C-07 II.B2.2.C-07 II.B3.1.C-07 II.B3.2.C-07
M	003	BWR/PWR	Concrete: dome; wall; basemat; ring girders; buttresses, concrete: containment; wall; basemat, concrete: basemat, concrete fill-in annulus	Reduction of strength and modulus of elasticity due to elevated temperature (>150 °F general; >200 °F local)	Plant-specific aging management program or AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring," enhanced as necessary	Yes (SRP-SLR Section 3.5.2.2.1.2)	II.A1.CP-34 II.B1.2.CP-57 II.B2.2.CP-57 II.B3.1.CP-65 II.B3.2.CP-108

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	004	BWR	Steel elements (inaccessible areas): drywell shell; drywell head	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	Yes (SRP-SLR Section 3.5.2.2.1.3.1)	II.B3.1.CP-113
	005	BWR/PWR	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, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	Yes (SRP-SLR Section 3.5.2.2.1.3.1)	II.A1.CP-98 II.A2.CP-98 II.B1.2.CP-63 II.B2.1.CP-63 II.B2.2.CP-63 II.B3.2.CP-98
	006	BWR	Steel elements: torus shell	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	Yes (SRP-SLR Section 3.5.2.2.1.3.2)	II.B1.1.CP-48

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	007	BWR	Steel elements: torus ring girders; downcomers; Steel elements: suppression chamber shell (interior surface)	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, “ASME Section XI, Subsection IWE”	Yes (SRP-SLR Section 3.5.2.2.1.3.3)	II.B1.1.CP-109 II.B3.1.CP-158
	008	BWR/PWR	Prestressing system: tendons	Loss of prestress due to relaxation; shrinkage; creep; elevated temperature	TLAA, SRP-SLR Section 4.5, “Concrete Containment Tendon Prestress,” and/or SRP-SLR Section 4.7, “Other Plant-Specific Time-Limited Aging Analyses”	Yes (SRP-SLR Section 3.5.2.2.1.4)	II.A1.C-11 II.B2.2.C-11
E	009	BWR/PWR	Metal liner, metal plate, personnel airlock, equipment hatch, control rod drive (CRD) hatch, penetration sleeves; penetration bellows, steel elements: torus; vent line; vent header; vent line	Cumulative fatigue damage due to cyclic loading (Only if current licensing basis (CLB) fatigue analysis exists)	TLAA, SRP-SLR Section 4.6, ““Containment Liner Plate and Penetration Fatigue Analysis”“	Yes (SRP-SLR Section 3.5.2.2.1.5)	II.A3.C-13 II.B1.1.C-21 II.B2.1.C-45 II.B2.2.C-48 II.B4.C-13

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			bellows; downcomers, suppression pool shell; unbraced downcomers, steel elements: vent header; downcomers				
	010	BWR/PWR	Penetration sleeves; penetration bellows	Cracking due to SCC	AMP XI.S1, ""ASME Section XI, Subsection IWE,"" and AMP XI.S4, ""10 CFR Part 50, Appendix J""	Yes (SRP-SLR Section 3.5.2.2.1.6)	II.A3.CP-38 II.B4.CP-38
M	011	BWR/PWR	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Plant-specific aging management program or AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring," enhanced as necessary	Yes (SRP-SLR Section 3.5.2.2.1.7)	II.A1.CP-147 II.A2.CP-70 II.B3.2.CP-135
M	012	BWR/PWR	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses,	Cracking due to expansion from reaction with aggregates	Plant-specific aging management program or AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures	Yes (SRP-SLR Section 3.5.2.2.1.8)	II.A1.CP-67 II.A2.CP-104 II.B1.2.CP-99 II.B2.2.CP-99 II.B3.1.CP-83 II.B3.2.CP-121

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			containment, concrete fill-in annulus		Monitoring," enhanced as necessary		
D	013						
M	014	BWR/PWR	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses, containment	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Plant-specific aging management program or AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring," enhanced as necessary	Yes (SRP-SLR Section 3.5.2.2.1.9)	II.A1.CP-102 II.A2.CP-53 II.B1.2.CP-110 II.B2.2.CP-110 II.B3.1.CP-53 II.B3.2.CP-122
D	015						
	016	BWR/PWR	Concrete (accessible areas): basemat, concrete: containment; wall	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	AMP XI.S2, ""ASME Section XI, Subsection IWL,"" and/or AMP XI.S6, ""Structures Monitoring""	No	II.A1.CP-87 II.A2.CP-72 II.B1.2.CP-106 II.B2.2.CP-106 II.B3.1.CP-72
D	017						
	018	BWR/PWR	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses	Loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.S2, ""ASME Section XI, Subsection IWL,"" and/or AMP XI.S6, ""Structures Monitoring""	No	II.A1.CP-31 II.A2.CP-51 II.B3.2.CP-52

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	019	BWR/PWR	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses, containment; concrete fill-in annulus	Cracking due to expansion from reaction with aggregates	AMP XI.S2, ““ASME Section XI, Subsection IWL,”“ and/or AMP XI.S6, ““Structures Monitoring”“	No	II.A1.CP-33 II.A2.CP-58 II.B1.2.CP-59 II.B2.2.CP-59 II.B3.1.CP-66 II.B3.2.CP-60
	020	BWR/PWR	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses, containment	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	AMP XI.S2, ““ASME Section XI, Subsection IWL”“	No	II.A1.CP-32 II.A2.CP-155 II.B1.2.CP-54 II.B2.2.CP-54 II.B3.1.CP-156 II.B3.2.CP-55
	021	BWR/PWR	Concrete (accessible 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	AMP XI.S2, ““ASME Section XI, Subsection IWL,”“ and/or AMP XI.S6, ““Structures Monitoring”“	No	II.A1.CP-68 II.A2.CP-74 II.B1.2.CP-79 II.B2.2.CP-79 II.B3.1.CP-74 II.B3.2.CP-88
D	022						
	023	BWR/PWR	Concrete (inaccessible	Cracking; loss of bond; and loss of	AMP XI.S2, ““ASME Section XI, Subsection	No	II.A1.CP-97 II.A2.CP-75

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			areas): basemat; reinforcing steel, dome; wall	material (spalling, scaling) due to corrosion of embedded steel	IWL,"" and/or AMP XI.S6, ""Structures Monitoring""		II.B1.2.CP-80 II.B2.2.CP-80 II.B3.1.CP-75 II.B3.2.CP-89
	024	BWR/PWR	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses, concrete (accessible areas): dome; wall; basemat	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	AMP XI.S2, ""ASME Section XI, Subsection IWL,"" and/or AMP XI.S6, ""Structures Monitoring""	No	II.A1.CP-100 II.A2.CP-71 II.B3.1.CP-71 II.B3.2.CP-73 II.B3.2.CP-84
D	025						
	026	BWR/PWR	Moisture barriers (caulking, flashing, and other sealants)	Loss of sealing due to wear, damage, erosion, tear, surface cracks, other defects	AMP XI.S1, ""ASME Section XI, Subsection IWE""	No	II.A3.CP-40 II.B4.CP-40
M	027	BWR/PWR	Metal liner, metal plate, airlock, equipment hatch, CRD hatch; penetration sleeves; penetration	Cracking due to cyclic loading (CLB fatigue analysis does not exist)	AMP XI.S1, ""ASME Section XI, Subsection IWE,"" and AMP XI.S4, ""10 CFR Part 50, Appendix J""	Yes (SRP-SLR Section 3.5.2.2.1.5)	II.A3.CP-37 II.B1.1.CP-49 II.B2.1.CP-107 II.B4.CP-37

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			bellows, steel elements: torus; vent line; vent header; vent line bellows; downcomers, suppression pool shell				
	028	BWR/PWR	Personnel airlock, equipment hatch, CRD hatch	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, ““ASME Section XI, Subsection IWE,”“ and AMP XI.S4, ““10 CFR Part 50, Appendix J”“	No	II.A3.C-16 II.B4.C-16
	029	BWR/PWR	Personnel airlock, equipment hatch, CRD hatch: locks, hinges, and closure mechanisms	Loss of leak tightness due to mechanical wear	AMP XI.S1, ““ASME Section XI, Subsection IWE,”“ and AMP XI.S4, ““10 CFR Part 50, Appendix J”“	No	II.A3.CP-39 II.B4.CP-39
	030	BWR/PWR	Pressure retaining bolting	Loss of preload due to self-loosening	AMP XI.S1, ““ASME Section XI, Subsection IWE,”“ and AMP XI.S4, ““10 CFR Part 50, Appendix J”“	No	II.A3.CP-150 II.B4.CP-150

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	031	BWR/PWR	Pressure retaining bolting, steel elements: downcomer pipes	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, ““ASME Section XI, Subsection IWE”“	No	II.A3.CP-148 II.B1.2.CP-117 II.B2.1.CP-117 II.B2.2.CP-117 II.B4.CP-148
	032	BWR/PWR	Prestressing system: tendons; anchorage components	Loss of material due to corrosion	AMP XI.S2, ““ASME Section XI, Subsection IWL”“	No	II.A1.C-10 II.B2.2.C-10
	033	BWR/PWR	Seals and gaskets	Loss of sealing due to wear, damage, erosion, tear, surface cracks, other defects	AMP XI.S4, ““10 CFR Part 50, Appendix J ““	No	II.A3.CP-41 II.B4.CP-41
	034	BWR/PWR	Service Level I coatings	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, or physical damage	AMP XI.S8, ““Protective Coating Monitoring and Maintenance”“	No	II.A3.CP-152 II.B4.CP-152
	035	BWR/PWR	Steel elements (accessible areas): liner; liner anchors; integral attachments, penetration sleeves, drywell	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, ““ASME Section XI, Subsection IWE,”“ and AMP XI.S4, ““10 CFR Part 50, Appendix J”“	Yes (SRP-SLR Section 3.5.2.2.1.3.1)	II.A1.CP-35 II.A2.CP-35 II.A3.CP-36 II.B1.1.CP-43 II.B1.2.CP-46 II.B2.1.CP-46 II.B2.2.CP-46

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			shell; drywell head; drywell shell in sand pocket regions; suppression chamber; drywell; embedded shell; region shielded by diaphragm floor (as applicable)				II.B3.1.CP-43 II.B3.2.CP-35 II.B4.CP-36
	036	BWR	Steel elements: drywell head; downcomers	Loss of material due to mechanical wear, including fretting	AMP XI.S1, ""ASME Section XI, Subsection IWE"""	No	II.B1.1.C-23 II.B1.2.C-23 II.B2.1.C-23 II.B2.2.C-23
	037	BWR	Steel elements: suppression chamber (torus) liner (interior surface)	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.S1, ""ASME Section XI, Subsection IWE,"" and AMP XI.S4, ""10 CFR Part 50, Appendix J"""	No	II.B1.2.C-49 II.B2.2.C-49
	038	BWR	Steel elements: suppression chamber shell (interior surface)	Cracking due to SCC	AMP XI.S1, ""ASME Section XI, Subsection IWE,"" and AMP XI.S4, ""10 CFR Part 50, Appendix J"""	Yes (SRP-SLR Section 3.5.2.2.1.6)	II.B3.1.C-24 II.B3.2.C-24
	039	BWR	Steel elements: vent line bellows	Cracking due to SCC	AMP XI.S1, ""ASME Section XI, Subsection	Yes (SRP-SLR Section 3.5.2.2.1.6)	II.B1.1.CP-50

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					IWE,”“ and AMP XI.S4, ““10 CFR Part 50, Appendix J”“		
M	040	BWR	Unbraced downcomers, steel elements: vent header; downcomers	Cracking due to cyclic loading (CLB fatigue analysis does not exist)	AMP XI.S1, ““ASME Section XI, Subsection IWE”“	Yes (SRP-SLR Section 3.5.2.2.1.5)	II.B2.1.CP-142 II.B2.2.CP-64
	041	BWR	Steel elements: drywell support skirt, steel elements (inaccessible areas): support skirt	None	None	No	II.B1.1.CP-44 II.B1.2.CP-114 II.B2.1.CP-114 II.B2.2.CP-114
M	042	BWR/PWR	Groups 1-3, 5, 7-9: concrete (inaccessible areas): foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Plant-specific aging management program or AMP XI.S6, “Structures Monitoring,” enhanced as necessary	Yes (SRP-SLR Section 3.5.2.2.2.1.1)	III.A1.TP-108 III.A2.TP-108 III.A3.TP-108 III.A5.TP-108 III.A7.TP-108 III.A8.TP-108 III.A9.TP-108
M	043	BWR/PWR	All Groups except Group 6: concrete (inaccessible areas): all	Cracking due to expansion from reaction with aggregates	Plant-specific aging management program or AMP XI.S6, “Structures Monitoring,”	Yes (SRP-SLR Section 3.5.2.2.2.1.2)	III.A1.TP-204 III.A2.TP-204 III.A3.TP-204 III.A4.TP-204

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					enhanced as necessary		III.A5.TP-204 III.A7.TP-204 III.A8.TP-204 III.A9.TP-204
	044	BWR/PWR	All Groups: concrete: all	Cracking and distortion due to increased stress levels from settlement	AMP XI.S6, ""Structures Monitoring"""	Yes (SRP-SLR Section 3.5.2.2.2.1.3)	III.A1.TP-30 III.A2.TP-30 III.A3.TP-30 III.A4.TP-30 III.A5.TP-30 III.A6.TP-30 III.A7.TP-30 III.A8.TP-30 III.A9.TP-30
D	045						
	046	BWR/PWR	Groups 1-3, 5-9: concrete: foundation; subfoundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	AMP XI.S6, ""Structures Monitoring"""	Yes (SRP-SLR Section 3.5.2.2.2.1.3)	III.A1.TP-31 III.A2.TP-31 III.A3.TP-31 III.A5.TP-31 III.A6.TP-31 III.A7.TP-31 III.A8.TP-31 III.A9.TP-31
M	047	BWR/PWR	Groups 1-5, 7-9: concrete (inaccessible areas): exterior	Increase in porosity and permeability; loss of strength due to leaching of calcium	Plant-specific aging management program or AMP XI.S6, "Structures Monitoring,"	Yes (SRP-SLR Section 3.5.2.2.2.1.4)	III.A1.TP-67 III.A2.TP-67 III.A3.TP-67 III.A4.TP-305

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			above- and below-grade; foundation	hydroxide and carbonation	enhanced as necessary		III.A5.TP-67 III.A7.TP-67 III.A8.TP-67 III.A9.TP-67
M	048	BWR/PWR	Groups 1-5: concrete: all	Reduction of strength and modulus due to elevated temperature (>150 °F general; >200 °F local)	Plant-specific aging management program or AMP XI.S6, “Structures Monitoring,” enhanced as necessary	Yes (SRP-SLR Section 3.5.2.2.2.2)	III.A1.TP-114 III.A2.TP-114 III.A3.TP-114 III.A4.TP-114 III.A5.TP-114
M	049	BWR/PWR	Groups 6 – concrete (inaccessible areas): exterior above- and below-grade; foundation; interior slab	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Plant-specific aging management program or AMP XI.S6, “Structures Monitoring,” enhanced as necessary	Yes (SRP-SLR Section 3.5.2.2.2.3.1)	III.A6.TP-110
M	050	BWR/PWR	Groups 6: concrete (inaccessible areas): all	Cracking due to expansion from reaction with aggregates	Plant-specific aging management program or AMP XI.S6, “Structures Monitoring,” enhanced as necessary	Yes (SRP-SLR Section 3.5.2.2.2.3.2)	III.A6.TP-220
M	051	BWR/PWR	Groups 6: concrete (inaccessible	Increase in porosity and permeability; loss of strength due to	Plant-specific aging management program or AMP XI.S6,	Yes (SRP-SLR Section 3.5.2.2.2.3.3)	III.A6.TP-109

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			areas): exterior above- and below-grade; foundation; interior slab	leaching of calcium hydroxide and carbonation	"Structures Monitoring," enhanced as necessary		
	052	BWR/PWR	Groups 7, 8 – steel components: tank liner	Cracking due to SCC; Loss of material due to pitting and crevice corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.4)	III.A7.T-23 III.A8.T-23
	053	BWR/PWR	Support members; welds; bolted connections; support anchorage to building structure	Cumulative fatigue damage due to cyclic loading (Only if CLB fatigue analysis exists)	TLAA, SRP-SLR Section 4.3 ""Metal Fatigue,"" and/or Section 4.7 ""Other Plant-Specific Time-Limited Aging Analyses""	Yes (SRP-SLR Section 3.5.2.2.2.5)	III.B1.1.T-26 III.B1.2.T-26 III.B1.3.T-26
M	054	BWR/PWR	All groups except 6: concrete (accessible areas): all	Cracking due to expansion from reaction with aggregates	AMP XI.S6, ""Structures Monitoring""	No	III.A1.TP-25 III.A2.TP-25 III.A3.TP-25 III.A4.TP-25 III.A5.TP-25 III.A7.TP-25 III.A8.TP-25 III.A9.TP-25
	055	BWR/PWR	Building concrete at locations of expansion and	Reduction in concrete anchor capacity due to local concrete	AMP XI.S6, ""Structures Monitoring""	No	III.B1.1.TP-42 III.B1.2.TP-42 III.B1.3.TP-42

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			grouted anchors; grout pads for support base plates	degradation/ service-induced cracking or other concrete aging mechanisms			III.B2.TP-42 III.B3.TP-42 III.B4.TP-42 III.B5.TP-42
	056	BWR/PWR	Concrete: exterior above- and below-grade; foundation; interior slab	Loss of material due to abrasion; cavitation	AMP XI.S7, ““Inspection of Water-Control Structures Associated with Nuclear Power Plants”“ or the Federal Energy Regulatory Commission (FERC)/ U.S. Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.T-20
	057	BWR/PWR	Constant and variable load spring hangers; guides; stops	Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear	AMP XI.S3, “ASME Section XI, Subsection IWF”	No	III.B1.1.T-28 III.B1.2.T-28 III.B1.3.T-28
	058	BWR/PWR	Earthen water-control structures: dams; embankments;	Loss of material; loss of form due to erosion, settlement, sedimentation, frost	AMP XI.S7, “Inspection of Water-Control Structures Associated with Nuclear Power	No	III.A6.T-22

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			reservoirs; channels; canals and ponds	action, waves, currents, surface runoff, seepage	Plants” or the FERC/U.S. Army Corp of Engineers dam inspections and maintenance programs.		
	059	BWR/PWR	Group 6: concrete (accessible areas): all	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	AMP XI.S7, “Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC/U.S. Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-38
	060	BWR/PWR	Group 6: concrete (accessible areas): exterior above- and below-grade; foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.S7, “Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC/U.S. Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-36

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	061	BWR/PWR	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	AMP XI.S7, “Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC/U.S. Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-37
	062	BWR/PWR	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	AMP XI.S7, “Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC/U.S. Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-223
	063	BWR/PWR	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	AMP XI.S6, “Structures Monitoring”	No	III.A1.TP-24 III.A2.TP-24 III.A3.TP-24 III.A5.TP-24 III.A7.TP-24 III.A8.TP-24 III.A9.TP-24

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	064	BWR/PWR	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	AMP XI.S6, “Structures Monitoring”	No	III.A1.TP-23 III.A2.TP-23 III.A3.TP-23 III.A5.TP-23 III.A7.TP-23 III.A8.TP-23 III.A9.TP-23
	065	BWR/PWR	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	AMP XI.S6, “Structures Monitoring”	No	III.A1.TP-212 III.A1.TP-27 III.A2.TP-212 III.A2.TP-27 III.A3.TP-212 III.A3.TP-27 III.A5.TP-212 III.A5.TP-27 III.A6.TP-104 III.A7.TP-212 III.A7.TP-27 III.A8.TP-212 III.A8.TP-27 III.A9.TP-212 III.A9.TP-27
	066	BWR/PWR	Groups 1-5, 7, 9: concrete (accessible areas):	Cracking; loss of bond; and loss of material (spalling, scaling) due to	AMP XI.S6, “Structures Monitoring”	No	III.A1.TP-26 III.A2.TP-26 III.A3.TP-26 III.A4.TP-26

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			interior and above-grade exterior	corrosion of embedded steel			III.A5.TP-26 III.A7.TP-26 III.A9.TP-26
	067	BWR/PWR	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	AMP XI.S6, “Structures Monitoring”	No	III.A1.TP-28 III.A1.TP-29 III.A2.TP-28 III.A2.TP-29 III.A3.TP-28 III.A3.TP-29 III.A4.TP-28 III.A5.TP-28 III.A5.TP-29 III.A6.TP-107 III.A7.TP-28 III.A7.TP-29 III.A8.TP-29 III.A9.TP-28 III.A9.TP-29
	068	BWR/PWR	High-strength steel structural bolting	Cracking due to SCC	AMP XI.S3, “ASME Section XI, Subsection IWF”	No	III.B1.1.TP-41
D	069						
	070	BWR/PWR	Masonry walls: all	Cracking due to restraint shrinkage, creep, aggressive environment	AMP XI.S5, “Masonry Walls”	No	III.A1.T-12 III.A2.T-12 III.A3.T-12

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							III.A5.T-12 III.A6.T-12
	071	BWR/PWR	Masonry walls: all	Loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.S5, “Masonry Walls”	No	III.A1.TP-34 III.A2.TP-34 III.A3.TP-34 III.A5.TP-34 III.A6.TP-34
	072	BWR/PWR	Seals; gasket; moisture barriers (caulking, flashing, and other sealants)	Loss of sealing due to wear, damage, erosion, tear, surface cracks, other defects	AMP XI.S6, “Structures Monitoring”	No	III.A6.TP-7
	073	BWR/PWR	Service Level I coatings	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, or physical damage	AMP XI.S8, “Protective Coating Monitoring and Maintenance”	No	III.A4.TP-301
	074	BWR/PWR	Sliding support bearings; sliding support surfaces	Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear	AMP XI.S6, “Structures Monitoring”	No	III.B2.TP-46 III.B2.TP-47 III.B4.TP-46 III.B4.TP-47

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	075	BWR/PWR	Sliding surfaces	Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-45 III.B1.2.TP-45 III.B1.3.TP-45
	076	BWR/PWR	Sliding surfaces: radial beam seats in BWR drywell	Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear	AMP XI.S6, "Structures Monitoring"	No	III.A4.TP-35
	077	BWR/PWR	Steel components: all structural steel	Loss of material due to corrosion	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-302 III.A2.TP-302 III.A3.TP-302 III.A4.TP-302 III.A5.TP-302 III.A7.TP-302 III.A8.TP-302
E	078	BWR/PWR	Stainless steel fuel pool liner	Cracking due to SCC; loss of material due to pitting and crevice corrosion	AMP XI.M2, "Water Chemistry," and monitoring of the spent fuel pool water level and leakage from the leak chase channels.	No	III.A5.T-14

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	079	BWR/PWR	Steel components: piles	Loss of material due to corrosion	AMP XI.S6, "Structures Monitoring"	No	III.A3.TP-219
	080	BWR/PWR	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-248 III.A2.TP-248 III.A3.TP-248 III.A4.TP-248 III.A5.TP-248 III.A6.TP-248 III.A7.TP-248 III.A8.TP-248 III.A9.TP-248 III.B2.TP-248 III.B3.TP-248 III.B4.TP-248 III.B5.TP-248
	081	BWR/PWR	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-226 III.B1.2.TP-226 III.B1.3.TP-226
	082	BWR/PWR	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-274 III.A2.TP-274 III.A3.TP-274 III.A4.TP-274 III.A5.TP-274 III.A7.TP-274 III.A8.TP-274 III.A9.TP-274 III.B2.TP-274

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							III.B3.TP-274 III.B4.TP-274 III.B5.TP-274
	083	BWR/PWR	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S7, “Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC/U.S. Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-221
D	084						
	085	BWR/PWR	Structural bolting	Loss of material due to pitting, crevice corrosion	AMP XI.M2, “Water Chemistry,” and AMP XI.S3, “ASME Section XI, Subsection IWF”	No	III.B1.1.TP-232 III.B1.2.TP-232 III.B1.3.TP-232
	086	BWR/PWR	Structural bolting	Loss of material due to pitting, crevice corrosion	AMP XI.S3, “ASME Section XI, Subsection IWF”	No	III.B1.1.TP-235 III.B1.2.TP-235 III.B1.3.TP-235
	087	BWR/PWR	Structural bolting	Loss of preload due to self-loosening	AMP XI.S3, “ASME Section XI, Subsection IWF”	No	III.B1.1.TP-229 III.B1.2.TP-229 III.B1.3.TP-229
	088	BWR/PWR	Structural bolting	Loss of preload due to self-loosening	AMP XI.S6, “Structures Monitoring”	No	III.A1.TP-261 III.A2.TP-261

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							III.A3.TP-261 III.A4.TP-261 III.A5.TP-261 III.A6.TP-261 III.A7.TP-261 III.A8.TP-261 III.A9.TP-261 III.B2.TP-261 III.B3.TP-261 III.B4.TP-261 III.B5.TP-261
	089	PWR	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to boric acid corrosion	AMP XI.M10, “Boric Acid Corrosion”	No	III.B1.1.T-25 III.B1.1.TP-3 III.B1.2.T-25 III.B1.3.TP-3 III.B1.2.TP-3 III.B2.T-25 III.B2.TP-3 III.B3.T-25 III.B3.TP-3 III.B4.T-25 III.B4.TP-3 III.B5.T-25 III.B5.TP-3
	090	BWR/PWR	Support members; welds; bolted connections;	Loss of material due to general (steel only),	AMP XI.M2, “Water Chemistry,” and AMP	No	III.B1.1.TP-10

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			support anchorage to building structure	pitting, crevice corrosion	XI.S3, “ASME Section XI, Subsection IWF”		
	091	BWR/PWR	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to general, pitting corrosion	AMP XI.S3, “ASME Section XI, Subsection IWF”	No	III.B1.1.T-24 III.B1.2.T-24 III.B1.3.T-24
	092	BWR/PWR	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to general, pitting corrosion	AMP XI.S6, “Structures Monitoring”	No	III.B2.TP-43 III.B3.TP-43 III.B4.TP-43 III.B5.TP-43
	093	BWR/PWR	Galvanized steel support members; welds; bolted connections; support anchorage to building structure	Loss of material due to pitting, crevice corrosion	AMP XI.S6, “Structures Monitoring”	No	III.B2.TP-6 III.B4.TP-6
	094	BWR/PWR	Vibration isolation elements	Reduction or loss of isolation function due to radiation hardening, temperature, humidity,	AMP XI.S3, “ASME Section XI, Subsection IWF,” and/or AMP	No	III.B1.1.T-33 III.B1.2.T-33 III.B1.3.T-33 III.B4.TP-44

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
				sustained vibratory loading	XI.S6, "Structures Monitoring"		
	095	BWR/PWR	Galvanized steel support members; welds; bolted connections; support anchorage to building structure	None	None	No	III.B1.1.TP-8 III.B1.2.TP-8 III.B1.3.TP-8 III.B2.TP-8 III.B3.TP-8 III.B4.TP-8 III.B5.TP-8
	096	BWR/PWR	Groups 6: concrete (accessible areas): all	Cracking due to expansion from reaction with aggregates	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants"	No	III.A6.T-34
M	097	BWR/PWR	Group 4: Concrete (reactor cavity area proximate to the reactor vessel): reactor (primary/biological) shield wall; sacrificial shield wall; reactor vessel support/pedestal structure	Reduction of strength; loss of mechanical properties due to irradiation (i.e., radiation interactions with material and radiation-induced heating)	Plant-specific aging management program or plant specific enhancements to selected AMPs	Yes (SRP-SLR Section 3.5.2.2.2.6)	III.A4.T-35

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	098	BWR/PWR	Stainless steel, aluminum alloy support members; welds; bolted connections; support anchorage to building structure	None	None	No	III.B1.1.TP-4 III.B1.2.TP-4 III.B1.3.TP-4 III.B2.TP-4 III.B3.TP-4 III.B4.TP-4 III.B5.TP-4
	099	BWR/PWR	Aluminum, stainless steel support members; welds; bolted connections; support anchorage to building structure	Loss of material due to pitting and crevice corrosion, cracking due to SCC	AMP XI.M32, “One-Time Inspection,” AMP XI.S3, “ASME Section XI, Subsection IWF,” or AMP XI.M36, “External Surfaces Monitoring of Mechanical Components”	Yes (SRP-SLR Section 3.5.2.2.2.4)	III.B1.1.T-36a III.B1.1.T-36b III.B1.1.T-36c III.B1.2.T-36a III.B1.2.T-36b III.B1.2.T-36c III.B1.3.T-36a III.B1.3.T-36b III.B1.3.T-36c
	100	BWR/PWR	Aluminum, stainless steel support members; welds; bolted connections; support anchorage to building structure	Loss of material due to pitting and crevice corrosion, cracking due to SCC	AMP XI.M32, “One-Time Inspection,” AMP XI.S6, “Structures Monitoring,” or AMP XI.M36, “External Surfaces Monitoring of Mechanical Components”	Yes (SRP-SLR Section 3.5.2.2.2.4)	III.B2.T-37a III.B2.T-37b III.B2.T-37c III.B3.T-37a III.B3.T-37b III.B3.T-37c III.B4.T-37a III.B4.T-37b III.B4.T-37c III.B5.T-37a

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
							III.B5.T-37b III.B5.T-37c
N	101	BWR/PWR	Wooden Poles	Loss of material; changes in material properties due to weathering, chemical degradation, insect infestation, repeated wetting and drying, fungal decay	Plant-specific aging management program, or AMP XI.S6, “Structures Monitoring,” enhanced as necessary	Yes (SRP-SLR Section 3.5.2.2.2.7)	III.B5.T-306
N	102	BWR/PWR	Reactor vessel steel structural supports, their assembled components (e.g., reactor vessel steel support skirt assembly; reactor vessel support girders/columns structure; neutron shield tank; reactor vessel support sliding feet assembly; reactor vessel seismic restraints; welds;	Reduction in fracture toughness and/or loss of intended function (mechanical/structural) due to irradiation-induced combined mechanisms	Plant-specific aging management program, or plant-specific enhancements to selected GALL-SLR AMPs (e.g., AMP XI.S3, “ASME Section XI, Subsection IWF,” and/or AMP XI.S6, “Structures Monitoring”)	Yes (SRP-SLR Section 3.5.2.2.2.8)	III.A4.T-36 III.A4.T-37

Table 3.5-1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR Report) (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			bolted connections; support anchorage to building structure)				
N	103	BWR/PWR	Reactor vessel support sliding surfaces, other special components (e.g., special coatings)	Loss of intended function (mechanical) due to irradiation	Plant-specific aging management program or plant-specific enhancement to selected GALL-SLR AMPs	Yes (SRP-SLR Section 3.5.2.2.2.8)	III.A4.TP-37

AMP = Aging Management Program; ASME = ASME International; BWR = boiling water reactor; CFR = *Code of Federal Regulations;* CLB = current licensing basis; CRD = control rod drive; FERC = Federal Energy Regulatory Commission; GALL-SLR = Generic Aging Lessons Learned for Subsequent License Renewal; PWR = pressurized water reactor; SRP-SLR = Standard Review Plan for Review of Subsequent License Renewal; TLAA = Time-Limited Aging Analyses.

Table 3.5-2 AMPs and Additional Guidance Appendices Recommended for Containments, Structures, and Component Supports

Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report Chapter/Aging Management Program (AMP)	Program Name
AMP XI.M2	Water Chemistry
AMP XI.M10	Boric Acid Corrosion
AMP XI.M32	One-time inspection
AMP XI.M36	External Surfaces Monitoring of Mechanical Components
AMP XI.S1	ASME Section XI, Subsection IWE
AMP XI.S2	ASME Section XI, Subsection IWL
AMP XI.S3	ASME Section XI, Subsection IWF
AMP XI.S4	10 *Code of Federal Regulations* Part 50, Appendix J
AMP XI.S5	Masonry Walls
AMP XI.S6	Structures Monitoring
AMP XI.S7	Inspection of Water-Control Structures Associated with Nuclear Power Plants
AMP XI.S8	Protective Coating Monitoring and Maintenance
GALL-SLR Report Appendix A	Quality Assurance for Aging Management Programs
GALL-SLR Report Appendix B	Operating Experience for Aging Management Programs
Standard Review Plan for Review of Subsequent License Renewal Appendix A.1	Aging Management Review—Generic (Branch Technical Position RLSB-1)

AMP = Aging Management Program; ASME = ASME International; GALL-SLR = Generic Aging Lessons Learned for Subsequent License Renewal.

3.6 Aging Management of Electrical and Instrumentation and Controls

Review Responsibilities

Primary—The branch(es) assigned responsibility by the PM for the safety review of the SLRA.

Secondary—None

3.6.1 Areas of Review

This section addresses the AMR and the AMPs of the electrical and I&C. For a recent vintage plant, the information related to the electrical and I&C is contained in Chapter 7, "Instrumentation and Controls," and Chapter 8, "Electric Power," of the plant's FSAR, consistent with the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" NRC 2021-TN8013). For older plants, the location of applicable information is plant-specific because an older plant's FSAR may have predated NUREG–0800. Typical electrical and I&C components that are subject to an AMR for SLR are electrical cables and connections, metal enclosed buses, cable bus, fuse holders, high-voltage insulators, transmission conductors and connections, and switchyard bus and connections.

The responsible review organization is to review the following SLRA AMR and AMP items assigned to it, per SRP-SLR Section 1.2:

AMRs

- AMR results consistent with the GALL-SLR Report
- AMR results for which further evaluation is recommended
- AMR results not consistent with or not addressed in the GALL-SLR Report

AMPs

- Consistent with GALL-SLR Report AMPs
- Plant-specific AMPs

FSAR Supplement

- The responsible review organization is to review the FSAR Supplement associated with each assigned AMP.

3.6.2 Acceptance Criteria

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the NRC regulations in 10 CFR 54.21.

3.6.2.1 Aging Management Review Results Consistent with the Generic Aging Lessons Learned for Subsequent License Renewal Report

The AMRs and the AMPs applicable to the electrical and I&C components are described and evaluated in Chapter VI of the GALL-SLR Report.

The applicant's SLRA should provide sufficient information for the NRC reviewer to confirm that the specific SLRA AMR item and the associated SLRA AMP are consistent with the cited GALL-SLR Report AMR item. The reviewer should then confirm that the SLRA AMR item is consistent with the GALL-SLR Report AMR item to which it is compared.

When the applicant is crediting a different AMP than recommended in the GALL-SLR Report, the reviewer should confirm that the alternate AMP is valid to use for aging management and will be capable of managing the effects of aging as adequately as the AMP recommended by the GALL-SLR Report.

3.6.2.2 Aging Management Review Results for Which Further Evaluation Is Recommended by the Generic Aging Lessons Learned for Subsequent License Renewal Report

The basic acceptance criteria defined in Section 3.6.2.1 need to be applied first for all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL-SLR Report AMR item to which the SLRA AMR item is compared identifies that "Further Evaluation Recommended," then additional criteria apply as identified by the GALL-SLR Report for each of the following aging effect/aging mechanism combinations. Refer to Table 3.6-1, comparing the "Further Evaluation Recommended" and the "GALL-SLR Item" column, for the AMR items that reference the following subsections.

3.6.2.2.1 Electrical Equipment Subject to Environmental Qualification

EQ is a TLAA as defined in 10 CFR 54.3 (TN4878). The 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-SLR.

3.6.2.2.2 Reduced Insulation Resistance Due to Age Degradation of Cable Bus Arrangements Caused by Intrusion of Moisture, Dust, Industrial Pollution, Rain, Ice, Photolysis, Ohmic Heating and Loss of Strength of Support Structures and Louvers of Cable Bus Arrangements Due to General Corrosion and Exposure to Air Outdoor

Reduced insulation resistance due to age degradation of cable bus caused by intrusion of moisture, dust, industrial pollution, rain, ice, photolysis (for ultraviolet sensitive material only), ohmic heating and loss of strength of support structures, covers or louvers of cable bus arrangements due to general corrosion or exposure to air outdoor could occur in cable bus assemblies. Cable bus is a variation of metal enclosed bus (MEB) which is similar in construction to an MEB, but instead of segregated or nonsegregated electrical buses, cable bus consists of a fully enclosed metal enclosure that utilizes three-phase insulated power cables installed on insulated support blocks. Cable bus may omit the top cover or use a louvered top cover and enclosure. Both the cable bus and enclosures are not sealed against intrusion of dust, industrial pollution, moisture, rain, and ice and therefore may introduce debris into the internal cable bus assembly.

Consequently, cable bus construction and arrangements are such that it may not readily fall under a specific GALL-SLR Report AMP (e.g., GALL-SLR Report AMP XI.E1 and AMP XI.E4). The GALL-SLR Report AMP XI.E1 calls for a visual inspection of accessible insulated cables and connections subject to an adverse localized environment which may not be applicable to cable bus due to inaccessibility or applicability of the aging mechanisms and effects. The GALL-SLR Report AMP XI.E4 includes tests and inspections of the internal and external portions of the MEB. The MEB internal and external inspections and tests may not be applicable to cable bus aging mechanisms and effects. Therefore, the GALL-SLR Report recommends cable bus aging mechanisms and effects be evaluated as a plant-specific further evaluation. The evaluation includes associated AMPs: AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” and AMP XI.S6, “Structures Monitoring.” Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

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 Preload for Transmission Conductors, Switchyard Bus, and Connections

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 preload could occur in transmission conductors and connections, and in switchyard bus and connections. The GALL-SLR Report recommends further evaluation of a plant-specific AMP to demonstrate that this aging effect is adequately managed. Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.6.2.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in BTP IQMB-1 (Appendix Section A.2 of this SRP-SLR).

3.6.2.2.5 Ongoing Review of Operating Experience

Acceptance criteria are described in Appendix SectionA.4, “Operating Experience for Aging Management Programs.”

3.6.2.3 Aging Management Review Results Not Consistent With or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report

Acceptance criteria are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.6.2.4 Aging Management Programs

For those AMPs that will be used for aging management and that are based on the program elements of an AMP in the GALL-SLR Report, the NRC reviewer performs an audit of AMPs credited in the SLRA to confirm consistency with the GALL-SLR Report AMPs identified in Chapters X and XI.

If the applicant identifies an exception to any of the program elements of the cited GALL-SLR Report AMP, the SLRA AMP should include a basis demonstrating how the criteria of 10 CFR 54.21(a)(3) (TN4878) would still be met. The NRC reviewer should then confirm that the SLRA AMP, with all exceptions, would satisfy the criteria of 10 CFR 54.21(a)(3). If, while assessing the SLRA AMP, the reviewer identifies a difference between the SLRA AMP and the GALL-SLR Report AMP that should have been identified as an exception to the GALL-SLR Report AMP, the difference should be reviewed and dispositioned appropriately. The reviewer should document the disposition of all SLRA-defined exceptions and NRC staff-identified differences.

The SLRA should identify any enhancements that are needed to permit an existing AMP to be declared consistent with the GALL-SLR Report AMP to which the SLRA AMP is compared. The reviewer is to confirm that the enhancement, when implemented, would allow the existing plant AMP to be consistent with the GALL-SLR Report AMP and also that the applicant has a commitment in the FSAR Supplement to implement the enhancement prior to the subsequent period of extended operation. The reviewer should evaluate and document the disposition of all enhancements.

If the applicant chooses to use a plant-specific program that is not a GALL-SLR Report AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.6.2.5 Final Safety Analysis Report Supplement

The summary description of the programs and activities for managing the effects of aging for the subsequent period of extended operation in the FSAR Supplement should be sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59 (TN249). The description should contain information associated with the bases for determining that aging effects are managed during the subsequent period of extended operation. The description should also contain any future aging management activities, including commitments, license conditions, enhancements, and exceptions, to be implemented prior to or during the subsequent period of extended operation. Table X-01 and Table XI-01 of the GALL-SLR Report provide examples of the type of information to be included in the FSAR Supplement. Table 3.6-2 lists the programs that are applicable for this SRP-SLR Section.

3.6.3 Review Procedures

For each area of review, the following review procedures are to be followed:

3.6.3.1 Aging Management Review Results Consistent With the Generic Aging Lessons Learned for Subsequent License Renewal Report

The applicant may reference the GALL-SLR Report in its SLRA, as appropriate, and demonstrate that the AMRs and AMPs at its facility are consistent with those reviewed and approved in the GALL-SLR Report. The reviewer should not conduct a re-review of the substance of the matters described in the GALL-SLR Report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL-SLR Report, the reviewer should find acceptable the applicant’s reference to the GALL-SLR Report in its SLRA. In making this determination, the reviewer confirms that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also confirms that the applicable aging effects, have been addressed based on the staff’s review of industry and plant-specific OE.

Furthermore, the reviewer should confirm that the applicant has addressed OE identified after the issuance of the GALL-SLR Report. Performance of this review includes confirming that the applicant has identified those aging effects for the electrical and I&C components that are contained in the GALL-SLR Report as applicable to its plant.

3.6.3.2 Aging Management Review Results for Which Further Evaluation Is Recommended by the Generic Aging Lessons Learned for Subsequent License Renewal Report

The basic review procedures defined in Section 3.6.3.1 need to be applied first for all of the AMRs and AMPs provided in this section. In addition, if the GALL-SLR AMR item to which the SLRA AMR item is compared identifies that “Further Evaluation Recommended,” then additional criteria apply as identified by the GALL-SLR Report for each of the following aging effect/aging mechanism combinations.

3.6.3.2.1 Electrical Equipment Subject to Environmental Qualification

The EQ is a TLAA as defined in 10 CFR 54.3 (TN4878). The TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The NRC staff reviews the evaluation of this TLAA separately following the guidance in Section 4.4 of this SRP-SLR.

3.6.3.2.2 Reduced Insulation Resistance Due to Age Degradation of Cable Bus Arrangements Caused by Intrusion of Moisture, Dust, Industrial Pollution, Rain, Ice, Photolysis, Ohmic Heating and Loss of Strength of Support Structures and Louvers of Cable Bus Arrangements Due to General Corrosion and Exposure to Air Outdoor

The GALL-SLR Report recommends a plant-specific Cable Bus AMP for the management of reduced insulation resistance due to age degradation of cable bus caused by intrusion of moisture, dust, industrial pollution, rain, ice, photolysis (for ultraviolet sensitive material only), ohmic heating, and loss of strength of support structures, covers or louvers of cable bus arrangements due to general corrosion or exposure to air outdoor. The reviewer evaluates the applicant's proposed program on a case-by-case basis to verify that an adequate program will be in place for the management of these aging effects.

3.6.3.2.3 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 Preload for Transmission Conductors, Switchyard Bus, and Connections

The GALL-SLR Report recommends a plant-specific AMP for the management of 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 preload in transmission conductors and connections, and in switchyard bus and connections. The reviewer evaluates the applicant's proposed program on a case-by-case basis to verify that an adequate program will be in place for the management of these aging effects.

3.6.3.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

The applicant's AMPs for SLR should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered by 10 CFR Part 50 (TN249), Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an AMR for SLR. Nevertheless, the applicant has the option to expand the scope of its 10 CFR Part 50, Appendix B program to include these components and address these program elements. If the applicant chooses this option, the reviewer confirms that the applicant has documented such a commitment in the FSAR Supplement. If the applicant chooses alternative means, the branch responsible for quality assurance should be requested to review the applicant's proposal on a case-by-case basis.

3.6.3.2.5 Ongoing Review of Operating Experience

The applicant's AMPs should contain the elements of OE. The reviewer verifies that the applicant has appropriate programs or processes for the ongoing review of both plant-specific and industry OE concerning age-related degradation and aging management. Such reviews are used to verify that the AMPs are effective to manage the aging effects for which they are created. The AMPs are either enhanced or new AMPs are developed, as appropriate, when it is determined through the evaluation of the OE that the effects of aging may not be adequately managed. Additional information is in Appendix Section A.4, "Operating Experience for Aging Management Programs" of this SRP-SLR. In addition, the reviewer confirms that the applicant has provided an appropriate summary description of these activities in the FSAR Supplement.

3.6.3.3 Aging Management Review Results Not Consistent with or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report

The reviewer should confirm that the applicant, in the SLRA, has identified applicable aging effects, listed the appropriate combination of materials and environments, and has credited AMPs that will adequately manage the aging effects. The AMP credited by the applicant could be an AMP that is described and evaluated in the GALL-SLR Report or in a plant-specific program. The review procedures are described in BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.6.3.4 Aging Management Programs

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR Report AMP. If the applicant identifies, in the SLRA AMP, an exception to any of the program elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3) (TN4878). If the reviewer identifies a difference, not identified by the SLRA, between the SLRA AMP and the GALL-SLR Report AMP with which the SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions, or differences. The AMPs evaluated in the GALL-SLR Report pertinent to the electrical and I&C components are summarized in Table 3.6-1 of this SRP-SLR. The "GALL-SLR Item" column identifies the AMR item numbers in the GALL-SLR Report, Chapters VI, presenting detailed information summarized by this row.

If the applicant chooses to use a plant-specific program that is not a GALL-SLR Report AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix Section A.1 of this SRP-SLR).

3.6.3.5 Final Safety Analysis Report Supplement

The reviewer confirms that the applicant has provided in its FSAR Supplement information equivalent to that provided in GALL-SLR Table X-01 and Table XI-01 for aging management of the Electrical and I&C System. Table 3.6-2 lists the AMPs that are applicable for this SRP-SLR Section. The reviewer also confirms that the applicant has provided information equivalent to that in GALL-SLR Table X-01 and Table XI-01 and Section 3.6.3.3 of this SRP-SLR, "Aging Management Review Results Not Consistent with or Not Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report."

The NRC staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursuant to 10 CFR 50.71(e)(4) (TN249). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR Supplement before the license is renewed, no condition will be necessary.

An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to make sure that the applicant will complete these activities no later than the committed date.

3.6.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of this section, then an evaluation finding similar to the following text should be included in the NRC staff's SER:

> On the basis of its review the NRC staff concludes that the applicant has demonstrated that the aging effects associated with the electrical and I&C components will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the subsequent period of extended operation, as required by 10 CFR 54.21(a)(3) (TN4878).
>
> The NRC staff also reviewed the applicable FSAR Supplement program summary descriptions and concludes that they adequately describe the AMPs credited for managing aging of electrical and I&C, as required by 10 CFR 54.21(d).

3.6.5 Implementation

Except for cases in which the applicant proposes an alternative method for complying with specified portions of NRC regulations, the NRC staff members follow the methods described herein in their evaluation of conformance with NRC regulations. The staff evaluates these alternatives and finds them acceptable if the staff determines that the alternatives provide reasonable assurance that the component's intended functions will be maintained.

3.6.6 References

1. NRC. NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." Agencywide Documents Access and Management System (ADAMS) Accession No. ML070630046. Washington, DC: U.S. Nuclear Regulatory Commission. March 2007. NRC 2021-TN8013

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
E	001	Boiling water reactor (BWR)/ pressurized water reactor (PWR)	Electrical equipment subject to 10 *Code of Federal Relations* (CFR) 50.49 Environmental Qualification (EQ) requirements composed of various polymeric and metallic materials in plant areas subject to a harsh environment i.e., loss of coolant accident (LOCA), high energy line break, or post-LOCA environment or, an adverse localized environment for the most limiting qualified condition for temperature, radiation, or moisture for the component material (e.g., cable or connection insulation).	Various aging effects due to various mechanisms in accordance with 10 CFR 50.49	The EQ is a TLAA to be evaluated for the subsequent period of extended operation. See the Standard Review Plan (SRP), Section 4.4, "Environmental Qualification (EQ) of Electric Equipment," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1)(i) and (ii). See AMP X.E1, "Environmental Qualification (EQ) of Electric Equipment," of this report for meeting the requirements of 10 CFR 54.21(c)(1)(i)-(iii).	Yes, TLAA (Standard Review Plan for Review of Subsequent License Renewal [SRP-SLR] Section 3.6.2.2.1)	VI.B.L-05

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
M	002	BWR/PWR	High-voltage electrical insulators composed of porcelain; malleable iron; aluminum; galvanized steel; cement; toughened glass; polymers; silicone rubber; fiber glass, aluminum alloy exposed to air – outdoor	Loss of material on metallic connectors due to mechanical wear or corrosion caused by movement of transmission conductors due to significant wind	AMP XI.E7, “High-Voltage Insulators”	No	VI.A.LP-32
M	003	BWR/PWR	High-voltage electrical insulators composed of porcelain; malleable iron; aluminum; galvanized steel; cement; toughened glass; polymers; silicone rubber; fiber glass, aluminum alloy exposed to air – outdoor	Reduced electrical insulation resistance due to presence of cracks, foreign debris, salt, dust, cooling tower plume or industrial effluent contamination, peeling of silicone rubber sleeves for polymer	AMP XI.E7, “High-Voltage Insulators”	No	VI.A.LP-28

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
				insulators, or degradation of glazing on porcelain insulators			
E	004	BWR/PWR	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 aluminum conductor steel reinforced (ACSR)	Yes (SRP-SLR Section 3.6.2.2.3)	VI.A.LP-38
	005	BWR/PWR	Transmission connectors composed of aluminum; steel exposed to air – outdoor	Increased electrical resistance of connection due to oxidation or loss of preload	A plant-specific aging management program is to be evaluated	Yes (SRP-SLR Section 3.6.2.2.3)	VI.A.LP-48
	006	BWR/PWR	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 electrical resistance of connection due to oxidation or loss of preload	A plant-specific aging management program is to be evaluated	Yes (SRP-SLR Section 3.6.2.2.3)	VI.A.LP-39

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
E	007	BWR/PWR	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 All Aluminum Conductor (AAC), aluminum conductor aluminum alloy reinforced (ACAR), and ACSR	Yes (SRP-SLR Section 3.6.2.2.3)	VI.A.LP-47
E	008	BWR/PWR	Electrical insulation for electrical cables and connections (including terminal blocks, etc.) composed of various organic polymers (e.g., ethylene propylene rubber [EPR], silicone rubber [SR], ethylene propylene diene monosomer [EPDM], cross-linked polyethylene [XLPE]) exposed to an adverse localized	Reduced electrical insulation resistance due to thermal/ thermoxidative degradation of organics, radiolysis, and photolysis (ultraviolet [UV] sensitive materials only) of organics; radiation-induced oxidation;	AMP XI.E1, "Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No	VI.A.LP-33

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			environment caused by heat, radiation, or moisture	moisture intrusion			
	009	BWR/PWR	Electrical insulation for electrical cables and connections used in instrumentation circuits that are sensitive to reduction in conductor IR composed of various organic polymers (e.g., EPR, SR, EPDM, XLPE) exposed to an adverse localized environment caused by heat, radiation, or moisture	Reduced electrical insulation resistance (IR) due to thermal/ thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	AMP XI.E2, “Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits”	No	VI.A.LP-34
	010	BWR/PWR	Electrical conductor insulation for inaccessible power, instrumentation, and control cables (e.g., installed in duct bank, buried conduit	Reduced electrical IR or degraded dielectric strength due to significant moisture	AMP XI.E3A, “Electrical Insulation for Inaccessible Medium-Voltage Power Cables Not Subject To 10 CFR 50.49 Environmental	No	VI.A.LP-35a VI.A.LP-35b VI.A.LP-35c

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			or direct buried) composed of various organic polymers such as EPR, SR, EPDM, XLPE, butyl rubber, and combined thermoplastic jacket/insulation shield exposed to an adverse localized environment caused by significant moisture		Qualification Requirements," AMP XI.E3B, "Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements," or AMP XI.E3C, "Electrical Insulation for Inaccessible Low-Voltage Power Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements"		
	011	BWR/PWR	Metal enclosed bus (MEB): enclosure assemblies composed of elastomers exposed to air – indoor controlled or	Surface cracking, crazing, scuffing, dimensional change (e.g., "ballooning" and "necking"), shrinkage,	AMP XI.E4, "Metal Enclosed Bus," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VI.A.LP-29

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
			uncontrolled, air – outdoor	discoloration, hardening or loss of strength due to elastomer degradation			
	012	BWR/PWR	MEB: bus/connections composed of various metals used for electrical bus and connections exposed to air – indoor controlled or uncontrolled, air – outdoor	Increased electrical resistance of connection due to the loosening of bolts caused by thermal cycling and ohmic heating	AMP XI.E4, “Metal Enclosed Bus”	No	VI.A.LP-25
	013	BWR/PWR	Metal enclosed bus: electrical insulation; insulators composed of porcelain; xenoy; thermoplastic organic polymers exposed to air – indoor controlled or uncontrolled, air – outdoor	Reduced electrical IR due to thermal/ thermoxidative degradation of organics/thermo plastics, radiation-induced oxidation, moisture/debris intrusion, and ohmic heating	AMP XI.E4, “Metal Enclosed Bus”	No	VI.A.LP-26

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	014	BWR/PWR	MEB: external surface of enclosure assemblies composed of steel exposed to air – indoor uncontrolled, air – outdoor	Loss of material due to general, pitting, crevice corrosion	AMP XI.E4, “Metal Enclosed Bus,” or AMP XI.S6, “Structures Monitoring”	No	VI.A.LP-43
	015	BWR/PWR	MEB: external surface of enclosure assemblies composed of galvanized steel; aluminum exposed to air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.E4, “Metal Enclosed Bus,” or AMP XI.S6, “Structures Monitoring”	No	VI.A.LP-42
	016	BWR/PWR	Fuse holders (not part of active equipment): metallic clamps composed of various metals used for electrical connections exposed to air – indoor uncontrolled	Increased electrical resistance of connection due to chemical contamination, corrosion, and oxidation (in an air, indoor controlled environment, increased resistance of connection due	AMP 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 and effects due to chemical	No	VI.A.LP-23

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
				to chemical contamination, corrosion and oxidation do not apply)	contamination, corrosion, and oxidation.		
	017	BWR/PWR	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 electrical resistance of connection due to fatigue from ohmic heating, thermal cycling, electrical transients	AMP XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are not subject to fatigue due to ohmic heating, thermal cycling, electrical transients.	No	VI.A.L-07
	018	BWR/PWR	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 electrical resistance of connection due to fatigue caused by frequent fuse removal/manipulation or vibration	AMP XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are not subject to fatigue caused by frequent fuse	No	VI.A.LP-31

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
					removal/manipulation or vibration.		
	019	BWR/PWR	Cable connections (metallic parts) composed of various metals used for electrical contacts exposed to air – indoor controlled or uncontrolled, air – outdoor	Increased electrical resistance of connection due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	AMP XI.E6, “Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements”	No	VI.A.LP-30
	020	PWR	Electrical connector contacts for electrical connectors composed of various metals used for electrical contacts exposed to air with borated water leakage	Increased electrical resistance of connection due to corrosion of connector contact surfaces caused by intrusion of borated water	AMP XI.M10, “Boric Acid Corrosion”	No	VI.A.LP-36

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	021	BWR/PWR	Transmission conductors composed of aluminum exposed to air – outdoor	Loss of conductor strength due to corrosion	None - for ACAR and AAC	No	VI.A.LP-46
	022	BWR/PWR	Fuse holders (not part of active equipment): insulation material composed of electrical insulation material: bakelite; phenolic melamine or ceramic; molded polycarbonate, and other, exposed to air – indoor controlled or uncontrolled	Reduced electrical IR due to thermal/ thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	AMP 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	No	VI.A.LP-24
	023	BWR/PWR	MEB: external surface of enclosure assemblies. Galvanized steel; aluminum. Air – indoor controlled or uncontrolled	None	None	No	VI.A.LP-41

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	024	BWR/PWR	MEB: external surface of enclosure assemblies. Steel air – indoor controlled	None	None	No	VI.A.LP-44
D	026						
	027	BWR/PWR	Cable bus: external surface of enclosure assemblies galvanized steel; aluminum; air – indoor controlled or uncontrolled	None	None	No	VI.A.L-09
D	028						
	029	BWR/PWR	Cable bus: electrical insulation; insulators – exposed to air – indoor controlled or uncontrolled, air – outdoor	Reduced electrical IR due to degradation caused thermal/ thermoxidative degradation of organics and photolysis (UV sensitive materials only) of organics, moisture/debris intrusion and ohmic heating	A plant-specific aging management program is to be evaluated	Yes (SRP-SLR Section 3.6.2.2.2)	VI.A.L-11

Table 3.6-1 Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report (Continued)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/ Mechanism	Aging Management Program (AMP)/ Time-Limited Aging Analyses (TLAA)	Further Evaluation Recommended	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Item
	030	BWR/PWR	Cable bus: external surface of enclosure assemblies composed of steel exposed to air – indoor uncontrolled or air – outdoor	Loss of material due to general, pitting, crevice corrosion	A plant-specific aging management program is to be evaluated	Yes (SRP-SLR Section 3.6.2.2.2)	VI.A.L-12
	031	BWR/PWR	Cable bus external surface of enclosure assemblies composed of galvanized steel; aluminum exposed to air – outdoor	Loss of material due to general, pitting, crevice corrosion	A plant-specific aging management program is to be evaluated	Yes (SRP-SLR Section 3.6.2.2.2)	VI.A.L-13
	032	BWR/PWR	Cable bus: external surface of enclosure assemblies: composed of steel; air – indoor controlled	None	None	No	VI.A.L-14

ACAR = aluminum conductor aluminum alloy reinforced; ACC = All Aluminum Conductor; ACSR = aluminum conductor steel reinforced; BWR = boiling water reactor; CFR = *Code of Federal Relations*; EPDM = ethylene propylene diene monosomer; EPR = ethylene propylene rubber; EQ = environmental qualification; IR = insulation resistance; LOCA = loss of coolant accident; MEB = metal enclosed bus; PWR = pressurized water reactor; SR = silicone rubber; SRP = Standard Review Plan; SRP-SIR = Standard Review Plan for Review of Subsequent License Renewal; UV = ultraviolet; XLPE = cross-linked polyethylene.

Table 3.6-2 Aging Management Programs and Additional Guidance Appendices Recommended for Electrical and Instrumentation and Control Systems

Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report Chapter/Aging Management Programs (AMP)	Program Name
AMP X.E1	Environmental Qualification of Electric Equipment
AMP XI.E1	Electrical Insulation for Electrical Cables and Connections Not Subject to 10 *Code of Federal Regulations* (CFR) 50.49 Environmental Qualification Requirements
AMP XI.E2	Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits
AMP XI.E3A	Electrical Insulation for Inaccessible Medium-Voltage Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
AMP XI.E3B	Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
AMP XI.E3C	Electrical Insulation for Inaccessible Low-Voltage Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
AMP XI.E4	Metal Enclosed Bus
AMP XI.E5	Fuse Holders
AMP XI.E6	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
AMP XI.E7	High-Voltage Insulators
AMP XI.M10	Boric Acid Corrosion
AMP XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
AMP XI.S6	Structures Monitoring
GALL-SLR Report Appendix A	Quality Assurance for Aging Management Programs
GALL-SLR Report Appendix B	Operating Experience for Aging Management Programs
Standard Review Plan for Review of Subsequent License Renewal Appendix A.1	Aging Management Review—Generic (Branch Technical Position RLBS-1)

AMP = Aging Management Programs; CFR = *Code of Federal Regulations;* GALL-SLR = Generic Aging Lessons Learned for Subsequent License Renewal

4.0 TIME-LIMITED AGING ANALYSES

4.1 Identification of Time-Limited Aging Analyses and Exemptions

Review Responsibilities

Primary — Branch(es) responsible for the time-limited aging analysis (TLAA) issues

Secondary — Other branches responsible for engineering, as appropriate

4.1.1 Areas of Review

This review plan section addresses the identification of TLAAs. The technical review of TLAAs is addressed in Sections 4.2 through 4.7. As explained in more detail below, the list of TLAAs are certain plant-specific safety analyses that are defined, in part, by the current operating term. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(c)(1), a license renewal applicant is required to provide a list of TLAAs, as defined in 10 CFR 54.3 (TN4878). The area relating to the identification of TLAAs is reviewed.

The TLAAs may have developed since issuance of a plant's operating license. As indicated in 10 CFR 54.30, the adequacy of the plant's current licensing basis (CLB), which includes TLAAs, is not an area within the scope of the subsequent license renewal (SLR) review. Any questions regarding the adequacy of the CLB are addressed under the backfit rule (10 CFR 50.109) (TN249) and are separate from the license renewal process.

In addition, pursuant to 10 CFR 54.21(c)(2), an applicant must provide a list of plant-specific exemptions granted under 10 CFR 50.12 that are based on TLAAs. The U.S. Nuclear Regulatory Commission (NRC) staff should focus its review to confirm that the applicant did not omit any TLAAs, as defined in 10 CFR 54.3.

Pursuant to 10 CFR 54.21(d), each application includes a Final Safety Analysis Report (FSAR), updated Final Safety Analysis Report, or updated Safety Analysis Report, as appropriate for the CLB supplement summary description for each TLAA that is identified in accordance with 10 CFR 54.21(c)(1).

4.1.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Section 4.1.1 of this review plan section delineate acceptable methods for meeting the requirements of the NRC's regulations in 10 CFR 54.21(c)(1) (TN4878). For the applicant's list of exemptions to be acceptable under the requirement in 10 CFR 54.21(c)(2), the NRC staff should have reasonable assurance that there has been no omission of TLAAs from the subsequent license renewal application (SLRA) that were used as the basis for receiving NRC approval of regulatory exemptions granted in accordance with 10 CFR 50.12 (TN249) requirements.

The TLAAs are those licensee calculations and analyses that meet all six of the following criteria, as defined in 10 CFR 54.3(a):

1. involve systems, structures, and components (SSC) within the scope of license renewal, as delineated in 10 CFR 54.4(a);

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 SSC to perform its intended function(s), as delineated in 10 CFR 54.4(b); and
6. are contained or incorporated by reference in the CLB.

The TLAA identification criterion in Criterion 1 is based only on a comparison to the scoping requirements in 10 CFR 54.4 (TN4878) and therefore does not limit the applicability of TLAAs only to those components that would be required to be screened in for an aging management review (AMR) in accordance with the requirement in 10 CFR 54.21(a)(1). Thus, the possibility exists that, for a given CLB, a TLAA may need to be identified for a given active component if the analysis in the CLB is determined to be in conformance with all six of the criteria in 10 CFR 54.3(a) for identifying an analysis as a TLAA. Fatigue flaw growth analyses of pressurized water reactor coolant pump flywheels are examples of plant-specific analyses that apply to an active component type and may need to be identified as a TLAA for a given application.

The applicant's FSAR (as updated) identifies TLAAs that were incorporated by reference into the CLB. In addition, for SLRAs, there may be situations where an analysis of record was not required to be identified as a TLAA for the current operating period (as approved in the renewed operating license for the facility), but will need to be identified as a TLAA for a proposed subsequent period of extended operation, as required by the regulation in 10 CFR 54.21(c)(1). Specifically, Criterion 3 for TLAAs in 10 CFR 54.3(a) establishes that to be a TLAA the analysis has to involve time-limited assumptions defined by the current operating term. In *Federal Register Notice* No. 95 11136, Volume 60, Number 88, dated May 8, 1995 (Ref. 1), the NRC identified that TLAAs are those:

> analyses with (i) time-related assumptions, (ii) utilized in determining the acceptability of SSCs, within the scope of license renewal (as defined in 10 CFR 54.4), (iii) which are based upon a period of plant operation equal to or greater than the current license term, but less than the cumulative period of plant operation (viz., the existing license term plus the period of extended operation requested in the renewed application).

For example, for an existing analysis that is part of the CLB and is based on a 60-year time assumption, the analysis would not necessarily have to be identified as a TLAA for the initial license renewal request because it would not conform to the definition of a TLAA, as clarified in *Federal Register Notice* No. 95-11136; however, if the same analysis was left unchanged in the CLB and was going to be relied upon for a proposed SLR period, the analysis would conform to the third criterion for TLAAs in 10 CFR 54.3(a) because the 60-year assumed life would form the updated current operating term basis for the proposed SLR period.

The reviewer evaluates the FSAR Supplement for each TLAA identified as being within the scope of the SLRA, as determined in accordance with the TLAA definition criteria in 10 CFR 54.3 and identified in accordance with the requirements in 10 CFR 54.21(c)(1).

4.1.3 Review Procedures

For each area of review described in Section 4.1.1, the reviewer adheres to the following review procedures:

The reviewer uses the plant FSAR (as updated) and other CLB documents, such as NRC staff safety evaluation reports (SERs), to perform the review. The reviewer selects analyses that the applicant did not identify as TLAAs that are likely to meet the six criteria identified in Section 4.1.2 The reviewer verifies that the selected analyses, not identified by the applicant as TLAAs, do not meet at least one of the following criteria:

Sections 4.2 through 4.6 identify typical types of TLAAs for most plants. Information on the applicant's methodology for identifying TLAAs also may be useful in identifying calculations that did not meet the six criteria below.

1. Involve systems, structures, and components within the scope of license renewal, as delineated in 10 CFR 54.4(a) (TN4878). Section 2 of this Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) provides the reviewer guidance on the scoping and screening methodology, and on plant-level and various system level scoping results.

2. Consider the effects of aging. The effects of aging include, but are not limited to, loss of material, changes in dimension, changes in material properties, loss of toughness, loss of prestress, settlement, cracking, and loss of dielectric properties.

3. Involve time-limited assumptions defined by the current operating term (e.g., 40 years). The defined operating term should be explicit in the analysis. Simply asserting that a component is designed for a service life or plant life is not sufficient. The assertion is supported by calculations or other analyses that explicitly include a time limit.

4. Determined to be relevant by the licensee in making a safety determination. Relevancy is a determination that the applicant makes based on a review of the information available. A calculation or analysis is relevant if it can be shown to have a direct bearing on the action taken as a result of the analysis performed. Analyses are also relevant if they provide the basis for a licensee's safety determination, and, in the absence of the analyses, the applicant might have reached a different safety conclusion.

5. Show capability of the system, structure, or component to perform its intended function(s), as delineated. Involve conclusions or provide the basis for conclusions related to 10 CFR 54.4(b). Analyses that do not affect the intended functions of SSCs are not TLAAs.

6. Incorporated by reference in the CLB. The CLB includes the technical specifications (TS) as well as design basis information (as defined in 10 CFR 50.2) (TN249), or licensee commitments documented in the plant-specific documents contained or incorporated by reference in the CLB, including but not limited to the FSAR, NRC SERs, the fire protection plan/hazards analyses, correspondence to and from the NRC, the quality assurance plan, and topical reports (TRs) included as references to the FSAR. Calculations and analyses that are not contained in the CLB or not incorporated by reference in the CLB are not TLAAs. If a Code of Record is in the FSAR for particular groups of structures or components, reference material includes all calculations called for by that Code of Record for those SCs.

The TLAAs that need to be addressed are not necessarily those analyses that have been previously reviewed or approved by the NRC. The following examples illustrate TLAAs that need to be addressed that were not previously reviewed and approved by the NRC:

> The FSAR states that the design complies with a certain national code and standard. A review of the code and standard reveals that it calls for an analysis or calculation. Some of these calculations or analyses will be TLAAs. The actual calculation was performed by the applicant to meet the code and standard. The specific calculation was not referenced in the FSAR. The NRC had not reviewed the calculation. In response to a generic letter (GL), a licensee submitted a letter to the NRC committing to perform a TLAA that would address the concern in the GL. The NRC had not documented a review of the applicant's response and had not reviewed the actual analysis.

The following examples illustrate analyses that are not TLAAs and need not be addressed under 10 CFR 54.21(c) (TN4878):

- population projections (Section 2.1.3 of NUREG–0800) (Ref. 2);
- cost-benefit analyses for plant modifications; and
- analysis with TLAAs defined short of the current operating term of the plant, for example, an analysis for a component based on a service life that would not reach the end of the current operating term.

The number and type of TLAAs vary depending on the plant-specific CLB. All six criteria set forth in 10 CFR 54.3 (and repeated in Section 4.1.2) must be satisfied to conclude that a calculation or analysis is a TLAA. Table 4.1-1 provides examples of how these six criteria may be applied (Ref. 3). Table 4.1-2 provides a list of generic TLAAs that are included in the SRP-SLR. Table 4.7-1 in SRP-SLR Section 4.7 provides examples of potential plant-specific TLAAs that have been identified by license renewal applicants. It is not expected that all applicants would identify all the analyses in these tables as TLAAs for their plants. Also, an applicant may perform specific TLAAs for its plant that are not shown in these tables.

The Criterion 3 for TLAAs in 10 CFR 54.3(a) establishes that, as one of the six criteria that are used to define a given analysis as a TLAA, the analysis has to involve time-limited assumptions defined by the current operating term (e.g., 40 years). Therefore, for proposed SLRAs, there may be instances where an existing, time-dependent analysis did not conform to Criterion 3 for TLAAs in 10 CFR 54.3(a) for the current period of extended operation, but would conform to this criterion for the subsequent period of extended operation that is requested for NRC approval. Therefore, the reviewer should perform a review of the CLB to determine whether there are any existing analyses for the CLB that will need to be identified as analyses that conform to Criterion 3 for TLAAs for the proposed subsequent period of extended operation even though the analyses did not conform to Criterion 3 for TLAAs for the previous period of extended operation that was approved in the renewed operating license for that period. For those cases where the addition of a proposed subsequent period of extended operation would cause a given analysis to conform to Criterion 3 for TLAAs in 10 CFR 54.3(a), the reviewer should assess whether the analysis also conforms to the remaining five criteria for identifying TLAAs in 10 CFR 54.3(a), and determine whether the analysis needs to be identified as a TLAA for the subsequent period of extended operation in accordance with the requirement in 10 CFR 54.21(c)(1).

As appropriate, NRC staff from other branches of the Office of Nuclear Reactor Regulation review the application in their assigned areas without examining the identification of TLAAs.

However, they may come across situations in which they may question why the applicant did not identify certain analyses as TLAAs. The reviewer coordinates the resolution of any such questions with these other NRC staff to determine whether these analyses should be evaluated as TLAAs.

In order to determine whether there is reasonable assurance that the applicant has identified the TLAAs for its plant, the reviewer should find that the analyses omitted from the applicant's list are not TLAAs. Should an applicant identify a TLAA that is also a basis for a plant-specific exemption that was granted pursuant to 10 CFR 50.12 (TN249) and the exemption is in effect for the current operating period, the reviewer verifies that the applicant also has identified that exemption pursuant to 10 CFR 54.21(c)(2). Examples of an exemptions that may have been granted in accordance with 10 CFR 50.12 and based on a TLAA are those NRC-granted exemptions that approved American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) case N-514 as an alternative basis for complying with the pressure lift and system enable temperature set point requirements for pressurized water reactors (PWRs) low temperature overpressure protection systems in 10 CFR Part 50, Appendix G and the ASME Code Section XI, Appendix G.

4.1.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section, and whether the NRC staff's evaluation supports conclusions of the following type, to be included in the SER:

On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided an acceptable list of TLAAs as defined in 10 CFR 54.3 (TN4878), and that no 10 CFR 50.12 (TN249) exemptions have been granted on the basis of a TLAA, as defined in 10 CFR 54.3.

4.1.5 References

1. NRC. "Nuclear Power Plant License Renewal; Revisions." *Federal Register*: Vol. 60. No. 88, pp. 22,461–22,495. May 8, 1995.
2. NRC. NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports Nuclear Power Plants." Agencywide Documents Access and Management System (ADAMS) Accession No. ML070630046. Washington, DC: U.S. Nuclear Regulatory Commission. March 2007. NRC 2021-TN8013
3. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54–The License Renewal Rule." Revision 6. ADAMS Accession No. ML051860406. Washington, DC: Nuclear Energy Institute. June 2005.

Table 4.1-1 Sample Process for Identifying Potential Time-Limited Aging Analyses and Basis for Disposition

Example of an analysis that meets all six of the criteria in 10 CFR 54.3(a) for defining an analysis as a Time-Limited Aging Analyses (TLAA): The current licensing basis (CLB) includes a time-dependent fatigue flaw growth analysis for the reactor coolant pump (RCP) flywheels. An age-related fatigue failure of flywheels could potentially be a source of missiles that have the potential to impact the structural integrity and pressure retaining function of the reactor coolant pressure boundary. The applicant has identified that the RCP flywheels are components that meet the scoping definition in Title 10 of the *Code of Federal Regulations* (10 CFR) 54.4(a)(1), in that the flywheels assure adequate heat removal during a plant trip and loss of power to the RCPs, as well as initiation of natural circulation flow as part of necessary safe shutdown activities.

The applicant has not included the RCP flywheels as components that need to be within the scope of an aging management review (AMR), as would otherwise be required in accordance with 10 CFR 54.21(a)(1). The analysis is referenced in the updated Final Safety Analysis Report (UFSAR) and is based on design basis transients that are assumed and evaluated in the UFSAR based on a 40-year design life. The analysis is relied upon to establish a 10-year augmented inservice inspection interval for performing inspections of RCP flywheels and to demonstrate that fatigue-induced growth of a flaw in the flywheels would not result in a flywheel missile that could threaten the structural integrity of the reactor coolant pressure boundary during the life of the plant.

Criterion in 10 CFR 54.3(a)	*Disposition Basis for Comparing to the Criterion in 10 CFR 54.3(a)*
Criterion 1: *The analysis must involve systems, structures, and components within the scope of license renewal, as delineated in 10 CFR 54.4(a).*	Although the RCP flywheels as active components do not need to be subjected to an AMR (as defined in 10 CFR 54.21(a)(1)), the components are within the scope of license renewal application because their failure could impact the intended pressure retaining function of a component that is located in the reactor coolant pressure boundary. Therefore, the fatigue flaw growth analysis does conform to Criterion 1 in 10 CFR 54.3(a) because the flywheels do need to be within the scope of license renewal as a component whose failure could impact the intended function of a component that has been scoped in for renewal in accordance with 10 CFR 54.4(a)(1).
Criterion 2: *The analysis must consider the effects of aging.*	The fatigue flaw growth analysis for the RCP flywheels does meet Criterion 2 because the analysis assumes the presence of a postulated crack in the components and assumes that an age-related growth mechanism (fatigue flaw growth) will propagate the flaw under the assumed transient loading conditions for the analysis.
Criterion 3: *The analysis must involve time-limited assumptions defined by the current operating term (for example, 40 years).*	The fatigue flaw growth analysis for the RCP flywheels does meet Criterion 3 because the analysis assumes that the loading conditions that induced fatigue flaw growth in the flywheel discs are based on the 40-year cyclic transient assumptions for specific design transients in the UFSAR. The 40-year cyclical nature of this assumption defines this analysis as one that involves time-limited assumptions defined by the current operating term.
Criterion 4: *The analysis must be determined to be relevant by the licensee in making a safety determination.*	The analysis conforms to Criterion 4 because the applicant is relying on the fatigue flaw growth analysis to establish a safety-related decision at the facility, which amounts to the applicant's safety decision to perform augmented inservice inspection of the RCP flywheels on a 10-year inservice inspection interval and relates to the applicant's basis for maintaining the integrity of the reactor coolant pressure boundary during the life of the plant.

Table 4.1-1 Sample Process for Identifying Potential Time-Limited Aging Analyses and Basis for Disposition (Continued)

Criterion 5: *The analysis must involve conclusions or provide the basis for conclusions related to the capability of the system, structure, or component to perform its intended function(s), as delineated in 10 CFR 54.4(b).*	The analysis conforms to Criterion 5 because the analysis evaluates the structural integrity of the RCP flywheels for fatigue-induced growth to ensure the integrity of the flywheels will be maintained during the licensed period of operation for the facility and that the integrity of the reactor coolant pressure boundary will be protected against the consequences of postulated flywheel missiles during the life of the plant.
Criterion 6: *The analysis is contained or incorporated by reference in the CLB.*	The analysis conforms to Criterion 6 because the analysis is referenced in the UFSAR for the facility.
Example of analyses that do not meet the six of the criteria for TLAAs in 10 CFR 54.3(a):	
Example of an analysis that does not meet Criterion 1 in 10 CFR 54.3(a): *The analysis must involve systems, structures, and components within the scope of license renewal, as delineated in 10 CFR 54.4(a).*	The CLB includes a time-dependent corrosion analysis for both a refueling water storage tank (RWST) and a standby RWST that are included in the plant design. The applicant can align the standby RWST to the safety injection system and containment spray system for the facility during a postulated loss of coolant accident and the applicant has performed a 40-year time-dependent corrosion analysis of both the RWST and standby RWST. The RWST is credited as a safety-related component that is credited for accident mitigation objectives in the plant's accident analyses that are defined and evaluated in the UFSAR. In contrast, the standby RWST is not credited for accident mitigation in the accident analyses defined in the UFSAR. A postulated failure of the standby RWST does not have the ability to impact the intended function [as defined in 10 CFR 54.4(b)] of any safety-related component or structure that is required to be scoped in for renewal in accordance with 10 CFR 54.4(a)(1); nor is the standby RWST within the scope of any special regulations, as defined in 10 CFR 54.4(a)(3). The applicant has not identified the standby RWST as a tank that is within the scope of license renewal. Although the corrosion analysis for the standby RWST is part of the plant design, the analysis does not apply to a plant component that is within the scope of the subsequent license renewal agreement (SLRA) because the component is not required to be within the scope of the license renewal application in accordance with 10 CFR 54.4 (a)(1), (a)(2), or (a)(3). Therefore, under this example, the corrosion analysis for the standby RWST does meet Criterion 1 in 10 CFR 54.3(a) and does not meet the definition of a TLAA in the 10 CFR Part 54 (TN4878) rule.
Example of an analysis that does not meet Criterion 2 in 10 CFR 54.3(a):	The CLB and design basis includes a stress analysis for a reactor coolant loop elbow that is compared to American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section III allowable stress values. The stress analysis is performed in accordance with ASME Code Section III requirements, as invoked by 10 CFR 50.55a requirements.

Table 4.1-1 Sample Process for Identifying Potential Time-Limited Aging Analyses and Basis for Disposition (Continued)

The analysis must consider the effects of aging.	Although the stress analysis is required by the U.S. Nuclear Regulatory Commission (NRC) regulations and ASME Code requirements and is part of the CLB, it does not involve any analysis of an applicable or postulated aging effect. Therefore, under this example, the analysis does not conform to Criterion 2 in 10 CFR 54.3(a) and does not meet the definition of a TLAA in the 10 CFR Part 54 rule.
Example of an analysis that does not meet Criterion 3 in 10 CFR 54.3(a): *The analysis must involve time-limited assumptions defined by the current operating term (for example, 40 years).*	The applicant has detected a flaw in one of its reactor vessel (RV) nozzle-to-safe end welds and has performed an ASME Code Section XI inservice inspection flaw growth analysis of the flaw in the components to justify further service of the impacted weld until the next outage in which the flaw would be inspected for acceptability, without the need of repair or replacement. The ASME-based flaw evaluation is part of the CLB and assumes the Class 1 design basis transients occur over a 20-year period from the time the flaw was detected. The analysis does not involve time-dependent assumptions defined by the current operating period because the assessment of design basis transient cycles was made on a time period less than that used for the current operating term. Therefore, under this example, the fatigue flaw analysis would not conform to Criterion 3 in 10 CFR 54.3(a) and would not meet the definition of a TLAA in the 10 CFR Part 54 (TN4878) rule.
Example of an analysis that does not meet Criterion 4 in 10 CFR 54.3(a): *The analysis must be determined to be relevant by the licensee in making a safety determination.*	The original licensing basis for a pressurized water reactor (PWR) included a high-energy line break (HELB) analysis for a piping location in the main reactor coolant loop that was based on ASME Code Section III cumulative usage factor analysis requirements for HELB locations and demonstrated the need for inclusion of a pipe whip restraint in the design of the piping location. Subsequent to the performance of this analysis, the applicant submitted a leak-before-break (LBB) analysis for the main coolant loop piping that demonstrated conformance with the revised dynamic effect requirements in U.S. Nuclear Regulatory Commission General Design Criterion (GDC) 4. The results of the LBB analysis demonstrated that the licensee would be capable of detecting a leak in the affected piping prior to a catastrophic failure of the component and that the pipe whip restraints could be removed from the design of the component. The LBB analysis was approved as part of an update of the CLB for the facility such that the HELB analysis is no longer relied upon as part of the CLB for the given piping location. The original HELB analysis for this piping location is no longer relied upon for the CLB because it was replaced by the NRC-approved LBB analysis for the main coolant loops, which included these piping locations. Therefore, the original HELB analysis for this piping location is not relevant in making a safety determination relative to the inclusion of a pipe whip restraint on the piping component. Under this example, the HELB analysis for this specific piping location does not conform to Criterion 4 in 10 CFR 54.3(a) and does not meet the definition of a TLAA in the 10 CFR Part 54 rule. HELB analyses for piping locations not excluded by LBB would still be relied upon for the CLB and would need to be identified as TLAAs for the SLRA.

Table 4.1-1 Sample Process for Identifying Potential Time-Limited Aging Analyses and Basis for Disposition (Continued)

Example of an analysis that does not meet Criterion 5 in 10 CFR 54.3(a): *The analysis must involve conclusions or provide the basis for conclusions related to the capability of the system, structure, or component to perform its intended function(s), as delineated in 10 CFR 54.4(b).*	The original licensing basis for a boiling water reactor (BWR) included an evaluation of the number of paint coats that would be applied to the inside surfaces of its condensate storage tanks (CSTs). The CSTs have been included in the scope of the license renewal application in accordance with 10 CFR 54.4(a)(1) requirements and are within the scope of an applicable AMR, as performed in accordance with 10 CFR 54.21(a)(1) requirements. Although the coating analysis for the inside surfaces of the CST is discussed in the UFSAR, the UFSAR states that the analysis is not relied upon for the structural integrity of the CST or for drawing a conclusion that the CST will fulfill its accident mitigation and safe shutdown functions. Although the coating analysis is part of the design basis, it is not used to draw a conclusion or provide the basis for concluding that the structural integrity of the CST walls will be maintained during the design life of the plant or the ability of the CST coolant inventory to meet the accident mitigation or safe shutdown objectives for the plant design. Therefore, the coating analysis for the CST does not involve conclusions or provide the basis for conclusions related to the capability of the CST to perform its intended functions, as defined in 10 CFR 54.4(b). Under this example, the coating analysis for the CST does not conform to Criterion 5 in 10 CFR 54.3(a) and does not meet the definition of a TLAA in the 10 CFR Part 54 (TN4878) rule.
Example of an analysis that does not meet Criterion 6 in 10 CFR 54.3(a): *The analysis is contained or incorporated by reference in the CLB.*	The CLB for a PWR includes a plant-specific, probabilistic main turbine missile analysis that is used as basis for meeting 10 CFR Part 50 (TN249), Appendix A, dynamic effect analysis design requirements, as given in GDC 4, "*Dynamic Effects*." This analysis is described and evaluated in the UFSAR, and states that the analysis was performed to demonstrate the main turbines will not generate a missile that could threaten the integrity of safety-related structures and components in the facility. The UFSAR indicates that the probabilistic turbine missile analysis was performed in lieu of a generic time-dependent turbine missile analysis that is provided in a specific vendor report and that meets all six of the criteria for defining TLAAs in 10 CFR 54.3(a). In this case, although the generic time-dependent turbine missile analysis in the vendor report could have been relied upon for the CLB, the applicant does not rely on the analysis in this report as its basis for meeting GDC 4 requirements in 10 CFR Part 50, Appendix A. Therefore, the generic analysis in the vendor report is not contained or incorporated by reference in the CLB. Under this example, the generic turbine missile analysis in the vendor report does not conform to Criterion 6 in 10 CFR 54.3(a) and does not meet the definition of a TLAA in the 10 CFR Part 54 rule.

AMR = aging management review; ASME = ASME International; BWR = boiling water reactor; CFR = *Code of Federal Regulations*; CLB = current licensing basis; CST = condensate storage tank; GDC = General Design Criterion; HELB = high-energy line break; LBB = leak-before-break; RCP = reactor coolant pump; RV = reactor vessel; RWST = refueling water storage tank; SLA = subsequent license renewal agreement; TLAA = Time-Limited Aging Analyses; UFSAR = updated Final Safety Analysis Report.

Table 4.1-2 Generic Time-Limited Aging Analyses

Upper-shelf energy (USE)	Neutron fluence
	Pressurized thermal shock (pressurized water reactors [PWRs] only)
	USE (PWRs and boiling water reactors [BWRs])
	Pressure-temperature limits (PWRs and BWRs)
	Low temperature overpressure protection system setpoints (PWRs Only)
	Ductility reduction evaluation for reactor internals (Babcock & Wilcox designed PWRs only)
	Reactor pressure vessel (RPV) circumferential weld relief–probability of failure and mean adjusted reference temperature analysis for the RPV circumferential welds (BWRs only)
	Reactor Vessel Axial Weld Probability of Failure and Mean Adjusted Reference Temperature Analysis (BWRs only)
Metal fatigue (Section 4.3)	Metal fatigue of Class 1 components
	Metal fatigue of Non-Class 1 components
	Environmentally assisted fatigue
	High-Energy Line Break Analyses
	Cycle-dependent fracture mechanics or flaw evaluations
	Cycle-dependent fatigue waivers
Environmental qualification of electrical equipment (Section 4.5)	
Concrete containment tendon prestress (Section 4.5)	
Containment liner plate, metal containments, and penetrations fatigue (Section 4.6)	

BWR = boiling water reactor; PWR = pressurized water reactor; RPV = reactor pressure vessel; USE = upper-shelf energy.

4.2 Reactor Pressure Vessel Neutron Embrittlement Analyses

Review Responsibilities

Primary — Branch(es) responsible for the TLAA issues

Secondary—Branch responsible for reactor systems

4.2.1 Areas of Review

During plant service, neutron irradiation reduces the fracture toughness of ferritic steel in the RPV beltline region of light-water nuclear power reactors, where the RPV beltline region is described in Regulatory Issue Summary (RIS) 2014-11 (Ref. 1) to include the traditional geometric beltline as defined in 10 CFR Part 50, Appendix G,[2] and all other reactor vessel (RV) ferritic materials with projected neutron fluence values greater than 1×10^{17} N/cm^2 (E > 1 MeV). The areas of review to make sure that the RPV has adequate fracture toughness to prevent brittle failure during normal and off-normal operating conditions are: (i) neutron fluence, (ii) upper-shelf energy (USE), (iii) pressurized thermal shock (PTS) for pressurized water reactor (PWRs), (iv) heat-up and cool-down (pressure-temperature [P-T] limits) curves, (v) Boiling Water Reactor Vessel and Internals Project (BWRVIP)-05 analysis for elimination of circumferential weld inspection and analysis of the axial welds, and (vi) other plant-specific TLAAs on RPV neutron embrittlement. The review of these TLAAs is coordinated due to their common use of material properties, copper and nickel content values for RV materials. The adequacy of the analyses for these five areas is reviewed for the subsequent period of extended operation.

The branch responsible for reactor systems reviews neutron fluence and dosimetry information in the application.

4.2.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Section 4.2.1 of this review plan section delineate acceptable methods for meeting the requirements of the NRC regulation in 10 CFR 54.21(c)(1) (TN4878).[3]

4.2.2.1 Time-Limited Aging Analyses

Pursuant to 10 CFR 54.21(c)(1)(i)–(iii) (TN4878), an applicant must demonstrate one of the following:

(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

[2] Beltline or Beltline region of RV includes the region of the RV (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. (10 CFR Part 50, Appendix G II.F)
[3] For SLRA, the period of extended operation concerns the period of operation after the expiration of the renewed license (i.e., operation from 60 to 80 years).

(iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

For the first three areas of review for the analysis of RPV neutron embrittlement, the specific acceptance criteria depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii).

4.2.2.1.1 Neutron Fluence

Neutron fluence is the number of neutrons accumulated per unit area during a certain period of neutron irradiation. An RPV neutron fluence analysis involves time-limited assumptions (e.g., 40 years of original design life) and is used to determine the loss of fracture toughness due to neutron irradiation embrittlement of the RPV. Appendix H of 10 CFR Part 50 (TN249) (Ref. 4) requires that an applicant must implement an RPV Surveillance program for an RPV if the peak neutron fluence at the end of the design life of the RPV exceeds a neutron fluence of 10^{17} N/cm^2 (E > 1 MeV). The RPV neutron fluence analysis is also integral to other neutron embrittlement TLAAs (e.g., USE and P-T limits analyses) because neutron fluence is a fundamental parameter which is used to determine the level of neutron irradiation embrittlement of an RPV. As discussed above, the RPV neutron fluence analysis is important in making a safety determination for an RPV in terms of loss of fracture toughness due to neutron irradiation embrittlement.

Typically, the RPV neutron fluence analysis is described in the 'FSAR or other design documents approved by NRC. In its SLRA, the applicant identifies: (i) the neutron fluence for each beltline material at the end of extended license term, (ii) the NRC staff-approved methodology used to calculate the neutron fluence or submits the methodology for NRC staff review, (iii) whether the methodology is consistent with the guidance in NRC Regulatory Guide (RG) 1.190 (Ref. 5), and (iv) how the neutron fluence is monitored during the subsequent period of extended operation. An applicant may take any one of the following three dispositions for the RPV neutron fluence analysis.

4.2.2.1.1.1 10 CFR 54.21(c)(1)(i)

A neutron fluence analysis typically accounts for planned operation by including assumptions regarding the neutron flux emitted from the core. The flux is integrated over time to yield the estimated fluence. Frequently, neutron fluence calculations will include projected fluence values for multiple periods of exposure, (e.g., 40, 60, and 80 calendar years). In order to use a disposition for fluence pursuant to 10 CFR 54.21(c)(1)(i), the applicant will demonstrate the existing RPV neutron fluence analysis, including the projected flux for planned operation, in the CLB remains valid during the subsequent period of extended operation. The fluence calculation will be reevaluated to confirm its validity.

4.2.2.1.1.2 10 CFR 54.21(c)(1)(ii)

For a disposition in accordance with 10 CFR 54.21(c)(1)(ii), the applicant will provide new or updated calculations that address the fluence effects during the subsequent period of extended operation. The new or updated RPV neutron fluence analysis is evaluated to consider the subsequent period of extended operation in accordance with: (i) NRC RG 1.190, or (ii) a methodology that has been approved for use by the NRC.

4.2.2.1.1.3 *10 CFR 54.21(c)(1)(iii)*

In the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report Aging Management Program (AMP) Section X.M2, "Neutron Fluence Monitoring," the NRC staff has evaluated an AMP for projecting and monitoring neutron fluence for the subsequent period of extended operation. The staff has determined that this program is acceptable to project and monitor neutron fluence as a basis for managing loss of fracture toughness due to neutron irradiation embrittlement of RPVs in accordance with 10 CFR 54.21(c)(1)(iii).

4.2.2.1.2 Upper-Shelf Energy

10 CFR Part 50 (TN249) Appendix G (Ref. 6) paragraph IV.A.1 requires that the RPV beltline materials have a Charpy USE of no less than 68 J (50 foot-pound [ft-lb]) throughout the life of the RPV, unless otherwise approved by the NRC. An applicant may take any one of the following three approaches.

4.2.2.1.2.1 *10 CFR 54.21(c)(1)(i)*

The RPV components evaluated in the existing USE analysis or NRC-approved equivalent margins analysis (EMA) are reevaluated to demonstrate that the existing analysis remains valid during the subsequent period of extended operation because the neutron fluence projected to the end of the subsequent period of extended operation is bounded by the neutron fluence in the existing USE analysis or NRC-approved EMA.

4.2.2.1.2.2 *10 CFR 54.21(c)(1)(ii)*

The RPV components evaluated in the existing USE analysis or NRC-approved EMA are reevaluated to consider the subsequent period of extended operation in accordance with 10 CFR Part 50, Appendix G.

10 CFR Part 50, Appendix G, Section IV.A.1, requires applicants to take further corrective actions where the 68 Joule (J) (50 ft-lb) end-of-life USE criterion cannot be met. When this occurs, a licensee is required to submit a supplemental analysis for NRC approval. The applicant will need to submit a plant-specific engineering analysis (usually an EMA) for NRC approval as supplemental information for SLR. Otherwise, failure to meet the USE requirements of 10 CFR Part 50, Appendix G for the RPV materials as evaluated using the neutron fluence that are projected for the subsequent period of extended operation mandates imposition of additional commitments or license conditions on USE for the SLRA.

4.2.2.1.2.3 *10 CFR 54.21(c)(1)(iii)*

Acceptance criteria for accepting USE TLAAs in accordance with 10 CFR 54.21(c)(1)(iii) (TN4878) have yet to be developed. They will be evaluated on a case-by-case basis to make sure that the aging effects will be managed such that the intended function(s) will be maintained during the subsequent period of extended operation.

4.2.2.1.3 Pressurized Thermal Shock (for PWRs)

For PWRs, 10 CFR 50.61 (TN249) requires that the reference temperature for RPV beltline materials evaluated at the neutron fluence corresponding to the end of the subsequent period of extended operation (i.e., reference temperature for pressurized thermal shock [RT_{PTS}]) be less than the PTS screening criteria at the expiration date of the operating license, unless otherwise approved by the NRC. The PTS screening criteria is 132 °C (270 °F) for plates, forgings, and axial weld materials, and 149 °C (300 °F) for circumferential weld materials. Alternatively, the licensee may comply with the requirements of 10 CFR 50.61a. The regulations require updating of the PTS assessment upon a request for a change in the expiration date of a facility's operating license, or whenever there is a significant change in projected values of RT_{PTS}. Therefore, the RT_{PTS} value must be calculated for the entire licensed operating period of the facility, including the subsequent period of extended operation. If the analyses result in RT_{PTS} values that exceed the PTS screening criteria at the end of the subsequent period of extended operation, the applicant is required to implement additional corrective actions as described in 10 CFR 50.61 or 10 CFR 50.61a. The PTS TLAA may be handled as follows.

4.2.2.1.3.1 10 CFR 54.21(c)(1)(i)

The existing PTS analysis based on 10 CFR 50.61 (TN249) remains valid during the subsequent period of extended operation because the neutron fluence projected to the end of the subsequent period of extended operation is bounded by the neutron fluence assumed in the existing analysis. If the existing PTS analysis is based on 10 CFR 50.61a, the applicant demonstrates that the current analysis remains applicable for the subsequent period of extended operation.

4.2.2.1.3.2 10 CFR 54.21(c)(1)(ii)

The PTS analysis is reevaluated to consider the subsequent period of extended operation in accordance with 10 CFR 50.61 or 10 CFR 50.61a (TN249). If the analyses result in RT_{PTS} values that exceed the PTS screening criteria at the end of the subsequent period of extended operation, the applicant is required to implement additional corrective actions as described in 10 CFR 50.61 or 10 CFR 50.61a. If the existing PTS analysis is based on 10 CFR 50.61a, the applicant updates the submittal to reflect the subsequent period of extended operation.

4.2.2.1.3.3 10 CFR 54.21(c)(1)(iii)

The NRC staff position for license renewal (LR) on this option is described in a May 27, 2004 letter from L.A. Reyes to the Commission (Ref. 9), which states that if the applicant does not extend the TLAA, the applicant provides an assessment of the CLB TLAA for PTS, a discussion of the flux reduction program implemented in accordance with 10 CFR 50.61(b)(3) (TN249), if necessary, and an identification of the viable options that exist for managing the aging effect in the future.

4.2.2.1.4 Pressure-Temperature Limits

The 10 CFR Part 50 (TN249), Appendix G, requires that the RPV be maintained within established P-T limits during normal operating conditions of the plant (including heat-ups and cool-downs of the reactor and anticipated operational transients), and during pressure tests and system leak tests. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the RPV becomes embrittled and its fracture toughness is reduced, the allowable pressure (given the required minimum temperature) is reduced. The RIS 2014-11 clarifies issues that must be addressed in developing P-T limits.

The P-T limits are TLAAs for the application if the plant currently has P-T limit curves approved for the expiration of the current period of operation (e.g., 32 effective full power year [EFPY] or some other licensed EFPY value defined for the expiration date of the current license). However, the P-T limits for the subsequent period of extended operation need not be submitted as part of the SLRA since the P-T limits need to be updated through the 10 CFR 50.90 licensing process when necessary for P-T limits that are located in the limiting conditions of operations (LCOs) of the TSs. For those plants that have approved pressure-temperature limit reports (PTLRs), the P-T limits for the subsequent period of extended operation will be updated at the appropriate time through the plant's Administrative Section of the TS and the plant's PTLR process. In either case, the 10 CFR 50.90 or the PTLR processes, which constitute the CLB, will make sure that the P-T limits for the subsequent period of extended operation will be updated prior to expiration of the P-T limit curves for the current period of operation.

The P-T limits may be handled as follows.

4.2.2.1.4.1 10 CFR 54.21(c)(1)(i)

The applicant demonstrates (on a case-by-case basis) that existing P-T limits in the CLB will remain valid during the subsequent period of extended operation.

4.2.2.1.4.2 10 CFR 54.21(c)(1)(ii)

The P-T limits are updated for the subsequent period of extended operation in accordance with 10 CFR Part 50 (TN249), Appendix G and the applicant's appropriate TS change process for updating the P-T limit curves.

For P-T limit curves that are included in and controlled by requirements in the LCOs of the plant TS, the applicant submits the changes to the P-T limits as a license amendment request (i.e., a TS change request) for the SLRA that is submitted in accordance with the requirements in 10 CFR 54.22 (TN4878) and uses the license amendment submittal as the basis for accepting the TLAA in accordance with 10 CFR 54.21(c)(1)(ii).

For P-T limits that are controlled by Administrative Controls TS requirements and located in an NRC-approved PTLR, the applicant updates the P-T limits in accordance with the methodology or methodologies approved in the applicable Administrative Controls TS section for its PTLR process and submits the updated PTLR(s) containing the updated P-T limits to the NRC (as information) in accordance the reporting requirements in the applicable Administrative Controls TS section. The applicant uses the submittal of the updated PTLR as the basis for accepting the TLAA in accordance with 10 CFR 54.21(c)(1)(ii).

4.2.2.1.4.3 10 CFR 54.21(c)(1)(iii)

The P-T limits for the subsequent period of extended operation will be updated (if required) prior to the plant's entry into the subsequent period of extended operation, or prior to exceeding their current terms of applicability'. The 10 CFR 50.90 (TN249) process for P-T limits located in the LCOs or the Administrative Controls Process for P-T limits that are administratively amended through a PTLR process can be considered adequate AMPs or aging management activities within the scope of 10 CFR 54.21(c)(1)(iii) (TN4878), such that P-T limits will be maintained through the subsequent period of extended operation.

4.2.2.1.5 Elimination of Boiling Water Reactor Circumferential Weld Inspections

Some BWRs have an approved technical alternative in the CLB, which eliminates the RPV circumferential shell weld inspections from the ASME Code Section XI program for the current license term.

BWRVIP-329-A, “BWR Vessel and Internals Program, Updated Probabilistic Fracture Mechanics Analyses for BWR RPV Welds to Address Extended Operations,” (ADAMS Accession No. ML21343A411) provides an alternative probabilistic fracture mechanics (PFM) evaluation of BWR RPV welds. The application of the results of BWRVIP-329-A provides BWR owners with a continuing basis to justify relief of circumferential weld examinations for RPVs. If these analyses are identified as TLAAs, they will be evaluated on a case-by-case basis in accordance with the requirements of 10 CFR 54.21(c)(1) (TN4878).

Implementation of the results in BWRVIP-329-A for a specific RPV are performed through the 10 CFR 50.55a(z)(1) process. If the applicant indicates that elimination of the circumferential weld examinations of the RPV will be made in accordance with 10 CFR 50.55a(z)(1), the applicant will manage this TLAA in accordance with 10 CFR 54.21(c)(1)(iii).

Since the evaluation in BWRVIP-329-A is generic, application of the results in BWRVIP-329-A for a specific RPV are performed at the time of the renewal application. An applicant relying on this report should provide plant-specific information in the SLRA to demonstrate that at the end of the subsequent period of extended operation the PFM evaluation in BWRVIP-329-A is applicable to the individual plant and that the effects of aging on the intended function of the reactor circumferential weld will be adequately managed. Section 5.0 of the NRC safety evaluation in BWRVIP-329-A discusses the use and referencing of BWRVIP-329-A.

In conjunction with demonstrating that relief of circumferential weld examinations are justified in accordance with 10 CFR 50.55a(z)(1), per the NRC staff’s safety evaluation of BWRVIP-74 (ADAMS Accession No. ML012920549), the applicant must demonstrate that operator training and procedures are utilized during the renewal term to limit the frequency for cold overpressure events to the amount specified in the NRC staff’s July 28, 1998, safety evaluation of BWRVIP-05 (ADAMS Accession No. ML20236V551).

4.2.2.1.6 Boiling Water Reactor Axial Welds

Those BWRs that have been approved to use the circumferential weld alternative were required to perform acceptable conditional probability of failure analyses of their RPV axial shell welds. BWRVIP-329-A provides an alternative PFM evaluation of BWR RPV welds and application of these results provide BWR owners with the capability to demonstrate acceptable integrity for axial welds for RPVs. If these analyses are identified as TLAAs, they will be evaluated on a case-by-case basis in accordance with the requirements of 10 CFR 54.21(c)(1) (TN4878).

The NRC staff’s safety evaluation of BWRVIP-74 (ADAMS Accession No. ML012920549) specifies that applicants monitor axial beltline weld embrittlement through the subsequent period of extended operation and that one acceptable method is to determine that the mean RT_{NDT} (nil-ductility reference temperature) of the limiting axial beltline weld at the end of the subsequent period of extended operation is less than the values specified in the BWRVIP-74 safety evaluation; the mean RT_{NDT} values in the BWRVIP-74 safety evaluation have corresponding RPV failure frequencies, which were based on underlying PFM analyses.

As stated above, BWRVIP-329-A provides an alternative PFM evaluation of BWR RPV welds, which is an acceptable alternative to the mean RT_{NDT} value comparison specified in the BWRVIP-74 safety evaluation. Since the evaluation in BWRVIP-329-A is generic, application of the results in BWRVIP-329-A for a specific RPV are performed at the time of the renewal application. An applicant relying on this report can provide plant-specific information in the SLRA to demonstrate that the PFM evaluation in this report is applicable to the individual plant. Section 5.0 of the NRC safety evaluation in BWRVIP-329-A discusses the use and referencing of BWRVIP-329-A.

4.2.2.2 Final Safety Analysis Report Supplement

The specific criterion for meeting 10 CFR 54.21(d) (TN4878) is that the summary description of the evaluation of TLAAs for the subsequent period of operation in the FSAR Supplement is sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59 (TN249). The description contains information associated with the TLAAs regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.2.3 Review Procedures

For each area of review described in Section 4.2.1, the following review procedures should be followed.

4.2.3.1 Time-Limited Aging Analyses

For the first four areas of review for the analysis of RPV neutron embrittlement, the review procedures depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878). For each area of review, the applicant's three options under Section 54.21(c)(1) are discussed in turn.

The applicant may identify activities to be performed to verify the assumption basis of the neutron fluence calculations that are used to evaluate the RPV neutron embrittlement analyses. An evaluation of that verification activity is provided by the applicant in the SLRA. The reviewer assures that the applicant's verification activity is sufficient to confirm the calculation assumptions for the 80-year period. If the assumption basis is not verified, the applicant must reevaluate the analysis and take appropriate corrective actions as necessary, consistent with the requirements of the affected regulation.

4.2.3.1.1 Neutron Fluence

<u>4.2.3.1.1.1</u> <u>10 CFR 54.21(c)(1)(i)</u>

The reviewer confirms that the applicant's existing RPV neutron fluence analysis remains valid during the subsequent period of extended operation. The reviewer also confirms that the applicant identifies: (i) the neutron fluence for each beltline material at the end of the subsequent period of extended operation, (ii) the NRC staff-approved methodology used to determine the neutron fluence or submits the methodology for NRC staff review, and (iii) whether the methodology is consistent with the guidance in NRC RG 1.190.

4.2.3.1.1.2 *10 CFR 54.21(c)(1)(ii)*

The reviewer confirms that the applicant adequately reevaluated its RPV neutron fluence analysis for the subsequent period of extended operation. A part of the review confirms if the applicant has accurately identified: (i) the neutron fluence for each beltline material at the end of the subsequent period of extended operation, (ii) the NRC staff-approved methodology used to determine the neutron fluence or submits the methodology for NRC staff review, and (iii) that the methodology is consistent with the guidance in NRC RG 1.190.

4.2.3.1.1.3 *10 CFR 54.21(c)(1)(iii)*

The GALL-SLR Report AMP X.M2, "Neutron Fluence Monitoring" provides an acceptable method to project and monitor RPV neutron fluence through the subsequent period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii) (TN4878). The NRC staff reviews an applicant's program for dispositioning the TLAA in accordance with the requirements of 10 CFR 54.21(c)(1)(iii) and the guidance in GALL-SLR Report AMP X.M2. Plant-specific approaches to projecting and monitoring neutron fluence will be evaluated on a case-by-case basis to make sure that the aging effects due to neutron irradiation embrittlement will be managed such that the intended functions(s) will be adequately maintained for the subsequent period of extended operation.

4.2.3.1.2 Upper-Shelf Energy

4.2.3.1.2.1 *10 CFR 54.21(c)(1)(i)*

The projected ¼T neutron fluence at the end of the subsequent period of extended operation is reviewed for all beltline materials to verify that it is bounded by the neutron fluence assumed in the existing USE or NRC-approved EMA analysis in the CLB. As discussed in RIS 2014-11 (Ref. 1), the beltline definition in 10 CFR Part 50, Appendix G is applicable to all RV ferritic materials with projected neutron fluence values greater than 1×10^{17} N/cm^2 (E > 1 MeV). This definition can lead to the evaluation of additional RV materials due to the projected neutron fluence exposure at the end of the subsequent period of extended operation; these additional materials are frequently termed "extended beltline" materials. The assessment would involve a revision to the USE analysis as provided in the CLB to address these additional RV materials. Therefore, the USE TLAA for the additional RV materials should be dispositioned and evaluated in accordance with 10 CFR 54.21(c)(1)(ii) or 10 CFR 54.21(c)(1)(iii). Similarly, any revision to the assessment of any RV material in the CLB should be dispositioned and evaluated in accordance with 10 CFR 54.21(c)(1)(ii) or 10 CFR 54.21(c)(1)(iii).

4.2.3.1.2.2 *10 CFR 54.21(c)(1)(ii)*

The documented results of the revised USE analysis (or revised EMA analysis, as applicable) based on the projected neutron fluence at the end of the subsequent period of extended operation are reviewed for compliance with 10 CFR Part 50 (TN249), Appendix G. The applicant may use NRC RG 1.99 Rev. 2 (Ref. 13) as the basis for using the ¼T neutron fluence values for the RV beltline components (as projected to the end of the SLR period) to project the USE values for the RV beltline components at the end of the subsequent period of extended operation. There are two methodologies in NRC RG 1.99, Revision 2, that can be used in the USE analysis. The first methodology applies when no credible plant-specific surveillance data are available and decreases in Charpy upper-shelf energy are evaluated as a function of fluence and copper content consistent with Figure 2 of NRC RG 1.99 Revision 2. The second methodology applies when a credible surveillance dataset exists for the RPV material, and is used consistent with NRC RG 1.99, Revision 2, to determine the decrease in Charpy upper-shelf energy at the end of the subsequent period of extended operation.

The applicant also may use ASME Code Section XI Appendix K (Ref. 14) for the purpose of performing an EMA to demonstrate that adequate protection for ductile failure is maintained to the end of the subsequent period of extended operation. The NRC staff reviews the applicant's methodology for this evaluation. Branch Technical Position 5-3, "Fracture Toughness Requirements," in Standard Review Plan (Ref. 15), Section 5.3.2, "Pressure Temperature Limits, Upper-Shelf Energy, and Pressurized Thermal Shock," provides additional NRC positions on estimations of USE values for RPV beltline materials.

The NRC staff confirms that the applicant has provided sufficient information for all USE and/or EMA calculations for the subsequent period of extended operation as follows:

The applicant identifies the neutron fluence at the ¼T location for each beltline material at the expiration of the subsequent period of extended operation.

To confirm that the USE analysis meets the requirements of Appendix G of 10 CFR Part 50 at the end of the subsequent period of extended operation, the NRC staff determines whether:

1. For each beltline material, the applicant provides the unirradiated USE, copper content, the projected USE at the end of the subsequent period of extended operation, and whether the drop in USE was determined using the limit lines in Figure 2 of NRC RG 1.99, Revision 2, based on the material copper content, or from surveillance data. For each beltline material previously evaluated in the CLB, the NRC staff confirms either: (i) this information is consistent with the values in the CLB, or (ii) revisions to the values in the CLB are appropriate or conservative. If an assessment of RV materials not previously addressed in the CLB is now necessary due to the projected neutron fluence exposure at the end of the subsequent period of extended operation, the NRC staff will perform a review and assess whether these values are appropriate or conservative for each additional RV material.

2. If there are two or more data for a surveillance material that is from the same heat of material as the RV material, the applicant provides analyses to determine whether the data are credible in accordance with NRC RG 1.99, Revision 2, and whether the use of this surveillance data is appropriate in determining the decrease in Charpy upper-shelf energy in accordance with NRC RG 1.99, Revision 2, Regulatory Position C.2.2. The NRC reviews the applicant's information to assess the adequacy of the applicant's conclusions.

3. If surveillance data from other plants are used in the assessment of USE, the NRC staff reviews the applicant's information to assess the adequacy of the applicant's conclusions on a case-by-case basis.

4. If an EMA is used to demonstrate compliance with the USE requirements in Appendix G of 10 CFR Part 50, the applicant provides the analysis or identifies an NRC-approved TR that contains the analysis which is applicable to the subsequent period of extended operation. Information the NRC staff considers to assess the EMA includes the unirradiated USE (if available) for the material, its copper content, the neutron fluence (¼T and at 1-in depth), the projected USE at the end of the subsequent period of extended operation, the operating temperature in the downcomer at full power, the

vessel radius, the vessel wall thickness, the J-applied analysis for Service Level C and D, the vessel accumulation pressure, and the vessel bounding heat-up/cool-down rate during normal operation. The NRC staff reviews this analysis to confirm that it is satisfies the requirements of Section IV.A.1 of Appendix G to 10 CFR Part 50, which states 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 and is performed using the latest edition and addenda of the ASME Code incorporated by reference in into 10 CFR 50.55a(b)(2) at the time of the analysis.

4.2.3.1.2.3 10 CFR 54.21(c)(1)(iii)

The applicant's proposal to demonstrate that the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation is reviewed on a case-by-case basis.

4.2.3.1.3 Pressurized Thermal Shock (for Pressurized Water Reactors)

4.2.3.1.3.1 10 CFR 54.21(c)(1)(i)

The projected clad-to-base metal interface neutron fluence at the end of the subsequent period of extended operation is reviewed to verify that it is bounded by the neutron fluence assumed in the existing PTS analysis. As discussed in RIS 2014-11 (Ref.1), the beltline definition in 10 CFR Part 50, Appendix G is applicable to all RV ferritic materials with projected neutron fluence values greater than 1×10^{17} N/cm^2 (E > 1 MeV). This definition can lead to the evaluation of additional RV materials due to the projected neutron fluence exposure at the end of the subsequent period of extended operation; these additional materials are frequently termed "extended beltline" materials. The assessment would involve a revision to the PTS analysis as provided in the CLB to address these additional RV materials. Therefore, the PTS TLAA for the additional RV materials should be dispositioned and evaluated in accordance with 10 CFR 54.21(c)(1)(ii) or 10 CFR 54.21(c)(1)(iii). Similarly, any revision to the assessment of any RV material in the CLB should be dispositioned and evaluated in accordance with 10 CFR 54.21(c)(1)(ii) or 10 CFR 54.21(c)(1)(iii).For PTS analysis based on an NRC-approved submittal based on 10 CFR 50.61a (TN249), the applicant demonstrates that the analysis bounds the subsequent period of extended operation and the NRC staff review of these analyses is performed in accordance with SRP-SLR Section 4.7.

4.2.3.1.3.2 10 CFR 54.21(c)(1)(ii)

The documented results of the revised PTS analysis based on the projected neutron fluence at the end of the subsequent period of extended operation are reviewed for compliance with 10 CFR 50.61or 10 CFR 50.61a (TN249), as appropriate.

The NRC staff confirms that the applicant has provided sufficient information for PTS for the subsequent period of extended operation as follows:

The applicant identified the neutron fluence at the clad-to-base metal interface for each beltline material at the expiration of the subsequent period of extended operation.

There are two methodologies from 10 CFR 50.61 that can be used in the PTS analysis, which is based on the projected neutron fluence at the end of the subsequent period of extended operation. RT_{NDT} is the reference temperature (NDT means nil-ductility temperature) used as an indexing parameter to determine the fracture toughness and the amount of embrittlement of a material. The RT_{PTS} is the reference temperature used in the PTS analysis and is related to RT_{NDT} at the end of the facility's operating license. The distinction between these two methodologies is whether the plant has surveillance data, from its RV material surveillance program that is "credible," as described in 10 CFR 50.61 and NRC RG 1.99, Revision 2. For the surveillance data to be defined as credible, the difference in the predicted values and the measured values for ΔRT_{NDT} must be less than 15.6 °C (28 °F) for weld metal components or less than 9.4 °C (17 °F) for base metal components.

The first methodology applies when no credible plant-specific surveillance data are available. In this case, delta RT_{NDT} (ΔRT_{NDT}, the mean value of the adjustment or shift in reference temperature caused by irradiation) is determined by multiplying a chemistry factor from the tables in 10 CFR 50.61 by a neutron fluence factor calculated from the neutron flux using Equation 3 in 10 CFR 50.61.

The second methodology applies when a credible surveillance dataset exists for the RV material, and the chemistry factor can be determined from these data in lieu of a value from the tables in 10 CFR 50.61. The standard deviation for the ΔRT_{NDT} used in the margin term assessment (e.g., $\sigma\Delta$) of the RT_{PTS} calculations may be reduced from 15.6 °C (28 °F) to 7.8 °C (14 °F) for welds or from 9.4 °C (17 °F) to 4.7 °C (8.5 °F) for base metal materials. However, $\sigma\Delta$ need not exceed one-half of the RT_{NDT} value used in the RT_{PTS} calculations. To confirm that the PTS analysis results in RT_{PTS} values below the screening criteria in 10 CFR 50.61 at the end of the subsequent period of extended operation, the applicant provides the following:

1. For each beltline material, provide the unirradiated RT_{NDT}, the method of calculating the unirradiated RT_{NDT} (either generic or plant-specific), copper content, nickel content, the margin, chemistry factor, the method of calculating the chemistry factor, the mean value for the shift in transition temperature, and the RT_{PTS} value. For each beltline material previously evaluated in the CLB, the NRC staff confirms either: (i) that this information is consistent with the values in the CLB, or (ii) revisions to the values in the CLB are appropriate or conservative. If an assessment of RV materials not previously addressed in the CLB is now necessary due to the projected neutron fluence exposure at the end of the subsequent period of extended operation, the NRC staff will perform a review and assess whether these values are appropriate or conservative for each additional RV material.

2. If there are two or more data for a surveillance material that is from the same heat of material as the RV material, provide analyses to determine whether the data are credible in accordance with 10 CFR 50.61 and NRC RG 1.99, Revision 2, and whether the margin value used in the analysis is appropriate. The NRC staff reviews the applicant's analysis to assess the adequacy of the applicant's conclusions.

3. If a surveillance program does not include the vessel beltline controlling material but two or more datasets are available from other beltline materials, then provide an analysis of the data in accordance with NRC RG 1.99, Revision 2, Regulatory Position C.2.1, to show that the results either bound or are comparable to the values that would be calculated for the same materials using Regulatory Position C.1.1. The NRC staff reviews the applicant's information to assess the adequacy of the applicant's conclusions.

4. If surveillance data from other plants are used in the assessment of PTS, the NRC staff reviews the applicant's information to assess the adequacy of the applicant's conclusions on a case-by-case basis.

If the PTS screening criteria in 10 CFR 50.61 are projected to be exceeded during the subsequent period of extended operation, an analysis based on NRC RG 1.154 (Ref. 16) or 10 CFR 50.61a may be submitted for review. For applicants with PTS analysis based upon an NRC-approved submittal using 10 CFR 50.61a, the analysis is revised to reflect the subsequent period of extended operation and the NRC staff review of these analyses are performed in accordance with SRP-SLR Section 4.7.

4.2.3.1.3.3 10 CFR 54.21(c)(1)(iii)

The NRC staff reviews the applicant's proposal to demonstrate that the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation will be reviewed on a case-by-case basis.

If corrective actions are necessary, the NRC staff ascertains that the SLRA provides an assessment of the CLB TLAA for PTS, a discussion of the flux reduction program implemented in accordance with § 50.61(b)(3), if necessary, and an identification of the viable options that exist for managing the aging effect in the future. As part of this review, the staff makes sure that the applicant addressed the following topics:

A. The applicant explains its core management plans (e.g., operation with a low leakage core design and/or integral burnable neutron absorbers) from now through the end of the subsequent period of extended operation. Based on this core management strategy, the applicant:

   (1) identifies the material in the RPV which has limiting RT_{PTS} value;

   (2) provides the projected neutron fluence value for the limiting material at end of the subsequent period of extended operation;

   (3) provides the projected RT_{PTS} value for the limiting material at end of the subsequent period of extended operation; and

   (4) provides the projected date and neutron fluence values at which the limiting material will exceed the screening criteria in § 50.61.

B. The applicant discusses the AMPs or aging management activities that it intends to implement, which actively "manage" the condition of the facility's RPV and hence, the risk associated with PTS. This discussion is expected to address, at least, the facility's reactor pressure vessel material surveillance program.

C. If corrective actions are necessary, the applicant briefly discusses the options that it is considering with respect to "resolving" the PTS issue through end of the subsequent period of extended operation. It is anticipated that this discussion includes some or all of the following:

   (1) plant modifications (e.g., heating of Emergency Core Cooling System injection water) which could limit the risk associated with postulated PTS events [see § 50.61(b)(4) and/or (b)(6)];

(2) more detailed safety analyses which may be performed to show that the PTS risk for the facility is acceptably low through end of the subsequent period of extended operation [see § 50.61(b)(4)];

(3) more advanced material property evaluation (e.g., use of Master Curve technology) to demonstrate greater fracture resistance for the limiting material [applies to § 50.61(b)(4)];

(4) the potential for RPV thermal annealing in accordance with § 50.66 [see § 50.61(b)(7)], and/or

(5) use of the alternative PTS Rule (§ 50.61a).

4.2.3.1.4 Pressure-Temperature Limits

The regulation in 10 CFR Part 50 (TN249), Appendix G requires that the RPV be maintained within established P-T limits during normal operating conditions of the plant, including heat-ups and cool-downs of the reactor and anticipated operational transients, and during pressure test and system leak test conditions. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the RPV becomes embrittled and its fracture toughness is reduced, the allowable pressure (given the required minimum temperature) is reduced.

The adjusted reference temperature (ART) of the limiting RV material is used to adjust the beltline P-T limit curves to account for irradiation effects. The NRC RG 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 fracture characteristics from ductile to brittle behavior. The RT_{NDT} is evaluated according to the procedures in the ASME Code, Section III, Paragraph NB-2331. Neutron embrittlement increases the RT_{NDT} beyond its initial value. 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} values are a function of neutron fluence and these ART calculations are used to establish P-T limits, they may be identified as a TLAA.

In some instances, the applicant may identify ART as a TLAA and the NRC staff review of these analyses is performed in accordance with SRP-SLR Section 4.7. If applicable, the review of ART is to be coordinated with the review of the TLAAs for USE and PTS due to commonality in their use of material properties , and the copper and nickel content values for RV materials.

The following are considerations for the applicant and the NRC staff review if ART is identified as a TLAA:

1. For each beltline material, provide the unirradiated RT_{NDT}, the method of calculating the unirradiated RT_{NDT} (either generic or plant-specific), copper content, nickel content, the margin, chemistry factor, the method of calculating the chemistry factor, the mean value for the shift in transition temperature, and the ART value. For each beltline material previously assessed in the CLB, the NRC staff confirms that either (i) this information is consistent with the values in the CLB, or (ii) revisions to the values in the CLB are

appropriate or conservative. If an assessment of RV materials not previously addressed in the CLB is now necessary due to the projected neutron fluence exposure at the end of the subsequent period of extended operation, the NRC staff will perform a review and assess whether these values are appropriate or conservative for each additional RV material.

2. If there are two or more datasets for a surveillance material from the same heat of material as the beltline material or RV material, provide analyses to determine whether the data are credible in accordance with NRC RG 1.99, Revision 2, and whether the margin value used in the analysis is appropriate. The NRC staff reviews the applicant's analysis to assess the adequacy of the applicant's conclusions.
3. If a surveillance program does not include the vessel beltline controlling material but two or more datasets are available from other beltline materials, then provide an analysis of the data in accordance with NRC RG 1.99, Revision 2, Regulatory Position C.2.1, to show that the results either bound or are comparable to the values that would be calculated for the same materials using Regulatory Position C.1.1. The NRC staff reviews the applicant's information to assess the adequacy of the applicant's conclusions.
4. If surveillance data from other plants are used in the assessment of ART, the NRC staff reviews the applicant's information to assess the adequacy of the applicant's conclusions on a case-by-case basis.

The regulation in 10 CFR 50.36 (Ref. 17) requires that P-T limits be controlled by plant TS; however, the process for performing updates of the P-T limits depends on whether the P-T limit curves for the facility are maintained in the TS LCOs or in a PTLR that is controlled and updated in accordance with the Administrative Controls Section of the plant TS (i.e., by an Administrative Controls TS Section). The P-T limits are TLAAs for the application if the plant currently has P-T limit curves approved for the expiration of the current period of operation (e.g., 32 EFPY or some other licensed EFPY value defined for the expiration date of the current license). However, as stated in SRP-SLR Section 4.2.2.1.3, the assessment of P-T limit TLAAs for incoming SLRAs and basis for accepting the TLAAs under the requirements of 10 CFR 54.21(c)(1)(i), (ii) or (iii) (TN4878) depends on the process that is used for updating the P-T limits.

For P-T limits that are located in the TS LCOs and are controlled by the 10 CFR 50.90 license amendment process, the P-T limits are required to be updated and approved by the NRC prior to expiration of the current P-T limit curves in the TS LCOs, or when a change to the P-T limits is needed for compliance with the requirements in Section IV.C of 10 CFR Part 50, Appendix H. For those plants that have approved PTLRs, the P-T limits are required to be updated prior to expiration of the current P-T limit curves in the PTLRs, or when a change to the P-T limits is needed for compliance with the requirements in Section IV.C of 10 CFR Part 50, Appendix H, or when required by a specific P-T limits update clause in the Administrative Controls TS Section that governs implementation of the PTLR process.

Specifically, for plants with approved PTLRs, the Administrative Controls TS Section governing the PTLR process requires that the update of the P-T limits be accomplished using prescribed methodologies referenced in the TS requirements. The NRC GL 96-03 (Ref. 18) provides the NRC's position on the minimum requirements that need to be included in the Administrative Controls TS Section that governs implementation of the PTLR process and the type of information that need to be included in the NRC-approved methodologies that will be used to update the P-T limits and PTLRs. The GL identifies that 10 CFR 50.90 license amendment requests are not necessary for updates of the P-T limit curves if the required methodologies are used to update the P-T limits in the PTLRs. Since GL 96-03 establishes the NRC's position on what needs be included within the scope of the P-T limit methodologies, applicants with approved PTLRs should verify that the P-T limit methodologies referenced in the applicable Administrative Controls TS Section for their PTLR processes are still in conformance with the criteria in GL 96 03, and that a resulting 10 CFR 54.22 change of the TS is not needed for their SLRAs. If it is determined that a change to the referenced methodologies is needed for the SLRA, the applicant should submit the changes to the referenced methodologies as part of a 10 CFR 54.22 implemented license amendment and TS change request for the SLRA.

4.2.3.1.4.1 10 CFR 54.21(c)(1)(i)

If the P-T limits are located in the TS LCOs or the PTLRs (whichever is applicable to CLB) and the applicant selects the 10 CFR 54.21(c)(1)(i) (TN4878) option as the basis for accepting the TLAA, the projected neutron fluences for the ¼T and ¾T locations of each of the RPV beltline components at the end of the subsequent period of extended operation are reviewed to confirm that they are bounded by the neutron fluences used to develop the existing P-T limit analysis.

4.2.3.1.4.2 10 CFR 54.21(c)(1)(ii)

The documented results of the revised P-T limit analysis based on the projected reduction in fracture toughness at the end of the subsequent period of extended operation is reviewed for compliance with 10 CFR Part 50 (TN249), Appendix G. If the P-T limits are controlled by the TS LCOs, the reviewer confirms that the updated P-T limits for the facility are submitted as a 10 CFR 54.22 (TN4878) required license amendment and TS change request for the facility. The reviewer reviews the submitted P-T limit analysis for compliance with requirements in 10 CFR Part 50, Appendix G. If the P-T limits are controlled by an applicable Administrative Control TS Section and a PTLR process, the updated P-T limits are reviewed to confirm that the updated P-T limits have been submitted in an updated PTLR that has been included with the SLRA. The P-T limits in the updated PTLR are also reviewed to confirm that the P-T limits have been calculated in accordance with the methodologies referenced in the applicable Administrative Controls TS Section for the PTLR process, or if not, that the updated methodology or methodologies used to generate the updated P-T limits in the PTLR has or have been submitted as part of a 10 CFR 54.22 implemented license amendment and TS change request for the SLRA.

The P-T limit evaluations are dependent upon the neutron fluence.

4.2.3.1.4.3 10 CFR 54.21(c)(1)(iii)

P-T limits for the subsequent period of extended operation will be updated (if required) prior to the plant's entry into the subsequent period of extended operation, or prior to exceeding their current terms of applicability. The 10 CFR 50.90 process for P-T limits located in the TS LCOs or the TS Administrative Controls Process for P-T limits that are administratively amended through a PTLR process can be considered adequate AMPs within the scope of 10 CFR 54.21(c)(1)(iii) (TN4878), such that P-T limits will be maintained through the subsequent period of extended operation.

For plants whose P-T limits are controlled by an applicable Administrative Controls TS Section and an NRC-approved PTLR process, the methodologies referenced in the applicable TS

Section are reviewed to verify that they will comply with the requirements in 10 CFR Part 50, Appendix G and conform to the recommended position for minimum methodology contents in GL 96-03. Otherwise, the basis of the methodology for generating updates of the P-T limits during the subsequent period of extended operation are reviewed to determine whether a 10 CFR 54.22-implemented license amendment and TS change of the methodology requirements is necessary for the SLRA.

For BWRs whose applicants are accepting their P-T limits in accordance with the criterion in 10 CFR 54.21(c)(1)(iii), the NRC staff confirms that the applicant addresses the following Renewal Applicant Action Item in the NRC staff's SER for BWRVIP 74 (Ref. 19).

> Action Item 9: Appendix A of BWRVIP-74-A (Ref. 20) indicates that a set of P-T curves should be developed for the heat-up and cool-down operating conditions in the plant at a given EFPY in the subsequent period of extended operation.

This means that, for this action item, the applicant has not provided updated curves, but shall have a procedure for updating P-T limits in accordance with 10 CFR Part 50, Appendix G, that will cover 80 years.

4.2.3.1.5 Elimination of Boiling Water Reactor Circumferential Weld Inspection

Some BWRs have an approved technical alternative in the CLB, which eliminates the RPV circumferential shell weld inspections from the ASME Code Section XI program for the current license term. If these analyses are identified as TLAAs, they will be evaluated on a case-by-case basis in accordance with 10 CFR 54.21(c)(1).

The staff verifies that the applicant has identified that, should the inspection relief be desired for the subsequent period of extended operation, an application will be made under 10 CFR 50.55a(z)(1) prior to entering the subsequent period of extended operation. If the applicant indicates that relief from circumferential weld examination will be provided under 10 CFR 50.55a(z)(1), and if the alternative is then approved by the staff, the applicant will manage this TLAA in accordance with 10 CFR 54.21(c)(1)(iii).

If the applicant relies on the generic evaluation in BWRVIP-329-A, the staff verifies the plant-specific information in the SLRA demonstrates that the PFM evaluation in this report is applicable and that the effects of aging on the intended function of the reactor circumferential weld will be adequately managed. Specifically, Table 5-1 in Section 5 of BWRVIP-329-A provides a means to verify that a specific BWR RPV is enveloped by the generic PFM analysis in the report, and Table 5-2 of Section 5 of BWRVIP-329-A provides a template for showing that the plant-specific limiting RPV beltline RT_{MAX} (mean inner surface reference temperature for RPV axial welds) values are less than the limiting RT_{MAX} values analyzed in BWRVIP-329-A.

Additionally, the staff verifies, during the application for relief of circumferential weld examinations in accordance with 10 CFR 50.55a(z)(1), that the applicant has demonstrated successfully that proper operator training and procedures were utilized during the subsequent license renewal term to limit the frequency for cold overpressure events to the amount specified in the NRC staff's July 28, 1998, safety evaluation of BWRVIP-05 (ADAMS Accession No. ML20236V551).

4.2.3.1.6 Boiling Water Reactor Axial Welds

Those BWRs that have been approved to use the circumferential weld alternative also were required to perform conditional probability of failure analyses of their RPV axial shell welds. If these analyses are identified as TLAAs, they will be evaluated on a case-by-case basis in accordance with 10 CFR 54.21(c)(1) (TN4878).

If the applicant relies on the generic evaluation in BWRVIP-329-A, the staff verifies the plant-specific information in the SLRA demonstrates that the PFM evaluation in this report related to the integrity of axial welds for RPVs are applicable. Specifically, Table 5-1 in Section 5 of BWRVIP-329-A provides a means to verify that a specific BWR RPV is enveloped by the generic PFM evaluation in the report, and Table 5-2 of Section 5 of BWRVIP-329-A provides a template for showing that the plant-specific limiting RPV beltline RT_{MAX} values are less than the limiting RT_{MAX} values analyzed in BWRVIP-329-A.

4.2.3.2 Final Safety Analysis Report Supplement

The reviewer verifies that the applicant has provided information to be included in the FSAR Supplement that includes a summary description of the evaluation of the RPV neutron embrittlement TLAA. Table 4.2-1, "Examples of FSAR Supplement for Reactor Vessel Neutron Embrittlement Analyses" of this review plan section contains examples of acceptable FSAR Supplement information for this TLAA. The reviewer verifies that the applicant has provided an FSAR Supplement with information equivalent to that in Table 4.2-1.

The NRC staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursuant to 10 CFR 50.71(e)(4) (TN249). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR Supplement before the license is renewed, no condition will be necessary.

An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to make sure that the applicant will complete these activities no later than the committed date.

4.2.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section and whether the NRC staff's evaluation supports conclusions of the following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878), to be included in the SER:

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that, for the RPV neutron embrittlement TLAA, [choose which is appropriate]

(i) the analyses remain valid for the subsequent period of extended operation,

(ii) the analyses have been projected to the end of the subsequent period of extended operation, or

(iii) the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation. The NRC staff also concludes that the FSAR Supplement contains an appropriate summary description of the RPV neutron embrittlement TLAA evaluation for the subsequent period of extended operation.

4.2.5 References

1. NRC. RIS No. 2014-11, "Information on Licensing Applications for Fracture Toughness Requirements for Ferritic Reactor Coolant Pressure Boundary Components." Agencywide Documents Access and Management System (ADAMS) Accession No. ML14149A165. Washington, DC: U.S. Nuclear Regulatory Commission. October 14, 2014. NRC 2014-TN7992

2. 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. 2016. 10 CFR Part 54-TN4878

3. 10 CFR 54.21, "Contents of Application–Technical Information." Washington, DC: U.S. Nuclear Regulatory Commission. 2016. TN4878

4. 10 CFR Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements." Washington, DC: U.S. Nuclear Regulatory Commission. 2016. TN249

5. NRC. Regulatory Guide 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence." ADAMS Accession No. ML010890301. Washington, DC: U.S. Nuclear Regulatory Commission. 2001.

6. 10 CFR Part 50, Appendix G, "Fracture Toughness Requirements." Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

7. 10 CFR 50.61, "Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events." Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

8. 10 CFR 50.61a, "Alternate Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events." Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

9. L.A. Reyes. Letter (May 27) to the Commission. ADAMS Accession No. ML041190564. Washington, DC: U.S. Nuclear Regulatory Commission. 2004.

10. 10 CFR 50.90, "Application for Amendment of License, Construction Permit, or Early Site Permit." Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

11. 10 CFR 54.22, "Contents of Application – Technical Specifications." Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

12. CFR 50.59, "Changes, Tests, and Experiments." Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

13. NRC. Regulatory Guide 1.99, "Radiation Embrittlement of Reactor Vessel Materials." Revision 2. ADAMS Accession No. ML003740284. Washington, DC: U.S. Nuclear Regulatory Commission. May, 1988.

14. ASME. ASME Code Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components, Nonmandatory Appendix K, Assessment of Reactor Vessels with Low Upper Shelf Charpy Impact Energy Levels.” New York, New York: The American Society of Mechanical Engineers. 2010.

15. NRC. NUREG–0800, “U.S. Nuclear Regulatory Commission, Standard Review Plan.” ADAMS Accession No. ML070630046. Washington, DC: U.S. Nuclear Regulatory Commission. March 2007. NRC 2021-TN8013

16. NRC. Regulatory Guide 1.154, “Format and Content of Plant-Specific Pressurized Thermal Shock Safety Analysis Reports for Pressurized Water Reactors.” Washington, DC: U.S. Nuclear Regulatory Commission. January 1987.

17. 10 CFR 50.36, “Technical Specifications.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

18. NRC. Generic Letter 96-03, “Relocation of the Pressure Temperature Limit Curves and Lower Temperature Overpressure Protection System Limits.” Washington, DC: U.S. Nuclear Regulatory Commission. 1996.

19. Christopher Grimes. Letter (October 18) to Carl Terry of Niagara Mohawk Power Company, BWRVIP Chairman, “Acceptance for Referencing of EPRI Proprietary Report TR-113596, BWR Vessel and Internals Project, BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines BWRVIP-74), and Appendix A, Demonstration of Compliance with the Technical Information Requirements of the License Renewal Rule (10 CFR 54.21).” Washington, DC: U.S. Nuclear Regulatory Commission. 2001.

20. EPRI. EPRI TR–1008872, “BWRVIP-74-A, BWR Vessels and Internals Project, BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal.” Palo Alto, California: Electric Power Research Institute. June 2003.

21. 10 CFR 50.71, “Maintenance of Records, Making of Reports.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

Table 4.2-1 Examples of Final Safety Analysis Report Supplement for Reactor Vessel Neutron Embrittlement Analyses

Time-Limited Aging Analyses (TLAA)	Description of Evaluation	Implementation Schedule*
Neutron fluence Example for acceptance per § 54.21(c)(1)(iii)	The neutron fluence of each reactor vessel (RV) component made from a ferritic steel material has been projected to the end of the period of extended operation using a methodology that conforms to the guidance in Regulatory Guide (RG) 1.190 or other fluence methodology approved by the staff. The neutron fluence values for these components may be monitored through the end of the subsequent period of extended operation using a program that conforms to the guidance in Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report AMP X.M2, “Neutron Fluence Monitoring,” or alternatively, using a plant-specific program that has been approved by the staff.	Fluence values have been projected for the subsequent period of extended operation and provided in the subsequent license renewal application (SLRA).
Upper-shelf energy (USE) Example for acceptance per § 54.21(c)(1)(ii)	Example for plant-specific USE analysis accepted under § 54.21(c)(1)(ii) 10 CFR Part 50 (TN249) Appendix G Paragraph IV.A.1 requires that the reactor pressure vessel (RPV) beltline materials must have Charpy USE of no less than 68 J (50 ft-lb) throughout the life of the RPV unless otherwise approved by the NRC. The USE analyses for the ferritic steel components (i.e., RPV shell plates or forgings, nozzle plates or forgings, and associated pressure retaining welds) in the beltline region of the RPV have been updated based on component neutron fluence values that have been projected to the end of the subsequent period of extended operation and the current RPV Surveillance test data for the facility. (Applicant to add any additional information it considers necessary for the quality of the Final Safety Analysis Report [FSAR] Supplement summary description, including information that it may desire to include relative to codes, standards, RG criteria, or other U.S. Nuclear Regulatory Commission [NRC]-approved methods used in performance of the USE calculations.)	The updated USE analysis is complete. That is, the updated USE analysis accepted under 10 *Code of Federal Regulations* (CFR) 54.21(c)(1)(ii) was completed and quality assurance (QA) reviewed by the applicant prior to submittal of the SLRA and is included in the SLRA submitted for NRC approval in accordance with 10 CFR Part 54 reporting requirements. The basis for demonstrating acceptance of the TLAA under 10 CFR 54.21(c)(1)(ii) is included in the SLRA.

Table 4.2-1 Examples of Final Safety Analysis Report Supplement for Reactor Vessel Neutron Embrittlement Analyses (Continued)

Time-Limited Aging Analyses (TLAA)	Description of Evaluation	Implementation Schedule*
	The updated USE values for the components are projected to exceed 68 J (50 ft-lb) at the end of the subsequent period of extended operation. This provides an acceptable basis for demonstrating that the USE TLAA is acceptable in accordance with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(ii) and that the analysis has been projected to the end of the subsequent period of extended operation.	
Upper-shelf energy (USE) Example for acceptance per § 54.21(c)(1)(ii)	Example for plant-specific RPV component USE assessment projected under §54.21(c)(1)(ii) that fails to meet the 50 ft-lb (68 J) USE requirement at the end of the subsequent period of extended operation and an EMA is submitted to demonstrate acceptability under 10 CFR 54.21(c)(1)(ii) The upper-shelf energy analysis for RPV (Insert specific RPV shell, forging or weld component description and ID number along with applicable Heat No. in parentheses), as projected to the end of the subsequent period of extended operation, did not comply with the 50 ft-lb (68 J) for these types of assessment in 10 CFR Part 50, Appendix G. To address the potential non-compliance, a plant-specific EMA for the component was submitted (Select Either: “with the LRA” or “in a license amendment”) to demonstrate that the safety margins against fracture for component are at least as conservative as those required for the component by the provisions in the ASME Boiler and Pressure Vessel Code, Section XI, for the facility. The EMA was approved (Select Either: “in the safety evaluation report for the SLRA.” or “in an individual safety evaluation for the license amendment action that was submitted in accordance with 10 CFR Part 50, Appendix G, reporting requirements.”) This provides sufficient demonstration that the EMA(s) for the RPV component(s) [is/are] acceptable in accordance with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(ii) and that the (analysis/analyses) (has/have]) been projected	The updated equivalent margins analysis (EMA) analysis is complete. That is, the updated EMA analysis submitted under 10 CFR 54.21(c)(1)(ii) was to be completed and QA reviewed by the applicant prior to submittal of the SLRA and to be included in the SLRA that is submitted for NRC approval in accordance with 10 CFR Part 54 (TN4878). Alternatively, the EMA analysis was submitted as a license amendment and approved by the NRC in accordance with 10 CFR 50.90, and the SLRA provides the basis for this prior license amendment as a sufficient demonstration that the TLAA is acceptable in accordance with 10 CFR 54.21(c)(1)(ii).

Table 4.2-1 Examples of Final Safety Analysis Report Supplement for Reactor Vessel Neutron Embrittlement Analyses (Continued)

Time-Limited Aging Analyses (TLAA)	Description of Evaluation	Implementation Schedule*
	to the end of the subsequent period of extended operation.	
Upper-shelf energy (USE) Example for acceptance per § 54.21(c)(1)(ii)	Example for boiling water reactor (BWR) SLRAs that submit updated Boiling Water Reactor Vessel and Internals Project (BWRVIP)-74 Equivalent Margins Analyses for their RPV components under 10 CFR 54.21(c)(1)(ii) The USE requirements in 10 CFR Part 50, Appendix G for the shell (Select Either: “plate components” or “forging components”), nozzles, and welds located in the beltline region of the RPV have been addressed through the performance of an EMA for the components, as permitted by the 10 CFR Part 50, Appendix G, rule. The EMAs were calculated using neutron fluence values for the components that were projected to the end of the subsequent period of extended operation. The EMAs were performed in accordance with the generic criteria for performing these types of assessments in Appendix B of Electric Power Research Institute Report No. 1008872 (BWRVIP-74-A) and were submitted for NRC review in accordance with Applicant Action Item No. 10 in the NRC safety evaluation for BWRVIP-74-A dated October 18, 2001 (ADAMS ML012920549). The NRC reviewed the updated EMAs for the components and found them to be acceptable in accordance with NRC’s criteria for accepting these types of EMAs, as given in the NRC safety evaluation for the BWRVIP-74-A. This provides sufficient demonstration that the EMAs for the RPV components are acceptable in accordance with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(ii) and that the analyses have been projected to the end of the subsequent period of extended operation.	The updated EMA analysis is complete. That is, the updated EMA analysis accepted under 10 CFR 54.21(c)(1)(ii) was completed and QA reviewed by the applicant prior to submittal of the SLRA and is included in the SLRA submitted for NRC approval in accordance with 10 CFR Part 54. Alternatively, the EMA analysis was submitted as a license amendment and approved by the NRC in accordance with 10 CFR 50.90, and the SLRA provides the basis for this prior license amendment as a sufficient demonstration that the TLAA is acceptable in accordance with 10 CFR 54.21(c)(1)(ii). Submittal of these types of EMAs are subject to the Applicant Action Item 10 in the staff’s safety evaluations for BWRVIP-74-A, dated October 18, 2001.
Pressurized thermal shock (for PWRs) Example for acceptance per § 54.21(c)(1)(ii)	For PWRs, 10 CFR 50.61 requires the reference temperature for pressurized thermal shock for RPV beltline materials to be less than the pressurized thermal shock (PTS) screening criteria at the expiration date of the operating license unless otherwise approved by the NRC. The reference temperature has been	The 10 CFR 50.61 evaluation is complete. Updated PTS analysis accepted under 10 CFR 54.21(c)(1)(ii) to be completed and ’QA’d by the applicant prior to submittal of the SLRA and to be included

Table 4.2-1 Examples of Final Safety Analysis Report Supplement for Reactor Vessel Neutron Embrittlement Analyses (Continued)

Time-Limited Aging Analyses (TLAA)	Description of Evaluation	Implementation Schedule*
	determined to be less than the PTS screening criteria at the end of the subsequent period of extended operation, unless alternate requirements have been invoked in accordance with 10 CFR 50.61(b) and approved by the NRC.	in the SLRA that is submitted for NRC approval in accordance with 10 CFR Part 54, and the applicant is to demonstrate acceptability of the TLAA during the SLRA review using the TLAA acceptance criteria in 10 CFR 54.21(c)(1)(ii).
Pressure-temperature (P-T) limits Example for acceptance per § 54.21(c)(1)(iii)	10 CFR Part 50 Appendix G requires that heat-ups and cool-downs of the RPV be accomplished within established P T limits. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the RPV becomes embrittled and its fracture toughness is reduced, the minimum allowable temperature for operating at a given reactor pressure in the pressure range for permissible operations (i.e., pressures up to the maximum allowable safety limit pressure set in technical specifications [TS]) allowable pressure is increased. 10 CFR Part 50 Appendix G requires periodic update of P-T limits based on projected embrittlement and data from a material surveillance program. The P-T limits will be updated in accordance with the requirements (Select Either: “the 10 CFR 50.90 license amendment process.” for facilities with P-T limits set and governed by the limiting conditions of operation in the plant TS, or “the plant’s program for implementing its pressure-temperature limits report process, as governed by the Administrative Controls Section of the plant technical specifications.” for plants licensed to implement pressure-temperature limit reports [PTLRs]) in order to consider the impacts of increasing neutron fluence levels caused by operations during the subsequent period of extended operation.	For P-T limits controlled by TS limiting conditions for operations (LCOs): Updates of the P-T limit curves are set relative to the expiration dates of the existing licensed P-T limit curves. Updates of the P-T limit curves are to be submitted for NRC approval in accordance with the applicant’s 10 CFR 50.90 license amendment request process. Updates of the P-T curves must be finalized, QA’d, submitted for NRC approval, approved by the NRC, and implemented prior to the expiration dates of the current licensed P-T limit curves located in the LCOs section of the plant TS. For P-T limits controlled by TS PTLR requirements: Updates of the P-T limit curves are set relative to the expiration dates of the existing licensed P-T limit curves. The updated P-T limit curves and PTLR are required to be updated in accordance with the applicant’s PTLR implementation process, as governed by applicable

Table 4.2-1 Examples of Final Safety Analysis Report Supplement for Reactor Vessel Neutron Embrittlement Analyses (Continued)

Time-Limited Aging Analyses (TLAA)	Description of Evaluation	Implementation Schedule*
		requirements in the Administrative Controls Section of the plant technical specifications (TS). Updates of the P-T curves must be finalized and implemented prior to the expiration dates of the licensed curves in the current PTLR. Updated PTLRs are to be submitted to the NRC in accordance with any applicable reporting requirements in the TS Administrative Controls Section governing implementation of the PTLR process (depending in the TS provisions, this may or may not require NRC approval).
Elimination of BWR circumferential weld inspections and analysis of BWR axial welds	Examples of the FSAR Supplements for these TLAAs are not given - approved technical alternatives for SLR have yet to be developed.	If the TLAA is applicable, a plant-specific implementation schedule to be provided on a plant-specific basis and justified by the applicant.
Other miscellaneous TLAAs on RV neutron embrittlement	Provide sufficient information on how the calculations for plant-specific TLAAs were performed, what the limiting TLAA parameter was calculated to be in accordance with the neutron fluence projected for the subsequent period of extended operation, and why the TLAA is acceptable under either 10 CFR 54.21 (c)(1)(i), (ii), or (iii).	If the TLAA is applicable, a plant-specific implementation schedule to be provided on a plant-specific basis and justified by the applicant.

*An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

BWR = boiling water reactor; BWRVIP = Boiling Water Reactor Vessel and Internals Project; CFR = *Code of Federal Regulations*; EMA = equivalent margins analysis; FSAR = Final Safety Analysis Report; GALL-SLR = Generic Aging Lessons Learned for Subsequent License Renewal; LCO = limiting conditions for operation; LRA = license renewal application; NRC = U.S. Nuclear Regulatory Commission; P-T = pressure-temperature; PTLR = pressure-temperature limit report; PTS = pressurized thermal shock; QA = quality assurance; RG = Regulatory Guide; RPV = reactor pressure vessel; RV = reactor vessel; SLRA = subsequent license renewal application; TLAA = Time-Limited Aging Analyses; TS = technical specifications; USE = upper-shelf energy.

4.3 Metal Fatigue

Review Responsibilities

Primary — Branch(es) responsible for the TLAA issues

Secondary — None

4.3.1 Area of Review

Fatigue occurs in a metal component when it is subjected to fluctuating loads. If the loading is of sufficient magnitude or frequency, cracks may initiate and propagate in the component at the location of maximum loading. To address fatigue concerns, Section III of the ASME Code requires a fatigue analysis for Class 1 components. The analysis must consider all expected cyclic loads based on the anticipated number of cyclic loadings. In the most rigorous evaluation, the ASME Code provisions include the calculation of the cumulative usage factor (CUF) for selected locations within a component, which is a calculated measure of the expended fatigue initiation life at each location in the component. Under these provisions, the ASME Code limits the CUF to a value of less than or equal to unity for acceptable fatigue design. A CUF below a value of unity provides assurance that no crack has initiated at the analyzed location in the component. Other provisions in Section III of the ASME Code allow less rigorous treatment to address the fatigue design in components that have smaller or less frequent cyclic loadings, (i.e., fatigue waiver evaluation). In some cases, continued adequacy of the fatigue life of a component may be demonstrated through reinspections that continue to demonstrate an absence of fatigue flaws (i.e., as supported by applicable flaw tolerance evaluations). In other cases, the growth of fatigue flaws is assessed to ensure that flaws detected in components remain within allowable limits.

The acceptability of metal components from a fatigue standpoint is demonstrated by one or more relevant fatigue parameters, which include, but are not limited to, the CUF values, the environmentally-adjusted CUF_{en} values, transient cycle limits, and predicted flaw sizes (for fatigue flaw tolerance or component flaw evaluations). The limits of the fatigue parameters are established by the applicable fatigue analyses and may be a design limit, for example from an ASME Code fatigue evaluation, or an analysis-specific value, for example based on the number of cyclic load occurrences assumed in fatigue waiver evaluations or the acceptable flaw sizes postulated in flaw tolerance or component flaw evaluations.

As a result of the assumptions used in the underlying evaluations associated with metal component fatigue parameters (i.e., the magnitude and frequency of the assumed cyclic loadings for the future operating life of the component), the continued validity of metal fatigue analyses is reviewed for the subsequent period of extended operation.

Areas of review to ascertain that the metal component fatigue parameter evaluations are valid for the subsequent period of extended operation include:

1. The CUF calculations or fatigue waiver evaluations for components designed using the fatigue requirements of Section III of the ASME Code or other Codes that use a I_t calculation (e.g., the 1969 edition of American National Standards Institute [ANSI] B31.7 for Class 1 piping, ASME NC-3200 vessels, ASME NE-3200 Class MC components, ASME NG-3200 core support structures, and metal bellows designed to ASME NC 3649.4(e)(3), ND-

3649.4(e)(3), or NE-3366.2(e)(3) or the Draft ASME Code for Pumps and Valves for It analyses).

2. Fatigue-based maximum allowable stress calculations for components evaluated to United States of America Standards ANSI B31.1 or ASME Code Class 2 and 3 requirements.
3. The CUF calculations for components that require evaluation of environmental effects (CUF_{en}).
4. Fatigue-based flaw growth, flaw tolerance, or fracture mechanics analyses, including those used to support reinspection intervals for components.

4.3.2 Acceptance Criteria

Acceptance criteria are provided in the following sections for the areas of review described in Section 4.3.1 that delineate acceptable methods for meeting the requirements of the UNRC regulations in 10 CFR 54.21(c)(1).

4.3.2.1 Time-Limited Aging Analysis

Pursuant to 10 CFR 54.21(c)(1)(i) through (iii) (TN4878), an applicant must demonstrate one of the following for each analysis:

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.

In some instances, the applicant may identify activities to be performed to verify the assumption bases of the fatigue analyses. Evaluations of those activities are provided by the applicant. The reviewer assures that the applicant’s activities are sufficient to confirm the calculation assumptions for the subsequent period of extended operation.

Specific acceptance criteria for metal component fatigue evaluations are discussed in the following sections.

4.3.2.1.1 Components Evaluated for Fatigue Parameters Other than CUF_{en}

For metal components evaluated for fatigue parameters other than CUF_{en}, the acceptance criteria depends on the applicant’s choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878), and are as follows:

4.3.2.1.1.1 10 CFR 54.21(c)(1)(i)

The existing fatigue parameter calculations remain valid for the subsequent period of extended operation because the number of accumulated cycles and the assumed severity of each of the cyclic loadings evaluated in the calculations are not projected to exceed the limits evaluated for these loadings. The revised projections are verified to be consistent with historical plant operating characteristics and anticipated future operation.

<u>4.3.2.1.1.2</u> <u>10 CFR 54.21(c)(1)(ii)</u>

The fatigue parameter calculations are revised and shown to remain acceptable throughout the subsequent period of extended operation based on a revised projection of the cumulative number and assumed severity of each of the cyclic loadings to the end of the subsequent period of extended operation. The revised projections are verified to be consistent with historical plant operating characteristics and anticipated future operation. The resulting fatigue parameter values are verified to remain less than or equal to their respective allowable value for the subsequent period of extended operation.

<u>4.3.2.1.1.3</u> <u>10 CFR 54.21(c)(1)(iii)</u>

The applicant proposes an AMP as the basis for demonstrating that the effect or effects of aging on the intended function(s) of the structure(s) or component(s) in the fatigue parameter evaluations will be adequately managed during the subsequent period of extended operation. The AMP in Section X.M1, “Fatigue Monitoring,” of the GALL-SLR Report provides one method that may be used to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii) (TN4878).

An applicant may also propose another AMP to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii). If the basis for aging management is a plant-specific AMP, the AMP is described in terms of the 10 program elements defined in the SRP-SLR, Appendix Section A.1, “Branch Technical Position, Aging Management Review—Generic,” Sections A.1.2.3.1 through A.1.2.3.10.

If an inspection program is proposed as the basis for aging management, the applicant should make sure that: (i) inspections will be performed for the specific component(s) or structure(s) in the evaluation and (ii) applicant has justified that the inspection methods and frequencies in the proposed inspection program are applicable to the component(s), such that they may be used to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii) (TN4878).

4.3.2.1.2 Components Evaluated for CUF_{en}

For metal components evaluated for CUF_{en}, the acceptance criteria depends on the applicant’s choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878).

Applicants should also include CUF_{en} calculations for additional component locations if they are considered to be more limiting than those previously evaluated. This sample set includes the locations identified in NUREG/CR–6260 and additional plant-specific component locations in the reactor coolant pressure boundary if they may be more limiting than those considered in NUREG/CR–6260. Plant-specific justification can be provided to demonstrate that calculations for the NUREG/CR–6260 locations do not need to be included. Environmental effects on fatigue for these critical components can be evaluated using the positions described in RG 1.207, Revision 1[4]; NUREG/CR–6909, Revision 0 (with “average temperature” used consistent with the clarification that was added to NUREG/CR–6909, Revision 1); or other subsequent NRC-endorsed alternatives.

[4] If and when published as RG 1.207, Revision 1 Final.

4.3.2.1.3 10 CFR 54.21(c)(1)(i)

The existing CUF_{en} calculations remain valid for the subsequent period of extended operation because the number of accumulated cycles, the assumed severity of the cyclic loadings, and the assumed water chemistry conditions evaluated in the calculations are not projected to exceed the limits evaluated for these parameters. The revised projections for the number of accumulated cycles are verified to be consistent with historical plant operating characteristics and anticipated future operation.

A plant-specific justification can be provided to demonstrate that existing CUF_{en} calculations performed using guidance in Section 4.3.2.1.3 of NUREG–1800, Revision 2 will remain valid for the subsequent period of extended operation and are sufficiently conservative when compared to those CUF_{en} calculations that would be generated using the guidance in RG 1.207, Revision 1[5], or in NUREG/CR–6909, Revision 0 (with “average temperature” used consistent with the clarification that was added to NUREG/CR–6909, Revision 1).

4.3.2.1.4 10 CFR 54.21(c)(1)(ii)

The CUF_{en} calculations are revised and shown to remain acceptable throughout the subsequent period of extended operation based on a revised projection of the cumulative number of occurrences, the assumed severity of cyclic loadings, and the assumed water chemistry conditions to the end of the subsequent period of extended operation. The revised projections are verified to be consistent with historical plant operating characteristics and anticipated future operation. The resulting CUF_{en} values are verified to remain less than or equal to unity for the subsequent period of extended operation.

4.3.2.1.5 10 CFR 54.21(c)(1)(iii)

In Section X.M1 of the GALL-SLR Report, the NRC staff evaluated a program for monitoring and tracking the number of occurrences and the severity of critical cyclic loadings for selected components. In Section XI.M2 of the GALL-SLR Report, the NRC staff evaluated a program for monitoring and tracking water chemistry conditions. The NRC staff determined that these programs, when used together, are acceptable AMPs to address the effects of reactor water environment on component fatigue life according to 10 CFR 54.21(c)(1)(iii) (TN4878). The GALL-SLR Report may be referenced in a SLRA and should be treated in the same manner as an approved TR. In referencing the GALL-SLR Report, the applicant should indicate that the material referenced is applicable to the specific plant involved and should provide the information necessary to adopt the finding of program acceptability as described and evaluated in the report. The applicant also should verify that the approvals set forth in the GALL-SLR Report for the generic program apply to the applicant’s program. Alternatively, the components could be replaced and the CUF_{en} values for the replacement components shown to be acceptable for the subsequent period of extended operation.

4.3.2.2 Final Safety Analysis Report Supplement

The specific criterion for meeting 10 CFR 54.21(d) (TN4878) is that the summary description of the evaluation of TLAAs for the subsequent period of operation in the FSAR Supplement is sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description should contain sufficient information such as source of the data, references to the

[5] If and when published as RG 1.207, Revision 1 Final.

methodology used, and parameters used. The basis for demonstrating acceptance of the TLAA under 10 CFR 54.21(c)(1)(i), (ii), or (iii), should be included and demonstrated in the SLRA.

4.3.3 Review Procedures

Review procedures for metal component fatigue parameter evaluations for the areas of review described in Subsection 4.3.1 are discussed in the following subsections.

4.3.3.1 Time-Limited Aging Analysis

The Code of Record should be used for the reevaluation, or the applicant may update to a later Code edition pursuant to 10 CFR 50.55a using an appropriate Code reconciliation. In the latter case, the reviewer verifies that the requirements in 10 CFR 50.55a are met. The reviewer assures that the applicant's activities are sufficient to confirm the calculation assumptions for the subsequent period of extended operation.

4.3.3.1.1 Components Evaluated for Fatigue Parameters Other Than CUF_{en}

For metal components evaluated for fatigue parameters other than CUF_{en}, the review procedures depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878), and are as follows:

4.3.3.1.1.1 10 CFR 54.21(c)(1)(i)

The operating cyclic load experience and a list of the assumed transients used in the existing fatigue parameter calculations are reviewed for the current operating term to ensure that the projected number of transient occurrences during the subsequent period of extended operation will not exceed the assumed number of transient occurrences in the existing fatigue parameter calculations. The projected number of occurrences for each transient is verified to be consistent with historical plant operating characteristics and anticipated future operation. In addition, a comparison of the operating cyclic load severity to the severity for each transient assumed in the existing fatigue parameter calculations is made to demonstrate that the cyclic load severity for each transient used in the fatigue parameter calculations remains bounding. For consistency purposes, the review also includes an assessment of the TLAA information against relevant design basis information and CLB information.

4.3.3.1.1.2 10 CFR 54.21(c)(1)(ii)

The operating cyclic load experience is reviewed to make sure that the increased number of cyclic load occurrences and their severity for each transient used for any reanalysis remains within the number of transient occurrences and severity for each transient projected to the end of the subsequent period of extended operation. The revised fatigue parameter calculations are reviewed to make sure that the fatigue parameter remains less than or equal to the allowed value at the end of the subsequent period of extended operation. The revised fatigue parameter calculations are shown to remain acceptable based on revised projections of the cumulative number of occurrences and the assumed severity of each transient to the end of the subsequent period of extended operation. The revised projections are verified to be consistent with historical plant operating characteristics and anticipated future operation. For consistency purposes, the review also includes an assessment of the TLAA information against relevant design basis information and CLB information.

4.3.3.1.1.3 *10 CFR 54.21(c)(1)(iii)*

Pursuant to 10 CFR 54.21(c)(1)(iii) (TN4878), the applicant proposes an AMP or aging management activities as the basis for demonstrating that the effect or effects of aging on the intended function(s) of the structure(s) or component(s) in the fatigue parameter evaluation will be adequately managed during the subsequent period of extended operation. If Section X.M1, "Fatigue Monitoring," of the GALL-SLR Report is used as the basis for managing cumulative fatigue damage or cracking due to fatigue or cyclical loading in the structure(s) or component(s), the reviewer reviews the applicant's AMP against the program elements defined in GALL-SLR Report Section X.M1.

An applicant also has the option of proposing another GALL-based AMP, a plant-specific AMP, or plant-specific activities, or combination of, to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii). If another GALL-based AMP is proposed as the basis for aging management, the reviewer evaluates the applicant's AMP against the program element criteria defined in the applicable AMP in Chapter XI of the GALL-SLR Report. If the basis for aging management is a plant-specific AMP or plant-specific aging management activities, the reviewer evaluates the program element criteria for the AMP or activities against the program element criteria defined in this SRP-SLR, Appendix Section A.1, "Branch Technical Position, Aging Management Review—Generic," Sections A.1.2.3.1 through A.1.2.3.10.

If a sampling-based inspection program (a type of condition monitoring program) is proposed as the basis for aging management, the reviewer ascertains that the AMP actually performs inspections of the specific component(s) or structure(s) in the evaluation at each unit in a multiunit site and that the applicant has appropriately justified that the inspection methods and associated frequencies are capable of managing cumulative fatigue damage or cracking by fatigue or cyclical loading in the component(s) or structure(s), such that the TLAA may be accepted in accordance with 10 CFR 54.21(c)(1)(iii).

4.3.3.1.2 Components Evaluated for CUF_{en}

For metal components evaluated for CUF_{en}, the review procedures depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878).

Applicants should include CUF_{en} calculations for the limiting component locations exposed to the reactor water environment. This sample set includes the locations identified in NUREG/CR–6260 and additional plant-specific component locations in the reactor coolant pressure boundary if they may be more limiting than those considered in NUREG/CR–6260. Plant-specific justification can be provided to demonstrate that calculations for the NUREG/CR–6260 locations do not need to be included. Environmental effects on fatigue for these critical components may be evaluated using the guidance in RG 1.207, Revision 1[6]; NUREG/CR–6909, Revision 0 (with "average temperature" used consistent with the clarification that was added to NUREG/CR–6909, Revision 1); or other subsequent NRC-endorsed alternatives.

4.3.3.1.2.1 *10 CFR 54.21(c)(1)(i)*

The operating cyclic load experience and a list of the assumed transients used in the existing fatigue parameter calculations are reviewed for the current operating term to ensure that the number of assumed occurrences of each transient would not be exceeded during the

[6] If and when published as RG 1.207, Revision 1 Final.

subsequent period of extended operation. A comparison of the operating cyclic load severity to the severity assumed in the existing fatigue parameter calculations for each transient should be made to demonstrate that the cyclic load severities used in the fatigue parameter calculations remain bounding. In addition, a comparison of the water chemistry conditions to those assumed in the existing environmental multiplier (F_{en}) calculations should be made to demonstrate that the water chemistry conditions used in the F_{en} calculations remain appropriate. For consistency purposes, the review also includes an assessment of the TLAA information against relevant design basis information and CLB information. A plant-specific justification can be provided to demonstrate that the guidance in Section 4.3.2.1.3 of NUREG–1800, Revision 2, is applicable to the existing CUF_{en} calculations. Considering the evaluations above, verify the existing CUF_{en} calculations remain valid for the subsequent period of extended operation.

4.3.3.1.2.2 10 CFR 54.21(c)(1)(ii)

The operating cyclic load experience and a list of the assumed transients used in the existing fatigue parameter calculations is reviewed for the current operating term to make sure that the number of assumed occurrences for each transient are projected to the end of the subsequent period of extended operation. The reviewer verifies that a comparison of the operating cyclic load severity to the severity assumed in the existing fatigue parameter calculations for each transient has been made to demonstrate that the cyclic load severities used in the fatigue parameter calculations remain bounding. In addition, the reviewer verifies that a comparison of the water chemistry conditions to those assumed in the F_{en} calculations has been made to demonstrate that the water chemistry conditions used in the F_{en} calculations are appropriate. For consistency purposes, the review also includes an assessment of the TLAA information against relevant design basis information and CLB information. The review includes verification that the applicant has updated the CUF_{en} calculations for the applicable NUREG/CR–6260 or more limiting component locations using the methods of analysis in either RG 1.207, Revision 16, NUREG/CR–6909, Revision 0 (with “average temperature” used consistent with the clarification that was added to NUREG/CR–6909, Revision 1); or other subsequent NRC-endorsed alternatives.

The Code of Record should be used for the reevaluation, or the applicant may update to a later Code edition pursuant to 10 CFR 50.55a using an appropriate Code reconciliation. In the latter case, the reviewer verifies that the requirements in 10 CFR 50.55a are met.

4.3.3.1.2.3 10 CFR 54.21(c)(1)(iii)

The applicant may reference Sections X.M1 and XI.M2 of the GALL-SLR Report in its SLRA and use these GALL-SLR chapters to accept the TLAA in accordance with 10 CFR 54.21(c)(1)(iii) (TN4878), as appropriate. The review should verify that the applicant has stated that the report is applicable to its plant with respect to its program that monitors and tracks the number and severity of critical cyclic loadings and water chemistry conditions for metal components. The reviewer verifies that the applicant has identified the appropriate programs as described and evaluated in the GALL-SLR Report. The reviewer also verifies that the applicant has stated that its program contains the same program elements that the NRC staff evaluated and relied upon in approving the corresponding generic program in the GALL-SLR Report. For consistency purposes, the review also includes an assessment of the TLAA information against relevant design basis and CLB information (including applicable cycle counting requirements and water chemistry monitoring set forth in the applicable AMPs).

An applicant also has the option of proposing another GALL-based AMP, a plant-specific AMP, or plant-specific activities, or combination of, to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii). If another GALL-based AMP is proposed as the basis for aging management, the reviewer evaluates the applicant's AMP against the program element criteria defined in the applicable AMP in Chapter XI of the GALL-SLR Report. If the basis for aging management is a plant-specific AMP or plant-specific aging management activities, the reviewer evaluates the program element criteria for the AMP or activities against the program element criteria defined in this SRP-SLR, Appendix Section A.1, "Branch Technical Position, Aging Management Review—Generic," Sections A.1.2.3.1 through A.1.2.3.10.

If a sampling-based inspection program (a type of condition monitoring program) is proposed as the basis for aging management, the reviewer ascertains that the AMP actually performs inspections of the specific component(s) or structure(s) in the evaluation at each unit in a multiunit site and that the applicant has appropriately justified that the inspection methods and associated frequencies are capable of managing cumulative fatigue damage or cracking by fatigue or cyclical loading in the component(s) or structure(s), such that the TLAA may be accepted in accordance with 10 CFR 54.21(c)(1)(iii).

4.3.3.2 Final Safety Analysis Report Supplement

The reviewer verifies that the applicant has provided information to be included in the FSAR Supplement that includes a summary description of the evaluation of the metal fatigue TLAA. Table 4.3-1 contains examples of acceptable FSAR Supplement information for fatigue parameter TLAAs that are dispositioned in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878). The reviewer verifies that the applicant has provided a FSAR Supplement with information equivalent to that in Table 4.3-1. The table includes examples for environmentally assisted fatigue parameter TLAAs and non-environmentally assisted fatigue parameter TLAAs.

The NRC staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR Supplement before the license is renewed, no condition will be necessary.

An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to make sure that the applicant will complete these activities no later than the committed date.

4.3.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section and whether the NRC staff's evaluation supports conclusions of the following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878), to be included in the NRC staff's SER:

On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that, for the (reviewer to insert applicable type of metal fatigue analysis) TLAA, (choose which is appropriate)

(i) the analyses remain valid for the subsequent period of extended operation;

(ii) the analyses have been projected to the end of the subsequent period of extended operation; or

(iii) the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation. The NRC staff also concludes that the FSAR Supplement contains an appropriate summary description of the (reviewer to insert applicable type of metal fatigue analysis) TLAA, evaluation for the subsequent period of extended operation.

4.3.5 References

1. ANSI/ASME B31.1, “Power Piping.” New York, New York: American National Standards Institute. Agencywide Documents Access and Management System (ADAMS) Accession No. ML031470592.
2. ANSI/ASME B31.7-1969, “Nuclear Power Piping.” New York, New York: American National Standards Institute.
3. NRC. Regulatory Guide 1.207, “Guidelines for Evaluating the Effects of Light-Water Reactor Coolant Environments in Fatigue Analyses of Metal Components.” Revision 1[7]. Washington, DC: U.S. Nuclear Regulatory Commission.
4. NRC. NUREG/CR–6909, Revision 1, ANL–12/60, “Effect of LWR Coolant Environments on the Fatigue Life of Reactor Materials.” Agencywide Documents Access and Management System (ADAMS) Accession No. ML14087A068. Washington, DC: U.S. Nuclear Regulatory Commission. March 2014.
5. ASME. ASME Code, Section III, “Rules for Construction of Nuclear Facility Components.” New York, New York: The American Society of Mechanical Engineers. 2021 Edition.
6. ASME. ASME Code, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components, Nonmandatory, Appendix A, Analysis of Flaws.” New York, New York: The American Society of Mechanical Engineers. 2020 Edition.
7. ASME. ASME Code, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components, Appendix C, Evaluation of Flaws in Austenitic Piping.” New York, New York: The American Society of Mechanical Engineers. 2020 Edition.
8. NRC. NUREG/CR–5704, “Effects of LWR Coolant Environments on Fatigue Design Curves of Austenitic Stainless Steels.” ADAMS Accession No. 9904280060. Washington, DC: U.S. Nuclear Regulatory Commission. April 1999.
9. NRC. NUREG/CR–6583,” Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low-Alloy Steels.” ADAMS Accession No. 9803260384. Washington, DC: U.S. Nuclear Regulatory Commission. March 1998.
10. NRC. NUREG/CR–6260, “Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components.” ADAMS Accession No. 9503280383. Washington, DC: U.S. Nuclear Regulatory Commission. March 1995.

[7] If and when published as RG 1.207, Revision 1 Final.

Table 4.3-1 Examples of Final Safety Analysis Report Supplement for Metal Fatigue Time-Limited Aging Analyses Evaluation

Time-Limited Aging Analyses(TLAA)	Description of Evaluation	Implementation Schedule*
10 *Code of Federal Regulations* (CFR) 54.21(c)(1)(i) Examples		
Components evaluated for fatigue parameters other than cumulative usage factor calculations for components that require evaluation of environmental effects (CUF_{en})	(Applicant to identify and provide adequate description of the specific metal fatigue parameter evaluation) The number of occurrences and severity of each of the thermal and pressure transients, projected to the end of the subsequent license renewal operating period, demonstrate that the (Applicant to insert Name of the TLAA) remains valid during the subsequent license renewal operating period and therefore, that this TLAA is acceptable in accordance with the criterion in 10 CFR 54.21(c)(1)(i).	Completed prior to a submittal of an SLRA
Components evaluated for CUF_{en}	(Applicant to identify and provide adequate description of the specific metal fatigue evaluation for evaluating environmentally assisted fatigue in American Society of Mechanical Engineers Boiler and Pressure Vessel Code [ASME Code] Class 1 or Safety Class 1 components) The effects of the water environment on component fatigue life have been addressed by assessing the impact of the water environment on the limiting component locations. (Applicant to provide adequate description of its plant-specific justification demonstrates that the guidance in Section 4.3.2.1.3 of U.S. Nuclear Regulatory Commission Regulation [NUREG]–1800, Revision 2 applies to the existing CUF_{en} calculations.) The number of occurrences and severity of each of the thermal and pressure transients, projected to the end of the subsequent license renewal operating period, and consideration of the water chemistry parameters demonstrate that the TLAA on environmentally assisted fatigue remains valid during the subsequent license renewal operating period and therefore, that this TLAA is acceptable in accordance with 10 CFR 54.21(c)(1)(i).	Completed prior to a submittal of an SLRA

Table 4.3-1 Examples of Final Safety Analysis Report Supplement for Metal Fatigue Time-Limited Aging Analyses Evaluation (Continued)

Time-Limited Aging Analyses(TLAA)	Description of Evaluation	Implementation Schedule*
10 CFR 54.21(c)(1)(ii) Examples		
Components evaluated for fatigue parameters Other than CUF_{en}	(Applicant to identify and provide adequate description of the specific metal fatigue parameter evaluation) The analysis has been projected to the end of the subsequent license renewal operating period, considering the number of occurrences and severity of each of the thermal and pressure transients, and demonstrates that the TLAA is acceptable in accordance with 10 CFR 54.21(c)(1)(ii).	Completed prior to a submittal of an SLRA
Components evaluated for CUF_{en}	(Applicant to identify and provide adequate description of the specific metal fatigue evaluation for evaluating environmentally assisted fatigue in ASME Code Class 1 or Safety Class 1 components) The effects of the water environment on component fatigue life have been addressed by assessing the impact of the water environment on the limiting component locations, using the positions described in Regulatory Guide 1.207, Revision 1†; NUREG/CR-6909, Revision 0 (with “average temperature” used consistent with the clarification that was added to NUREG/CR-6909, Revision 1); or other subsequent NRC-endorsed alternatives. The analysis for environmentally assisted fatigue has been projected to the end of the subsequent license renewal operating period, considering the number of occurrences and severity of each of the thermal and pressure transients and the water chemistry parameters, and demonstrates that the TLAA is acceptable in accordance with 10 CFR 54.21(c)(1)(ii).	Completed prior to a submittal of an SLRA
10 CFR 54.21(c)(1)(iii) Examples		
Components evaluated for fatigue parameters other than CUF_{en}	Fatigue evaluations were performed to ensure the continued validity of the metal fatigue analyses for the subsequent period of extended operation. (Applicant to provide adequate description of the specific metal fatigue parameter evaluation) The fatigue monitoring program is being used as the basis for accepting these TLAAs in accordance with 10 CFR 54.21(c)(1)(iii). The aging management program (AMP) is for accepting these TLAAs in accordance with 10 CFR 54.21(c)(1)(iii). The AMP The AMP monitors and	(If the applicant will be using the Fatigue Monitoring Program to accept the TLAA. This Final Safety Analysis Report (FSAR) Supplement would not apply for an applicant that is accepting the fatigue TLAA using an AMP different from the

Table 4.3-1 Examples of Final Safety Analysis Report Supplement for Metal Fatigue Time-Limited Aging Analyses Evaluation (Continued)

Time-Limited Aging Analyses(TLAA)	Description of Evaluation	Implementation Schedule*
	tracks the number of occurrences and severity of thermal and pressure transients, and requires corrective actions to ensure that applicable fatigue analyses remain within their allowable limits. The effects of aging due to fatigue will be managed by the AMP for the subsequent period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).	Fatigue Monitoring Program.) In order to justify continued acceptance of the TLAA under 10 CFR 54.21(c)(1)(iii), the existing fatigue monitoring program will continue to be implemented during the subsequent period of extended operation. Any SLR enhancements of the program needed for aging management and acceptance of the TLAA are to be incorporated and implemented into the program at least 6 months prior to entry into the subsequent period of extended operation.
Components Evaluated for CUF_{en}	The effects of the water environment on component fatigue life will be addressed by assessing the impact of the water environment on the limiting component locations, using the positions described in Regulatory Guide 1.207, Revision 1†; NUREG/CR–6909, Revision 0 (with "average temperature" used consistent with the clarification that was added to NUREG/CR–6909, Revision 1); or other subsequent NRC-endorsed alternatives. A limiting sample of critical components can be evaluated by applying environmental adjustment factors to the existing CUF analyses or by performing more refined calculations. The AMPs monitor and track the number of occurrences and severity of thermal and pressure transients, monitor water chemistry, and require corrective actions to ensure that the applicable fatigue analyses remain within their allowable limits. The effects of aging due to environmentally assisted fatigue will be managed by the	In order to justify continued acceptance of the TLAA under 10 CFR 54.21(c)(1)(iii), the existing fatigue monitoring program will continue to be implemented during the subsequent period of extended operation. Any SLR enhancements of the program needed for aging management and acceptance of the TLAA are to be incorporated and implemented into the

Table 4.3-1 Examples of Final Safety Analysis Report Supplement for Metal Fatigue Time-Limited Aging Analyses Evaluation (Continued)

Time-Limited Aging Analyses(TLAA)	Description of Evaluation	Implementation Schedule*
	AMPs for the subsequent license renewal operating period in accordance with 10 CFR 54.21(c)(1)(iii).	program at least six months prior to entry into the subsequent period of extended operation.

*An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

†If and when published as RG 1.207, Revision 1 Final.

ASME = ASME International; CUE_{en} = ; NUREG = U.S. Nuclear Regulatory Commission Regulation; SLRA = subsequent license renewal application; TLAA = Time-Limited Aging Analyses.

4.4 Environmental Qualification of Electric Equipment

Review Responsibilities

Primary — Branch responsible for electrical engineering

Secondary — None

4.4.1 Areas of Review

The NRC has established environmental qualification (EQ) requirements in the 10 CFR Part 50, Appendix A, Criterion 4, and 10 CFR 50.49. Section 50.49 specifically requires each nuclear power plant licensee to establish a program to qualify certain electric equipment (not including equipment located in mild environments) so that such equipment, up to its end-of-life condition (qualified life), will meet its performance specifications during and following design basis accidents under the most severe environmental conditions postulated at the equipment's respective location. Such conditions include, among others, conditions resulting from a design basis event (DBE) such as a loss of coolant accident (LOCA), high-energy line break, and post-LOCA environments. Electric equipment is qualified to perform its safety function in its respective harsh environment after the effects of inservice (operational) aging. Per 10 CFR 50.49, the effects of significant aging mechanisms are addressed as part of EQ. Those components with a qualified life equal to or greater than the duration of the current plant operating term are covered by time-limited aging analyses (TLAAs).

For equipment located in a harsh environment, the objective of EQ is to demonstrate with reasonable assurance that electric equipment important to safety, for which a qualified life has been established, can perform its safety function(s) without experiencing common cause failures before, during or after applicable DBE.

For equipment located in a mild environment (an environment that at no time would be significantly more severe than the environment occurring during normal operation, including anticipated operational occurrences (10 CFR 50.49), the demonstration that the equipment can meet its functional requirements during normal environmental conditions and anticipated operational occurrences is in accordance with the plant's design and licensing bases. Equipment important to safety located in a mild environment is not part of an EQ program according to 10 CFR 50.49(c). Documents that demonstrate that a component is qualified or designed for a mild environment include design/purchase specifications, seismic qualification reports, an evaluation or certificate of conformance as applicable.

Some nuclear power plants have mechanical equipment that was qualified in accordance with the provisions of Criterion 4 of Appendix A to 10 CFR Part 50. If a plant has qualified mechanical equipment, it is typically documented in the plant's master EQ list. If this qualified mechanical equipment requires a performance of a TLAA, it should be performed in accordance with the provisions of Standard Review Plan for Review of Subsequent License Renewal (SRP-SLR) Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses." If a TLAA of qualified mechanical equipment is necessary, usually it will involve assessments of the environmental effects on consumable components such as seals, gaskets, lubricants, fluids for hydraulic systems, or diaphragms.

4.4.1.1 Time-Limited Aging Analysis

All operating plants must meet the requirements of 10 CFR 50.49 for certain important to safety electrical components. It defines the scope of components to be included, requires the preparation and maintenance of a list of in-scope components, and requires the preparation and maintenance of a qualification file that includes component performance specifications, electrical characteristics, and environmental conditions. The provisions of 10 CFR 50.49(e) require, in part, consideration of all significant types of aging degradation that can affect component functional capability. Additionally, 10 CFR 50.49(e)(5) requires component replacement or refurbishment prior to the end of designated life, unless additional life is established through reanalysis or ongoing qualification. Four methods of demonstrating qualification for aging and accident conditions are established in the 10 CFR 50.49(f). Different qualification criteria are permitted by 10 CFR 50.49(k) and based on plant and component vintage. Supplemental EQ regulatory guidance for compliance with these different qualification criteria is provided in NRC Regulatory Guide 1.89, Rev. 1, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants" (Ref. 1), and the Division of Operating Reactors (DOR) Guidelines (Ref. 2), and NUREG–0588 (Ref. 3). The principal nuclear industry qualification standards for electric equipment are Institute of Electrical and Electronics Engineers (IEEE) STD 323-1971 (Ref. 4) and IEEE STD 323-1974 (Ref. 5). These standards contain explicit EQ considerations based on TLAAs. Compliance with 10 CFR 50.49 provides reasonable assurance that the component can perform its intended functions during and following accident conditions after experiencing the effects of inservice aging for applicable equipment.

4.4.1.1.1 Division of Operating Reactors Guidelines

The qualification of electric equipment that is subject to significant known degradation due to aging where a qualified life was previously required to be established in accordance with Section 5.2.4 of the DOR Guidelines is reviewed for the subsequent period of extended operation according to those requirements. If a qualified life was not previously established, the qualification is reviewed in accordance with Section 7 of the DOR Guidelines. In addition, 10 CFR 50.49(l) should be addressed for replacement equipment.

4.4.1.1.2 NUREG–0588, Category II (IEEE STD 323-1971)

The qualification of certain electric equipment important to safety for which qualification was required in accordance with NUREG–0588, Category II, is reviewed for conformance to those requirements for the subsequent period of extended operation to assess the validity of the extended qualification. These requirements include IEEE STD 382-1972 (Ref. 6) for valve operators and IEEE STD 334-1971 (Ref. 7). In addition, 10 CFR 50.49(l) has to be addressed for replacement equipment.

4.4.1.1.3 NUREG–0588, Category I (IEEE STD 323-1974)

The qualification of certain electric equipment important to safety for which qualification was required in accordance with NUREG–0588, Category I, is reviewed for conformance to those requirements for the subsequent period of extended operation to assess the validity of the extended qualification.

4.4.1.2 Generic Safety Issue

RIS 2003-09 was issued on May 2, 2003, (Ref. 8) to inform addressees of the results of the technical assessment of generic safety issue-168, “Environmental Qualification of Electrical Equipment” (Ref. 9). This RIS requires no action on the part of the addressees.

4.4.1.3 Final Safety Analysis Report Supplement

The detailed information on the evaluation of TLAAs is contained in the SLRA. A summary description of the evaluation of TLAAs for the period of extended operation is contained in the applicant’s FSAR Supplement. The FSAR Supplement is an area of review.

4.4.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Section 4.4.1 of this review plan section delineate acceptable methods for meeting the requirements of the NRC’s regulations in 10 CFR 54.21(c)(1) (TN4878).

4.4.2.1 Time-Limited Aging Analysis

For long-term operation, TLAAs are reviewed to determine continued acceptability of the analyzed component for the subsequent period of extended operation. The time-dependent parameter is reevaluated, analyzed or assumed to determine a value that applies to the subsequent period of extended operation. This new value of the time-dependent parameter is then used to reevaluate the analysis parameter, applicable to the subsequent period of extended operation.

Pursuant to 10 CFR 54.21(c)(1)(i)–(iii) (TN4878), the TLAA is acceptable if it meets one of the following cases:

(i) The analysis remains valid for the subsequent period of extended operation. The time-dependent parameter(s) for the subsequent period of extended operation does not exceed the time-dependent parameter value used in the existing EQ analysis.

(ii) The analysis has been projected to the end of the subsequent period of extended operation and remains acceptable for the subsequent period of extended operation. The time-dependent parameter(s) is projected for the subsequent period of extended operation. The value of the time-dependent analysis parameter(s) remains bounded to the value used in the existing EQ analysis.

(iii) The effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation.

Specific acceptance criteria for EQ of certain electric equipment important to safety analyzed to Section 5.2.4 of the DOR Guidelines; NUREG–0588, Category II (Section 4); or NUREG–0588, Category I, depend on the applicant’s choice, that is, 10 CFR 54.21(c)(1)(i), (ii), or (iii), and are:

4.4.2.1.1 10 CFR 54.21(c)(1)(i)

The existing qualification is based on previous testing, analysis, or operating experience (OE), or combinations thereof that demonstrate that the equipment is qualified for the period of extended operation. For option: (i), the aging evaluation existing at the time of the SLRA for the component remains valid for the subsequent period of extended operation, and no further evaluation is necessary.

4.4.2.1.2 10 CFR 54.21(c)(1)(ii)

Qualification of the equipment is extended for the subsequent period of extended operation by testing, analysis, or OE, or combinations thereof, in accordance with the CLB. For option (ii), a reanalysis of the aging evaluation is performed in order to project the qualification of the component through the subsequent period of extended operation. Important reanalysis attributes 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. These reanalysis attributes are discussed in Table 4.4-1.

4.4.2.1.3 10 CFR 54.21(c)(1)(iii)

In Chapter X of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report (Ref. 10), the NRC staff has evaluated the EQ program (10 CFR 50.49) and determined that it is an acceptable aging management program (AMP) to address EQ according to 10 CFR 54.21(c)(1)(iii) (TN4878). The GALL-SLR Report may be referenced in an SLRA and should be treated in the same manner as an approved TR. However, the GALL-SLR Report contains one acceptable way and is not the only way to manage aging for subsequent license renewal.

In referencing the GALL-SLR Report, the applicant should indicate that the material referenced is applicable to the specific plant involved and should provide the information necessary to adopt the finding of program acceptability as described and evaluated in the report. The applicant should also verify that the approvals set forth in the GALL-SLR Report for the generic program apply to the applicant’s program.

4.4.2.2 Final Safety Analysis Report Supplement

The specific criterion for meeting 10 CFR 54.21(d) (TN4878) is that the summary description of the evaluation of TLAAs for the subsequent period of operation in the FSAR Supplement is sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description should contain sufficient information associated with the TLAAs for the reviewer to determine that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.4.3 Review Procedures

For each area of review described in Section 4.4.1, the following review procedures should be followed:

4.4.3.1 Time-Limited Aging Analysis

For electric equipment qualified to the requirements of 10 CFR 50.49, the review procedures depend on the applicant’s choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878), which are:

4.4.3.1.1 10 CFR 54.21(c)(1)(i)

The documented results, test data, analyses, etc., of the previous qualification, which consisted of an appropriate combination of testing, analysis, and OE) are reviewed to confirm that the original qualified life remains valid for the subsequent period of extended operation.

4.4.3.1.2 10 CFR 54.21(c)(1)(ii)

The results of projecting the qualification to the end of the subsequent period of extended operation are reviewed. The qualification methods include testing, inspection, OE, reanalysis, ongoing qualification or combinations thereof.

The reanalysis of an aging evaluation is normally performed to extend the qualification by reevaluating original attributes, assumptions and conservatisms for environmental conditions and other factors to identify excess conservatisms incorporated in the prior evaluation. Reanalysis of an aging evaluation to extend the qualification of electrical equipment is performed pursuant to 10 CFR 50.49(e) as part of an EQ program. While an electrical equipment life limiting condition may be due to thermal, radiation, or operational/testing and cyclic aging, the majority of electrical equipment aging limits are based on thermal conditions. Conservatism may exist in aging evaluation parameters, such as the assumed service conditions including temperature and radiation, loading, power, signal conditions, cycles, and application (e.g., de-energized versus energized), or the use of an unrealistically low activation energy.

The reanalysis of an aging evaluation is performed according to the station's QA program requirements, which requires the verification of assumptions and conclusions including the maintenance of required margins and uncertainties.

For reanalysis, the reviewer verifies that an applicant has completed its reanalysis, addressing attributes of analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions if acceptance criteria are not met (see Table 4.4-1). The reviewer also verifies that the reanalysis has been completed in a timely manner prior to the end of qualified life.

4.4.3.1.3 CFR 54.21(c)(1)(iii)

The applicant may reference the GALL-SLR Report in its SLRA, as appropriate. The review should verify that the applicant has stated that the report is applicable to its plant with respect to its EQ program. The reviewer verifies that the applicant has identified the appropriate AMP as described and evaluated in the GALL-SLR Report. The reviewer also verifies that the applicant has stated that its EQ program contains, and is consistent with, the same program elements that the NRC staff evaluated and relied upon in approving the corresponding generic AMP in the GALL-SLR Report. No further NRC staff evaluation is necessary.

If the applicant does not reference the GALL-SLR Report in its renewal application, additional NRC staff evaluation is necessary to determine whether the applicant's TLAA analysis and EQ AMP is acceptable for this area of review.

4.4.3.2 *Final Safety Analysis Report Supplement*

The reviewer verifies that the applicant has provided information to be included in the FSAR Supplement that includes a summary description of the TLAA evaluation of the applicant's EQ AMP including time-dependent electric equipment. Table 4.4-2 contains examples of acceptable FSAR Supplement information for this TLAA. The reviewer verifies that the applicant has provided a FSAR Supplement with information consistent with that in Table 4.4-2 including plant-specific commitments, license conditions, enhancements or exceptions.

The NRC staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR Supplement before the license is renewed, no condition will be necessary.

An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to make sure that the applicant will complete these activities no later than the committed date.

4.4.4 Evaluation Findings

The reviewer determines whether the applicant has provided information sufficient to satisfy the provisions of this section and whether the applicant's evaluation supports conclusions of the applicant's TLAA evaluation. Depending on the applicant's selection, a review of the applicant's 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878) evaluation is to be included in the NRC staff'sSER:

> On the basis of its review, the NRC staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.2 (c)(1), that, for the environmental qualification of Electric Equipment TLAA, [choose which is appropriate]
>
> (i) the analyses remain valid for the subsequent period of extended operation,
>
> (ii) the analyses have been projected to the end of the subsequent period of extended operation, or
>
> (iii) the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation. The staff also concludes that the FSAR Supplement contains an appropriate summary description of electrical equipment TLAA evaluation for the subsequent period of extended operation.

4.4.5 References

1. NRC. Regulatory Guide 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants." Revision 1. Agencywide Documents Access and Management System (ADAMS) Accession No. ML14070A119. Washington, DC: U.S. Nuclear Regulatory Commission. May 20, 1984.

2. NRC. “Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors.” DOR Guidelines. ADAMS Accession No. ML032541214. Washington, DC: U.S. Nuclear Regulatory Commission. November 13, 1979.

3. NRC. NUREG–0588, “Interim Staff Position on Environmental Qualification of Safety Related Equipment.” ADAMS Accession No. ML031480402. Washington, DC: U.S. Nuclear Regulatory Commission. July 31, 1981.

4. IEEE. IEEE Standard 323-1971, “IEEE Trial Use Standard; General Guide for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.” ADAMS Accession No. ML032200240. New York, New York: Institute of Electrical and Electronics Engineers. September 16, 1971.

5. IEEE. IEEE Standard 323-1974, “IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.” ADAMS Accession No. ML03220206. New York, New York: Institute of Electrical and Electronics Engineers. December 31, 1974.

6. IEEE. IEEE Standard 382-1972, “Standard for Qualification of Actuators for Power Operated Valve Assemblies with Safety Related Functions for Nuclear Power Plants.” ADAMS Accession No. ML032200228. New York, New York: Institute of Electrical and Electronics Engineers. April 10, 1973.

7. IEEE. IEEE Standard 334-1971, “IEEE Standard for Type Tests of Continuous Duty Class 1E Motors for Nuclear Power Generating Stations.” New York, New York: Institute of Electrical and Electronics Engineers.

8. NRC. Regulatory Issue Summary 2003-09, “Environmental Qualification of Low-Voltage Instrumentation and Control Cables.” ADAMS Accession No. ML031220078. Washington, DC: U.S. Nuclear Regulatory Commission. May 2, 2003.

9. NRC. “Environmental Qualification of Low-Voltage Instrumentation and Control Cables.” Generic Safety Issue-168. ADAMS Accession No. ML022910316. Washington, DC: U.S. Nuclear Regulatory Commission. August 16, 2002.

10. NRC. “Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report.” Washington, DC: U.S. Nuclear Regulatory Commission.

11. 10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016. 10 CFR Part 50-TN249

12. 10 CFR 50.49, “Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016. 10 CFR Part 50-TN249

13. NRC. Regulatory Guide 1.211, “Qualification of Safety-Related Cables and Field Splices for Nuclear Power Plants.” ADAMS Accession No. ML082530205. Washington, DC: U.S. Nuclear Regulatory Commission. April 1, 2009.

14. NRC. Regulatory Guide 1.100, “Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants.” ADAMS Accession No. ML0913204680. Washington, DC: U.S. Nuclear Regulatory Commission. September 30, 2009.

15. NRC. Regulatory Guide 1.218, “Condition-Monitoring Techniques for Electric Cables Used in Nuclear Power Plants.” ADAMS Accession No. ML103510458. Washington, DC: U.S. Nuclear Regulatory Commission. April 30, 2012.

16. IEEE. IEEE Standard 1205-2014, “IEEE Guide for Assessing, Monitoring, and Mitigating Aging Effects on Electrical Equipment Used in Nuclear Power Generating Stations and Other Nuclear Facilities.” New York, New York: Institute of Electrical and Electronics Engineers.

17. NRC. Regulatory Guide 1.40, “Qualification of Continuous Duty Safety-Related Motors for Nuclear Power Plants.” ADAMS Accession No. ML093080087. Washington, DC: U.S. Nuclear Regulatory Commission. February 24, 2012.

18. NRC. Regulatory Guide 1.73, “Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants.” ADAMS Accession No. ML003740261. Washington, DC: U.S. Nuclear Regulatory Commission. January 31, 1974.

Table 4.4-1 Environmental Qualification Reanalysis and Ongoing Qualification Attributes

Attributes	Description
Analytical methods	The analytical models used in the reanalysis of an aging evaluation are the same 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 (i.e., normal radiation dose for the projected installed life plus accident radiation dose). For subsequent license renewal (SLR), one acceptable method of establishing the 80-year normal radiation dose is to multiply the 60-year normal radiation dose by 2.0 (i.e., 80 years/ 40 years). The result is added to the accident radiation dose to obtain the total integrated dose for the component. For aging effects attributed to cyclic aging, a similar approach may be used. Other models may be justified on a case-by-case basis.
Data collection and reduction methods	The identification of excess conservatism in electrical equipment service conditions used in the prior aging evaluation is the chief method used for a reanalysis. For example, temperature data, associated margins, and uncertainties used in an equipment environmental qualification (EQ) evaluation may be based on anticipated plant design temperatures found to be conservative when compared to actual plant temperature data. When used, plant environmental data may be obtained from monitors used for technical specification compliance; other installed monitors, measurements made by plant operators during rounds, dedicated monitors for EQ equipment or combinations of the above. The environmental data gathering and analysis method used to identify conservatism in the original EQ analysis adequately quantifies the EQ equipment inservice environment (e.g., sensor locations and number, frequency of measurement, and calendar duration), and is shown to maintain qualification margins, conservatisms, and uncertainties per 10 *Code of Federal Regulations* (CFR) 50.49. Environmental data measurements are evaluated to establish the environmental parameter (e.g., temperature, radiation, cycles) used in an analysis. Plant environmental data may be used in the aging evaluation in different ways, such as (a) directly applying the plant environmental data in the evaluation or (b) using the plant environmental data to demonstrate conservatism when using plant design values for an evaluation. The methodology for environmental monitoring, data collection and the analysis of localized EQ equipment environmental data used in the reanalysis is documented in the record of the reanalysis qualification report. Any changes to material activation energy values included as part of a reanalysis are justified by the applicant on a plant-specific basis.

Table 4.4-1 Environmental Qualification Reanalysis and Ongoing Qualification Attributes (Continued)

Attributes	Description
Underlying assumptions	EQ equipment aging evaluations contain conservatism to account for most environmental changes occurring due to plant modifications and events. A reanalysis demonstrates that adequate margin is maintained consistent with the original analysis in accordance with 10 CFR 50.59 requiring certain margins and accounting for the unquantified uncertainties established in the EQ aging evaluation of the equipment. A reanalysis that utilizes initial qualification conservatisms and/or in-service environmental conditions (e.g., actual temperature and radiation conditions) are part of an EQ program. Adverse localized environments are identified during periodic inspections, or by operational or maintenance activities that affect the operating environment of an environmentally qualified component, the affected component is evaluated and appropriate corrective actions are taken, which may include changes to the qualification bases and conclusions (e.g., changes to qualified life).
Acceptance criteria and corrective actions	The reanalysis of an aging evaluation is used to extend the environmental qualification of a component. If the qualification cannot be extended by reanalysis, the component must be refurbished, replaced, or requalified prior to exceeding the current qualified life. A reanalysis should be performed in a timely manner (such that sufficient time is available to refurbish, replace, or requalify the component if the reanalysis is unfavorable). A modification to qualified life either by reanalysis or ongoing qualification must demonstrate that adequate margin is maintained consistent with the original analysis including unquantified uncertainties established in the original EQ equipment aging valuation.
Ongoing qualification	Ongoing qualification techniques may be implemented when assessed margins, conservatisms, or assumptions do not support reanalysis of an EQ component of electric equipment important to safety. The requirements of 10 CFR 50.49 provide methods that may be used to evaluate and maintain equipment EQ, including qualified life, for the subsequent period of extended operation.

CFR = *Code of Federal Regulations;* EQ = environmental qualification; SLR = subsequent license renewal.

Table 4.4-2 Examples of Final Safety Analysis Report Supplement for Environmental Qualification Electric Equipment Time-Limited Aging Analyses Evaluation

10 *Code of Federal Regulations* (CFR) 54.2(c)(1)(i) Example			
Time-Limited Aging Analyses (TLAA)		**Description of Evaluation**	**Implementation Schedule***
4.4	Environmental qualification of electric equipment	The original environmental qualification qualified life has been shown to remain valid for the subsequent period of extended operation.	Completed
10 CFR 54.21(c)(1)(ii) Example			
TLAA		**Description of Evaluation**	**Implementation Schedule***
4.4	Environmental qualification of electric equipment	The environmental qualification has been projected to the end of the period of extended operation. Reanalysis addresses attributes of analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions.	Summary report on the methods and assumptions are submitted in the subsequent license renewal application (SLRA).
10 CFR 54.21(c)(1)(iii) Example			
TLAA		**Description of Evaluation**	**Implementation Schedule***
4.4	Environmental qualification of electric equipment	The existing environmental qualification process, in accordance with 10 CFR 50.49, will adequately manage aging of environmental qualification equipment for the subsequent period of extended operation because equipment will be replaced prior to reaching the end of its qualified life.	Program and subsequent license renewal enhancements, when applicable, are implemented six months prior to the subsequent period of extended operation

*An applicant should incorporate the implementation schedule into its final Safety Analysis Report. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

SLRA = subsequent license renewal application; TLAA = Time-Limited Aging Analyses.

4.5 Concrete Containment Unbonded Tendon Prestress Analysis

Review Responsibilities

Primary — Branch responsible for structural engineering

Secondary — None

4.5.1 Areas of Review

The prestressing tendons in prestressed concrete containments undergo losses in prestressing forces with time due to creep and shrinkage of concrete and relaxation of the prestressing steel. During the design phase, engineers estimated these losses to the end of the prestressed containment operating life, normally 40 years. The OEs with the trend of prestressing forces indicate the prestressing tendons may lose their prestressing forces at a rate higher than predicted due to sustained high temperature, as discussed in Information Notice (IN) 99-10, “Degradation of Prestressing Tendon Systems in Prestressed Concrete Containments.” In addition, loss of prestress or reduction in tendon force can occur due to breakage of tendon wires or improper anchorages. The stress corrosion cracking in individual tendons can also occur and contribute to the loss of tendon prestress if there is a susceptible material and environment combination. Moreover, consideration should be given to an increased tendon relaxation when replacing existing inservice tendons with new. Thus, it is necessary to make sure that the applicant addresses existing TLAAs for the subsequent period of extended operation. Plant-specific TLAAs regarding loss of prestress (e.g., predicted tendon prestress force lower limit–predicted lower limit, bonded tendons) are addressed and reviewed in Section 4.7, “Other Plant Specific Time-Limited Aging Analyses.”

The adequacy of the prestressing forces in prestressed concrete containments is reviewed for the subsequent period of extended operation.

4.5.2 Acceptance Criteria

The acceptance criteria for the area of review described in Section 4.5.1 delineate acceptable methods for meeting the requirements of NRC regulations in 10 CFR 54.21(c)(1).

4.5.2.1 Time-Limited Aging Analysis

Pursuant to 10 CFR 54.21(c)(1)(i) through (iii) (TN4878), an applicant must demonstrate one of the following:

(i) the analyses remain valid for the subsequent period of extended operation;

(ii) he analyses have been projected to the end of the subsequent period of extended operation; or

(iii) the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation.

4.5.2.1.1 10 CFR 54.21(c)(1)(i)

The existing prestressing force evaluation remains valid because: (i) losses of the prestressing force are less than the predicted losses, as evidenced from the trend lines constructed from the recent inspection, (ii) the period of evaluation covers the subsequent period of extended operation, and (iii) the trend lines of the measured prestressing forces remain above the minimum required prestress force specified at anchorages for each group of tendons for the subsequent period of extended operation.

4.5.2.1.2 10 CFR 54.21(c)(1)(ii)

The prediction line of prestressing forces for each group of tendons initially developed for 40 years of operation should be extended to 80 years. The applicant demonstrates through analysis the unbonded tendon prestressed concrete containment design adequacy remains valid and that the trend lines of the measured prestressing forces will stay above the design Minimum Required Value in the CLB for each group of tendons during the subsequent period of extended operation.

4.5.2.1.3 10 CFR 54.21(c)(1)(iii)

In Chapter X of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report, the NRC staff evaluated a program that assesses the concrete containment tendon prestressing forces (AMP Section X.S1, "Concrete Containment Unbonded Tendon Prestress"), and has determined that it is an acceptable AMP to address concrete containment tendon prestress according to 10 CFR 54.21(c)(1)(iii) (TN4878), except for OE. Further evaluation is recommended of the applicant's OE related to the containment prestress force. However, the GALL-SLR Report contains one acceptable way and not the only way to manage aging. The GALL-SLR Report may be referenced in a SLRA, and is treated in the same manner as an approved TR.

In referencing the GALL-SLR Report, an applicant indicates that the material referenced is applicable to the specific plant involved and should provide the information necessary to adopt the finding of program acceptability as described and evaluated in the report. An applicant also verifies that the approvals set forth in the GALL-SLR Report for the generic program apply to the applicant's program.

4.5.2.2 Final Safety Analysis Report Supplement

The specific criterion for meeting 10 CFR 54.21(d) (TN4878) is that the summary description of the evaluation of TLAAs for the subsequent period of operation in the FSAR Supplement is sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description contains information associated with the TLAAs regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.5.3 Review Procedures

For each area of review described in Section 4.5.1, the following review procedures should be followed:

4.5.3.1 Time-Limited Aging Analysis

For a concrete containment prestressing tendon system, the review procedures, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878), are:

4.5.3.1.1 10 CFR 54.21(c)(1)(i)

The results of a recent inspection to measure the amount of prestress loss are reviewed to ensure that the reduction of prestressing force is less than the predicted loss in the existing analysis. The reviewer verifies that the trend line of the measured prestressing force, when plotted on the predicted prestressing force curve, shows that the existing analysis remains valid for the subsequent period of extended operation.

4.5.3.1.2 10 CFR 54.21(c)(1)(ii)

The reviewer evaluates the trend lines of the measured prestressing forces to make sure that individual tendon lift-off forces (rather than average lift-off forces of the sampled tendon group) are considered in the regression analysis for the subsequent period of extended operation, as discussed in IN 99-10, "Degradation of Prestressing Tendon Systems in Prestressed Concrete Containments." The reviewer then verifies that the trend lines will stay above the minimum required prestressing forces for each group of tendons during the subsequent period of extended operation so that the design adequacy is maintained in the subsequent period of extended operation.

4.5.3.1.3 10 CFR 54.21(c)(1)(iii)

An applicant may reference the GALL-SLR Report in its SLRA, as appropriate. The reviewer verifies that the applicant has stated that the report is applicable to its plant with respect to its program that assesses the concrete containment tendon prestressing forces. The reviewer verifies that the applicant has identified the appropriate program (i.e., GALL-SLR Report AMP X.S1) as described and evaluated in the GALL-SLR Report. The reviewer also makes sure that the applicant has stated that its program contains the same program elements that the NRC staff evaluated and relied upon in approving the corresponding generic program in the GALL-SLR Report.

Further evaluation is recommended of the applicant's OE related to the containment prestress force. The applicant's program should incorporate the relevant OE that occurred at the applicant's plant as well as at other plants. The applicant considers applicable portions of the experience with prestressing systems described in IN 99 10. Tendon OE could vary among plants with prestressed concrete containments. The difference could be due to the prestressing system design (for example, button-heads, wedge or swaged anchorages), environment, or type of reactor (PWR or BWR). The reviewer evaluates the applicant's program to verify that the applicant has adequately considered plant-specific OE.

If the applicant does not reference the GALL-SLR Report in its SLRA, additional NRC staff evaluation is necessary to determine whether the applicant's program is acceptable for this area of review. The reviewer uses the guidance provided in RLSB-1 of this SRP-SLR to ascertain that loss of prestress in the concrete containment prestressing tendons are adequately managed so that trend lines will remain above the minimum required prestressing forces for each group of tendons for the subsequent period of extended operation.

4.5.3.2 Final Safety Analysis Report Supplement

The reviewer verifies that the applicant has provided information, to be included in the FSAR Supplement that includes a summary description of the evaluation of the tendon prestress TLAA. Table 4.5-1 contains examples of acceptable FSAR Supplement information for this TLAA. The reviewer verifies that the applicant has provided an FSAR Supplement with information equivalent to that in Table 4.5-1.

The NRC staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR Supplement before the license is renewed, no condition will be necessary.

An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to make sure that the applicant will complete these activities no later than the committed date.

4.5.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of Section 4.5 and whether the NRC staff's evaluation supports conclusions of the following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878), to be included in the SER:

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that, for the concrete containment tendon prestress TLAA, (choose which is appropriate)
>
> (i) the analyses remain valid for the subsequent period of extended operation;
>
> (ii) the analyses have been projected to the end of the subsequent period of extended operation; or
>
> (iii) the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation. The NRC staff also concludes that the FSAR Supplement contains an appropriate description of the concrete containment tendon prestress TLAA evaluation for the subsequent period of extended operation.

4.5.5 References

1. NRC. Regulatory Guide 1.35.1, "Determining Prestressing Forces for Inspection of Prestressed Concrete Containments." Agencywide Documents Access and Management System (ADAMS) Accession No. ML003740040. Washington, DC: U.S. Nuclear Regulatory Commission. July 1990.

2. NRC. Information Notice 99-10, “Degradation of Prestressing Tendon Systems in Prestressed Concrete Containments.” ADAMS Accession No. ML031500244. Washington, DC: U.S. Nuclear Regulatory Commission. April 1999.

Table 4.5-1 Examples of Final Safety Analysis Report Supplement for Concrete Containment Tendon Prestress Time-Limited Aging Analyses Evaluation

10 *Code of Federal Regulations* (CFR) 54.21(c)(1)(i) Example		
Time-Limited Aging Analyses (TLAA)	**Description of Evaluation**	**Implementation Schedule***
Concrete containment tendon prestress	The prestressing tendons are used to impart compressive forces in the prestressed concrete containments to resist the internal pressure inside the containment that would be generated in the event of a loss of coolant accident (LOCA). The prestressing forces generated by the tendons diminish over time due to losses in prestressing forces in the tendons and in the surrounding concrete. The existing prestressing force review and evaluation remains valid to the end of the subsequent period of extended operation, and the trend lines of the measured prestressing forces will stay above the minimum required prestressing forces for each group of tendons to the end of this period.	Completed, validation provided in the (subsequent license renewal application) SLRA
10 CFR 54.21(c)(1)(ii) Example		
TLAA	**Description of Evaluation**	**Implementation Schedule***
Concrete containment tendon prestress	The prestressing tendons are used to impart compressive forces in the prestressed concrete containments to resist the internal pressure inside the containment that would be generated in the event of a LOCA. The prestressing forces generated by the tendons diminish over time due to losses in prestressing forces in the tendons and in the surrounding concrete. The prestressing force analysis and evaluation has been completed and determined to remain within allowable limits to the end of the subsequent period of extended operation, and the trend lines of the measured prestressing forces will stay above the minimum required prestressing forces for each group of tendons to the end of this period.	Completed, validation provided in the SLRA

Table 4.5-1 Examples of Final Safety Analysis Report Supplement for Concrete Containment Tendon Prestress Time-Limited Aging Analyses Evaluation (Continued)

10 CFR 54.21(c)(1)(iii) Example		
TLAA	**Description of Evaluation**	**Implementation Schedule***
Concrete containment tendon prestress	The prestressing tendons are used to impart compressive forces in the prestressed concrete containments to resist the internal pressure inside the containment that would be generated in the event of a LOCA. The prestressing forces generated by the tendons diminish over time due to losses of prestressing forces in the tendons and in the surrounding concrete. The [insert the aging management program(s) (AMPs) credited to manage this aging effect] developed to monitor the prestressing forces will ensure that, during each inspection, the trend lines of the measured prestressing forces show that they meet the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Subsection IWL, as incorporated by reference in 10 CFR 50.55a and as supplemented. If the trend lines cross the predicted lower limit lines, corrective actions should be taken. The program incorporates plant-specific and industry operating experience.	Program and SLR enhancements, when applicable, are implemented six months prior to the subsequent period of extended operation.

*An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

AMP = aging management program; ASME = ASME International; CFR = *Code of Federal Regulations*; LOCA = loss of coolant accident; SLR = subsequent license renewal; SLRA = subsequent license renewal application; TLAA = Time-Limited Aging Analyses.

4.6 Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analysis

Review Responsibilities

Primary — Branch responsible for structural engineering

Secondary — Branch responsible for mechanical engineering

4.6.1 Areas of Review

This section addresses fatigue analyses for containment metal liner plates, metal containments (including BWR containment suppression chamber and the vent system), and penetrations (including personnel airlocks, equipment hatches, sleeves, dissimilar metal welds, and bellows).

The interior surface of a concrete containment structure is lined with thin metallic plates to provide a leak-tight barrier against the uncontrolled release of radioactivity to the environment, as required by 10 CFR Part 50, Appendix J. The thickness of the liner plates is generally between 1/4 in (6.2 millimeter [mm]) and 3/8-in (9.5 mm). The liner plates are attached to the concrete containment wall by stud anchors or structural rolled shapes or both. The design process assumes that the liner plates do not carry loads. However, imposed loads or conditions (e.g., dead, seismic, thermal, internal pressure, creep and shrinkage) induce cyclic stresses in the liner plates. Thus, under design basis conditions, the liner plates could experience cyclic strains. Some plants may have metal containments instead of concrete containments with liner plates. The metal containments are designed to carry dead loads and seismic loads in addition to the internal pressure and temperature loads. For BWR Mark I metal containments, the containment suppression pool torus chamber (wet well) and the vent system are designed appropriately or evaluated for hydrodynamic loads associated with actuation of safety relief valves and the discharge into the suppression pool chamber.

Fatigue of the containment liner plates or metal containments may be considered in the design based on an assumed number of occurrences and severities of cyclic loads for the current operating term. The cyclic loads include reactor building interior temperature variations during heat-ups and cool-downs of the reactor coolant system, loss of coolant accident as applicable, annual outdoor temperature variations, thermal loads due to the high energy containment penetration piping lines (such as steam and feedwater lines), seismic loads, and pressurization due to periodic Type A integrated leak rate tests. The BWR containment suppression pool chamber and the vent system are designed or evaluated for the hydrodynamic cyclic loads as described in Section 6.2.1.1.C, “Pressure-Suppression Type BWR Containments,” of NUREG–0800, “Standard Review Plan.”

Electrical penetration assemblies are usually sealed canisters penetrating the containment liner plate or metal containment barrier such that a pressure boundary between the inboard and outboard sides of the penetration exists while maintaining electrical continuity through the device. Mechanical penetrations include piping penetrations, access penetrations, drywell head, and fuel transfer tubes. High energy piping penetrations and the fuel transfer tubes in some plants are equipped with S) bellow assemblies. These penetrations accommodate loads from relative movements between the containment wall (including the liner) and the adjoining structures, and from Type B, local leak rate tests. The penetrations have sleeves (up to 3 meter [m] [10 feet {ft}] in length, with a 5-8 centimeter [cm] [2-3 in.] annulus around the piping) to penetrate the concrete containment wall and allow movement of the piping system. Dissimilar metal welds connect the piping penetrations to the bellows or stainless steel plates to provide essentially leak-tight penetrations. Historical maintenance records, industry OE, and aging mechanisms that include degradation due to fatigue and their effects on electrical and mechanical penetrations, are discussed in Electric Power Research Institute (EPRI) TR 1003456, “Aging Management Guideline for Commercial Nuclear Power Plants Electrical and Mechanical Penetrations.”

The containment metal liner plates, metal containments (including BWR containment suppression chamber and the vent system), and penetrations (including personnel airlocks, equipment hatches, sleeves, dissimilar metal welds, and bellows), may be designed in accordance with requirements of Section III of the ASME Code. If a plant’s Code of Record requires a fatigue parameter evaluation (fatigue analysis or fatigue waiver), then this analysis may be a TLAA and should be evaluated in accordance with 10 CFR 54.21(c)(1) (TN4878) for the subsequent period of extended operation.

The adequacy of the fatigue parameter evaluations of the containment liner plates, metal containments, and penetrations is reviewed in this section for the subsequent period of extended operation. The number of cyclic load occurrences assumed in the fatigue parameter evaluations should be clearly identified in Section 4.6 of the applicant’s SLRA. The fatigue parameter evaluations of the pressure boundary of process piping are reviewed separately following the guidance in SRP-SLR Section 4.3, “Metal Fatigue.”

4.6.1.1 Time-Limited Aging Analysis (Fatigue Parameter Evaluations)

The ASME Code contains explicit requirements for fatigue parameter evaluations (fatigue analyses or fatigue waivers), which are TLAAs. Specific requirements are contained in the design code of reference for each plant. The severities and the numbers of cycles of actual loadings for each cyclic load assumed in the underlying analyses should be verified against the numbers and severities of the actual loads projected for the subsequent period of extended operation. Monitoring of cyclic loading is accomplished through a TLAA AMP consistent with the GALL-SLR Report, Section X.M1 “Fatigue Monitoring,” or through a site-specific AMP consistent with the guidance provided in the SRP-SLR, Appendix Section A.1.

4.6.1.1.1 Fatigue Analyses (ASME Section III, MC or Class 1)

The ASME Code, Section III, Division 2, “Code for Concrete Containments, Rules for Construction of Nuclear Facility Components,” and ASME Code, Section III, Division 1, “Subsection NE, Class MC Components, Rules for Construction of Nuclear Facility Components,” require a fatigue analysis for liner plates, metal containments, and penetrations that considers all cyclic loads based on the anticipated number of cycles. Containment components also may be designed to ASME Code Section III Class 1 requirements. A Section III, MC or Class 1 fatigue analysis requires the calculation of the CUF based on the fatigue properties of the materials and the expected fatigue service of the component. The ASME Code limits the CUF to a value less than or equal to one for acceptable fatigue design. The fatigue resistance of the liner plates or metal containments, and penetrations during the subsequent period of extended operation is an area of review.

Other evaluations also contain metal fatigue analysis requirements based on a CUF calculation, such as metal bellows designed to ASME NC-3649.4(e)(3) or NE-3366.2(e)(3) standards.

4.6.1.1.2 Fatigue Waiver Evaluations

The CLB may include fatigue waiver evaluations that preclude the need for performing CUF analyses of structural components. The ASME Code Section III rules for performing fatigue waiver evaluations for structural components are analogous to those in the Code for performing fatigue waiver evaluations of mechanical components. The ASME Code NE 3131(d) (1974 editions or later) rules out consideration for earthquake transients unless they impact designated liner locations recognized in the specifications. The ASME Code NE 3222.4(d) "Analysis for Cyclic Operations, Vessels Not Requiring Analysis for Cyclic Operation," provides for a waiver from fatigue analysis when certain cyclic loading criteria are met.

4.6.1.2 Final Safety Analysis Report Supplement

The SLRA contains TLAA information for containment liner plates, metal containments, and penetrations. A summary description of the evaluation of containment liner plates, metal containments, and penetrations TLAAs for the subsequent period of extended operation is also contained in the applicant's proposed FSAR Supplement. The FSAR Supplement is an area of review.

4.6.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Section 4.6.1 delineate acceptable methods for meeting the requirements of the NRC)regulations in 10 CFR 54.21(c)(1) (TN4878).

4.6.2.1 Time-Limited Aging Analysis

In some instances, the applicant may identify activities to be performed to verify the assumption bases of the fatigue parameter evaluations, the fatigue analyses, or the fatigue waiver evaluations. Evaluations of those activities are provided by the applicant. The reviewer assures that the applicant's activities are sufficient to confirm the calculation assumptions for the subsequent period of extended operation.

Pursuant to 10 CFR 54.21(c)(1), an applicant must demonstrate one of the following:

(i) the analyses remain valid for the subsequent period of extended operation;

(ii) the analyses have been projected to the end of the subsequent period of extended operation; or

(iii) the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation.

Specific acceptance criteria for fatigue of containment liner plates, metal containments, and penetrations are provided in the following subsections.

4.6.2.1.1 Fatigue Parameter Evaluations

For containment liner plates, metal containments, and penetrations that have fatigue parameter evaluations, the acceptance criteria are provided in the following subsections depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878). This section applies to the evaluations identified in Sections 4.6.1.1.1 and 4.6.1.1.2.

4.6.2.1.1.1 10 CFR 54.21(c)(1)(i)

The fatigue parameter evaluations remain valid because the numbers of occurrences and severities of assumed cyclic loads are not projected to exceed during the subsequent period of extended operation.

4.6.2.1.1.2 10 CFR 54.21(c)(1)(ii)

The fatigue parameter evaluations have been reevaluated based on revised numbers of occurrences and severities of assumed cyclic loads for the subsequent period of extended operation and have been shown to remain within the allowed limits.

4.6.2.1.1.3 10 CFR 54.21(c)(1)(iii)

The applicant proposes an AMP as the basis for demonstrating that the effects of aging on the intended function(s) of the structure(s) or component(s) in the fatigue parameter evaluations will be adequately managed during the subsequent period of extended operation. The GALL-SLR Report AMP X.M1 provides one method that may be used to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii) (TN4878).

An applicant may also propose another AMP to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii). If the basis for aging management is a plant-specific AMP, the AMP should be defined in terms of the 10 program elements defined in the SRP-SLR, Appendix Section A.1.

If an inspection program is proposed as the basis for aging management, the AMP implements inspections of the component(s) or structure(s) in the evaluation. The AMP justifies the inspection methods and frequencies that are applicable to the component(s) or structure(s), such that the TLAA will meet the requirement of 10 CFR 54.21(c)(1)(iii).

Consistent with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(iii), an AMP is proposed to accept the TLAA in accordance with 10 CFR 54.21(c)(1)(iii) and to manage the effects of cumulative fatigue damage or fatigue-induced cracking on the intended functions of the components during the subsequent period of extended operation. The GALL-SLR Report AMP XI.M1 provides one AMP that may be used as the basis for accepting the fatigue parameter evaluation in accordance with 10 CFR 54.21(c)(1)(iii). However, other GALL-SLR Report AMPs or plant-specific AMPs or activities may be used to accept the TLAA in accordance 10 CFR 54.21(c)(1)(iii) if appropriately justified in the SLRA.

4.6.2.2 Final Safety Analysis Report Supplement

The specific criterion for meeting 10 CFR 54.21(d) (TN4878) is that the summary description of the evaluation of TLAAs for the subsequent period of operation in the FSAR Supplement is sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description contains information associated with the TLAAs regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.6.3 Review Procedures

For each area of review described in Section 4.6.1, the review procedures in the following subsections should be used.

4.6.3.1 Time-Limited Aging Analysis

4.6.3.1.1 Fatigue Parameter Evaluations

For containment liner plates, metal containments, and penetrations with fatigue parameter evaluations, the review procedures are provided in the following subsections depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878).

4.6.3.1.1.1 10 CFR 54.21(c)(1)(i)

The projected number of occurrences and severities of cyclic loadings at the end of the subsequent period of extended operation is compared to the number of occurrences and severities of cyclic loadings used in the existing fatigue parameter evaluations. The comparison confirms that the number of occurrences and severities of cyclic loadings in the existing fatigue parameter evaluations will not be exceeded during the subsequent period of extended operation.

4.6.3.1.1.2 10 CFR 54.21(c)(1)(ii)

The revised number of occurrences and severities of cyclic loadings projected to the end of the subsequent period of extended operation is reevaluated. The revised fatigue parameter evaluations based on the projected number of occurrences and severities of cyclic loads are reviewed to make sure that the calculated fatigue parameters remain less than the allowed values at the end of the subsequent period of extended operation.

If applicable, the Code of Record is used for the revised fatigue parameter evaluations, or the applicant may update to a later code edition pursuant to 10 CFR 50.55a. In the latter case, the reviewer verifies that the requirements in 10 CFR 50.55a are met.

4.6.3.1.1.3 10 CFR 54.21(c)(1)(iii)

Pursuant to 10 CFR 54.21(c)(1)(iii) (TN4878), the applicant proposes an AMP or aging management activities as the basis for demonstrating that the effects of aging on the intended function(s) of the structure(s) or component(s) in the fatigue parameter evaluation will be adequately managed during the subsequent period of extended operation. If an AMP corresponding to GALL-SLR Report AMP X.M1 is used as the basis for managing cumulative fatigue damage or cracking due to fatigue or cyclical loading in the structure(s) or component(s), the reviewer evaluates the applicant's AMP against the program elements defined in GALL-SLR Report AMP X.M1.

An applicant also has the option of proposing another GALL-based AMP, plant-specific AMP, or plant-specific activities, or combination thereof, to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii). If another GALL-based AMP is proposed as the basis for aging management, the reviewer evaluates the applicant's AMP against the program element criteria defined in the applicable AMP in Appendix A of the GALL-SLR Report. If the basis for aging management is a plant-specific AMP or plant-specific aging management activities, the reviewer verifies the program element criteria for the AMP or activities against the criteria defined in the SRP-SLR, Appendix Section A.1.

If a sampling-based inspection program (a type of condition monitoring program) is proposed as the basis for aging management, the reviewer ensures that the AMP actually performs inspections of the component(s) or structure(s) in the evaluation and that the applicant has appropriately justified that the inspection bases are capable of managing cumulative fatigue damage or cracking by fatigue or cyclical loading in the component(s) or structure(s), such that the TLAA may be accepted in accordance with 10 CFR 54.21(c)(1)(iii).

4.6.3.2 Final Safety Analysis Report Supplement

The reviewer verifies that the applicant has provided information, to be included in the FSAR Supplement, that includes a summary description of the fatigue parameter TLAA evaluations for the containment liner plates, metal containments, and penetrations. The SRP-SLR Table 4.6-1 contains examples of acceptable FSAR Supplement information for this TLAA. The reviewer verifies that the applicant has provided an FSAR Supplement with information equivalent to that in Table 4.6-1.

The NRC staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR Supplement before the license is renewed, no condition will be necessary.

An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to make sure that the applicant will complete these activities no later than the committed date.

4.6.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section and to support the following conclusions, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878), to be included in the SER:

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that the (reviewer inserts the type of fatigue parameter evaluation) TLAA evaluations, (choose which is appropriate)
>
> (i) remains valid for the subsequent period of extended operation;
>
> (ii) has been projected to the end of the subsequent period of extended operation; or
>
> (iii) the effects of aging on the intended function(s) will be adequately managed during the subsequent period of extended operation. The NRC staff also concludes that the FSAR Supplement contains an appropriate summary description of the (the reviewer inserts the type of fatigue parameter evaluation) TLAA evaluations for the subsequent period of extended operation.

4.6.5 References

1. NRC. NUREG–0661, "Mark I Containment Long-Term Program Resolution of Generic Technical Activity A-7." Agencywide Documents Access and Management System (ADAMS) Accession No. ML072710452. Washington, DC: U.S. Nuclear Regulatory Commission. July 1980.
2. NRC. NUREG–0800, "U.S. Nuclear Regulatory Commission, Standard Review Plan." Section 6.2.1.1.C. ADAMS Accession No. ML070630046. Washington, DC: U.S. Nuclear Regulatory Commission. March 2007. NRC 2021-TN8013
3. ASME. ASME Code, Section III, Division 2, "Code for Concrete Containments, Rules for Construction of Nuclear Facility Components." New York, New York: The American Society of Mechanical Engineers, (as endorsed in Regulatory Guide 1.136, "Design Limits, Loading Combinations, Materials, Construction, and Testing of Concrete Containments.")
4. ASME. ASME Code, Section III, Division 1, "Rules for Construction of Nuclear Facility Components." New York, New York: The American Society of Mechanical Engineers. 1974 or later as applicable.
5. EPRI. EPRI TR–1003456, "Aging Management Guideline for Commercial Nuclear Power Plants Electrical and Mechanical Penetrations." Palo Alto, California: Electric Power Research Institute. April 2002.

Table 4.6-1 Examples of Final Safety Analysis Report Supplement for Containment Liner Plates, Metal Containments, and Penetrations Fatigue Time-Limited Aging Analyses Evaluation

10 *Code of Federal Regulations* (CFR) 54.21(c)(1)(i) Example		
Time-Limited Aging Analyses (TLAA)	**Description of Evaluation**	**Implementation Schedule***
Containment liner plates, metal containments, and penetrations fatigue	The containment liner plates, metal containments, and penetrations provide an essentially leak-tight barrier. Current fatigue parameter evaluations remain valid during the subsequent period of extended operation.	Completed, validation provided in the subsequent license renewal application (SLRA)
10 CFR 54.21(c)(1)(ii) Example		
TLAA	**Description of Evaluation**	**Implementation Schedule***
Containment liner plates, metal containments, and penetrations fatigue	The containment liner plates, metal containments, and penetrations provide an essentially leak-tight barrier. Fatigue parameter evaluations have been reevaluated based on revised numbers of occurrences and severities of cyclic loads projected for the subsequent period of extended operation. The revised fatigue parameter values remain within allowable limits for the subsequent period of extended operation.	Completed, validation provided in the SLRA
10 CFR 54.21(c)(1)(iii) Example		
TLAA	**Description of Evaluation**	**Implementation Schedule***
Containment liner plates, metal containments, and penetrations fatigue	The containment liner plates, metal containments, and penetrations provide an essentially leak-tight barrier. The applicant identifies an aging management program to manage the effects of fatigue on such components during the subsequent period of extended operation. The program monitors and tracks the number of cycles and occurrences and severities of relevant transients. The program is effective when fatigue evaluations and/or fatigue usage remain within the allowable limits or requires corrective actions (e.g., reanalyses and/or component replacement) when the limits are exceeded. If the component is replaced, the fatigue parameter value for the replacement should be shown to be less than the allowable limit during the subsequent period of extended operation.	Program and subsequent license renewal enhancements, when applicable, are implemented six months prior to the subsequent period of extended operation.

*An applicant should incorporate the implementation schedule into its final Safety Analysis Report. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.
Note: All containment components need not meet the same requirement. It is likely that the liner plate and the bellows may be evaluated per 10 CFR 54.21(c)(1)(i), while high energy penetrations may be evaluated per 10 CFR 54.21(c)(1)(ii).

CFR = *Code of Federal Regulations*; SLRA = subsequent license renewal application; TLAA = Time-Limited Aging Analyses.

4.7 Other Plant-Specific Time-Limited Aging Analyses

Review Responsibilities

Primary — Branch responsible for TLAA issues

Secondary — Other branches responsible for systems, as appropriate

4.7.1 Areas of Review

There are certain plant-specific safety analyses that may involve time-limited assumptions defined by the current operating term of the plant (for example, aspects of the RV design) and may, therefore, be TLAAs. Pursuant to 10 CFR 54.21(c), a SLR applicant is required to evaluate TLAAs. The definition of TLAAs is provided in 10 CFR 54.3 (TN4878) and in Section 4.1 of this SRP-SLR.

As indicated in 10 CFR 54.30, the adequacy of the plant's CLB is not an area within the scope of the SLR review. Any questions regarding the adequacy of the CLB must be addressed under the backfit rule (10 CFR 50.109) and are separate from the license renewal process. The SLR reviews focus on the subsequent period of extended operation. Pursuant to 10 CFR 54.30, if the reviews required by 10 CFR 54.21(a) or (c) show that there is not reasonable assurance during the current license term that licensed activities will be conducted in accordance with the CLB, the licensee is required to take measures under its current license to ensure that the intended functions of those SSCs are maintained in accordance with the CLB throughout the term of the current license. The adequacy of the measures for the term of the current license is not within the scope of the SLR review.

Pursuant to 10 CFR 54.21(c), an applicant must provide a listing of TLAAs and plant-specific exemptions that are based on TLAAs. The NRC staff reviews the applicant's identification of TLAAs and exemptions separately, following the guidance in Section 4.1 of this SRP-SLR.

The NRC staff has developed review procedures for the evaluation of certain TLAAs. If an applicant identifies these TLAAs as applicable to its plant, the NRC staff reviews them separately, following the guidance in Sections 4.2 through 4.6 of this SRP-SLR.

Table 4.7-1 provides examples of potential plant-specific TLAA topics. The reviewer follows the generic guidance in this section of the SRP-SLR for reviewing these and any other plant-specific TLAAs that have been identified by the applicant. For particular systems, the reviewers from branches responsible for those systems may be requested to assist in the review, as appropriate.

The following subsections identify the areas of review for plant-specific TLAAs.

4.7.1.1 Time-Limited Aging Analysis

The applicant's evaluation of the TLAA for the subsequent period of extended operation is reviewed.

4.7.1.2 Final Safety Analysis Report Supplement

The FSAR Supplement summarizing the applicant's evaluation of the TLAA for the subsequent period of extended operation is reviewed.

4.7.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Section 4.7.1 delineate acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1) and 10 CFR 54.21(d) (TN4878).

4.7.2.1 Time-Limited Aging Analysis

Pursuant to 10 CFR 54.21(c)(1), an applicant must demonstrate one of the following for TLAAs:

(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.

Acceptance criteria for each TLAA demonstration are discussed in the following sections.

4.7.2.1.1 10 CFR 54.21(c)(1)(i)

The applicant must demonstrate that the analysis remains valid for the subsequent period of extended operation. The analysis remains valid because it is shown to be bounding even during the subsequent period of extended operation. No changes to the existing analysis are necessary.

4.7.2.1.2 10 CFR 54.21(c)(1)(ii)

The applicant must demonstrate that the analysis has been projected to the end of the subsequent period of extended operation. The existing analysis is updated or recalculated to show acceptable results for the subsequent period of extended operation.

4.7.2.1.3 10 CFR 54.21(c)(1)(iii)

The applicant must demonstrate that the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation. Appendix Section A.1 of this SRP-SLR provides the acceptance criteria for programs and activities used to manage the effects of aging.

4.7.2.2 Final Safety Analysis Report Supplement

The specific criterion for meeting 10 CFR 54.21(d) is that the summary description of the evaluation of TLAAs for the subsequent period of operation in the FSAR Supplement is sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description contains information associated with the TLAAs regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.7.3 Review Procedures

For certain applicants, plant-specific analyses may meet the definition of a TLAA as given in 10 CFR 54.3 (TN4878). The concern for SLR is that these analyses may not have properly considered the full-length of the subsequent period of extended operation, which may change conclusions with regard to safety and the capability of SSCs within the scope of 10 CFR Part 54 to perform one or more safety functions. The review of these TLAAs provides assurance that the effects of aging are properly addressed through the subsequent period of extended operation.

The following sections provide the review procedures for each area of review described in Section 4.7.1.

4.7.3.1 Time-Limited Aging Analysis

For each TLAA, the review procedures depend on the applicant's choice of methods of compliance in 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878).

4.7.3.1.1 10 CFR 54.21(c)(1)(i)

Justification provided by the applicant is reviewed to verify that the existing analysis remains valid for the subsequent period of extended operation. The existing analysis should be shown to be bounding even during the subsequent period of extended operation.

The applicant describes the TLAA with respect to the objectives of the analysis, assumptions used in the analysis, conditions, acceptance criteria, relevant aging effects, and intended function(s). For those analyses that consider cyclic loading, each load or transient type should be identified along with the corresponding number of total cycles assumed in the analysis and the number of cycles that are anticipated to occur through the subsequent period of extended operation. The applicant shows that: (i) conditions and assumptions used in the analysis already address the relevant aging effects for the subsequent period of extended operation, and (ii) acceptance criteria are maintained to provide reasonable assurance that the intended function(s) is maintained. Thus, no reanalysis is necessary.

In some instances, the applicant may identify activities to be performed to verify the assumption basis for the calculation (e.g., cycle counting). An evaluation of that activity is provided by the applicant. The reviewer assures that the applicant's verification activities are sufficient to confirm the validity of the calculation assumptions for the subsequent period of extended operation.

If the TLAA must be modified or recalculated to extend the period of evaluation to consider the subsequent period of extended operation, then reevaluation should be addressed under 10 CFR 54.21(c)(1)(ii) (TN4878).

4.7.3.1.2 10 CFR 54.21(c)(1)(ii)

The documented results of the revised analyses are reviewed to verify that their period of evaluation is extended such that they are valid for the subsequent period of extended operation. The applicable analysis technique can be the one that is in effect in the plant's CLB at the time that the SLRA is filed.

The applicant may recalculate the TLAA using an 80-year period to show that the acceptance criteria continue to be satisfied for the subsequent period of extended operation. The applicant also may revise the TLAA by recognizing and reevaluating any overly conservative conditions and assumptions. Examples include relaxing overly conservative assumptions in the original analysis, using new or refined analytical techniques, and performing the analysis using an 80 year period. The applicant should provide a sufficient description of the analysis and document the results of the reanalysis to show that it is satisfactory for the subsequent period of extended operation.

As applicable, the plant's Code of Record is used for the reevaluation, or the applicant may update to a later code edition pursuant to 10 CFR 50.55a. In the latter case, the reviewer verifies that the requirements in 10 CFR 50.55a are met.

In some cases, the applicant may identify activities to be performed to verify the assumption basis for the calculation (e.g., cycle counting). An evaluation of that activity is provided by the applicant. The reviewer assures that the applicant's verification activities are sufficient to confirm the validity of the calculation assumptions for the subsequent period of extended operation.

4.7.3.1.3 10 CFR 54.21(c)(1)(iii)

Under this option, the applicant proposes to manage the aging effects associated with the TLAA by an AMP or aging management activities in the same manner as described in the integrated plant assessment in 10 CFR 54.21(a)(3) (TN4878). The reviewer reviews the applicant's AMP or aging management activities to verify that the effects of aging on the intended function(s) are adequately managed consistent with the CLB for the subsequent period of extended operation.

The applicant identifies the SCs associated with the TLAA. The TLAA is described with respect to the objectives of the analysis, conditions, assumptions used, acceptance criteria, relevant aging effects, and intended function(s). The reviewer uses the guidance in Appendix Section A.1 of this SRP-SLR to ensure that the effects of aging on the SC-intended function(s) are adequately managed for the subsequent period of extended operation.

4.7.3.2 Final Safety Analysis Report Supplement

The reviewer verifies that the applicant has provided information to be included in the FSAR Supplement that includes a summary description of the evaluation of each TLAA. Each such summary description is reviewed to verify that it is sufficiently comprehensive.

The NRC staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR Supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR Supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR Supplement before the license is renewed, no condition will be necessary.

An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to make sure that the applicant will complete these activities no later than the committed date.

4.7.4 Guidance for Specific TLAA Reviews

4.7.4.1 Leak-before-break Analysis

As described in SRP-SLR Section 3.6.3, General Design Criterion 4 in 10 CFR Part 50, Appendix A allows the use of analyses reviewed and approved by the NRC staff to eliminate the dynamic effects of pipe ruptures from the plant design basis (Ref. 1). The dynamic effects, which may be eliminated, include the effects of pipe whipping and discharging fluids resulting from piping failure. Therefore, during the current license term, an NRC staff-approved leak-before-break (LBB) analysis may be used to remove protective hardware such as pipe whip restraints and jet impingement barriers. SRP-SLR Section 3.6.3 describes the evaluation procedures used to approve an LBB analysis for the current license term.

If the applicant's CLB contains an LBB analysis that meets the definition of a TLAA in 10 CFR 54.3, the applicant is required to submit an evaluation of the LBB TLAA as part of the SLRA to demonstrate in accordance with 10 CFR 54.21(c)(1) that: (i) the LBB TLAA remains valid for the subsequent period of extended operation; (ii) the LBB TLAA has been projected to the end of the subsequent period of extended operation; or (iii) the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation.

In its review of an LBB TLAA for SLR, the NRC staff evaluates the aspects or methods of the LBB TLAA, which have been changed from those of the CLB LBB analysis. The NRC staff performs this evaluation in accordance with the evaluation procedures and guidance in SRP 3.6.3. The examples of the aspects or methods of the analysis, which may have been changed from those in the CLB LBB analysis, are the changes in the following: (i) piping materials and mechanical properties of the materials (e.g., due to piping replacement activities, identification of previously omitted piping materials or material property changes due to thermal aging effects); (ii) piping designs and configurations; (iii) operational conditions (e.g., temperature and pressure); (iv) piping stress levels based on updated stress analyses; (v) locations of critical cracks; (vi) methods used to estimate applied loads or perform crack stability analyses; and (vii) methods used to determine the leak rates of leakage cracks.

In addition, the NRC staff reviews the time-dependent parameters and the associated analysis to confirm the adequacy in projecting the parameters and evaluating the effects of the projected parameters on the LBB analysis. The examples of the time-dependent parameters and the associated analysis in the LBB TLAA are: (i) fracture toughness of cast austenitic stainless steel (CASS) piping materials due to thermal aging effect and (ii) fatigue transient cycles and crack sizes.

4.7.4.2 Pump Casing Flaw Tolerance Analysis

An SLR applicant may have a flaw tolerance analysis for its CASS pump casing in the CLB. Typically, pump casing flaw tolerance analyses have been performed in the current licensing bases of PWRs to confirm the structural stability of the components. If the CASS pump casing analysis meets the definition of a TLAA in 10 CFR 54.3, the applicant is required to submit an evaluation of the pump casing TLAA as part of the SLR application in accordance with 10 CFR 54.21(c).

The applicant's pump casing flaw tolerance TLAA may be based on the provisions in ASME Code Case N-481 (Ref. 2, 3). In this case, the NRC staff reviews the TLAA to confirm that the TLAA is consistent with the provisions in Code Case N-481 with focus on the aspects or methods of the flaw tolerance TLAA that have been changed from the analysis contained in the CLB. The NRC staff also reviews the time-dependent parameters and the associated analysis to confirm the adequacy in projecting the parameters and evaluating the effects of the projected parameters on the flaw tolerance TLAA (e.g., fracture toughness properties of CASS materials susceptible to thermal aging embrittlement, fatigue transient cycles, and fatigue crack sizes).

In 2019, the NRC staff-approved a reactor coolant pump (RCP) casing flaw tolerance analysis for SLR as described in PWROG-17033-NP-A, Revision 1 (Ref. 3). The RCP casing flaw tolerance analysis is an update to the previous industry analyses, which were based on ASME Code Case N-481. The updated analysis is intended to confirm the structural stability of RCP casings for 80 years of operation. An applicant may rely on PWROG-17033-NP-A, Revision 1 as conditioned by the NRC staff (Ref. 3) to demonstrate the acceptable evaluation and disposition of the pump casing flaw tolerance TLAA. If an applicant credits the approved PWROG-17033-NP-A, Revision 1 for the evaluation of the pump casing flaw tolerance TLAA, the NRC staff confirms that the applicant's evaluation of the TLAA adequately addressed the NRC staff-imposed conditions for PWROG-17033-NP-A, Revision 1, including the applicability of the PWROG report to the applicant's pump casings.

4.7.5 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this Section 4.7 and whether the NRC staff's evaluation supports conclusions of the following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878), to be included in the SER:

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that, for the (name of specific) TLAA, (choose which is appropriate)
>
> (i) the analyses remain valid for the subsequent 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 subsequent period of extended operation. The NRC staff also concludes that the FSAR Supplement contains an appropriate summary description of this TLAA evaluation for the period of extended operation, as required by 10 CFR 54.21(d).

4.7.6 References

1. NRC. NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Revision 1, Section 3.6.3, "Leak-before-break Evaluation Procedures." ADAMS Accession No. ML063600396. Washington, DC: U.S. Nuclear Regulatory Commission. March 2007.

2. ASME. ASME Code Case N-481, "Alternative Examination Requirements for Cast Austenitic Pump Casings." New York, New York: The American Society of Mechanical Engineers. March 1990.

3. PWR Owners Group Report No. PWROG-17033-NP-A, Revision 1, “Update for Subsequent License Renewal: WCAP-13045, ‘Compliance to ASME Code Case N-481 of the Primary Loop Pump Casings of Westinghouse Type Nuclear Steam Supply Systems’.” ADAMS Accession No. ML19319A188. Pittsburgh, Pennsylvania: Westinghouse Electric Company. November 2019.

Table 4.7-1 Examples of Potential Plant-Specific Time-Limited Aging Analyses Topics

Boiling Water Reactor (BWRs)
Re-flood thermal shock of the reactor pressure vessel (RPV)
Re-flood thermal shock of the core shroud and other reactor vessel internals
Loss of preload for core plate rim holddown bolts
Erosion of the main steam line flow restrictors
Susceptibility to irradiation-assisted stress corrosion cracking
Pressurized Water Reactor (PWRs)
RPV underclad cracking
Leak-before-break
Reactor coolant pump flywheel fatigue crack growth
Response to NRC Bulletin 88-11, “Pressurizer Surge Line Thermal Stratification”
Response to NRC Bulletin 88-08, “Thermal Stresses in Piping Connected to Reactor Cooling Systems”
Electric Power Research Institute Materials Reliability Program (MRP) cycle-based and fluence-based analyses in support of MRP-227
Pump casing flaw tolerance
BWRs and PWRs
Fatigue of cranes (crane cycle limits)
Fatigue of the spent fuel pool liner
Corrosion allowance calculations
Flaw growth due to stress corrosion cracking
Predicted lower limit

BWR = boiling water reactor; MRP = Materials Reliability Program; PWR = pressurized water reactor; RPV = reactor pressure vessel; RV = reactor vessel

5.0 TECHNICAL SPECIFICATIONS CHANGES

5.1 Review of Technical Specifications Changes and Additions Necessary to Manage the Effects of Aging During the Subsequent Period of Extended Operation

Review Responsibilities

Primary — Branch responsible for reviewing technical specifications (TS) requirements related to aging management programs (AMPs) or time-limited aging analyses (TLAAs)

Secondary — Other branches responsible for engineering, as appropriate

5.1.1 Areas of Review

The requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 54.22 (Ref. 1) require an applicant to identify any new TS or TS changes (i.e., amendments) that are needed to manage the effects of aging during the subsequent period of extended operations. This section of the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) provides guidance for determining whether plant TS changes need to be included in a plant-specific subsequent license renewal application (SLRA).

5.1.2 Acceptance Criteria

The TS for a relicensed LWR facility may contain specific TS sections that may have relationships to AMPs or TLAAs that are identified in an SLRA. The following provide examples of (but are not limited to) TS requirements that may relate to AMPs or TLAAs:

- For TS that include Administrative Controls Section provisions that establish preventative maintenance and periodic visual inspection requirements for plant systems located outside of containment (i.e., for applicant's whose SLRAs include periodic surveillance and preventative maintenance AMPs and whose current licensing basis [CLB] include these types of TS requirements), the AMPs should establish the relationship of the TS requirements to the applicable program element criteria for their AMPs, as applicable.
- For TS that include Administrative Controls Section provisions that establish fuel oil testing requirements for emergency diesel fuel storage tanks (i.e., for applicant's whose SLRAs include diesel fuel oil testing AMPs and with CLBs that include these types of TS requirements), the AMPs should establish the relationship of the TS requirements to the applicable program element criteria for their AMPs, as applicable.
- For TS that include pressure-temperature (P-T) limits for their reactor vessels and reactor coolant pressure boundary components in the limiting conditions of operations and control updates of these P-T limits through their 10 CFR 50.90 license amendment request process, the TS requirements may have direct bearing on how the P-T limit TLAAs for the SLRA are accepted in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878).
- For TS that include P-T limits for their reactor vessels and reactor coolant pressure boundary components in a pressure-temperature limit report (PTLR) and controls updates of the P-T limits and PTLR in accordance with a program and process controlled by the Administrative Controls Section of their TS, the TS requirements may have direct bearing on

how the P-T limit TLAAs for the SLRA are accepted in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii) (TN4878).

Acceptance criteria for plant-specific TS are contained in the specific TS provisions or alternatively in referenced documents invoked by the TS requirements. For those SLRAs for plants whose CLBs include TS requirements that relate to an AMP's program element bases for managing specific aging effects, the TS requirements should be reviewed to confirm that they remain adequate for managing the aging effects that are within the scope of the AMPs. Otherwise, the TS requirements should be amended accordingly as part of the SLRA in accordance with 10 CFR 54.22 and the changes in the TS requirement criteria factored into the program element bases for the AMP, as appropriate.

For those TS requirements that relate to TLAAs, the TS requirements and any methodologies or processes invoked by the TS requirements should be reviewed to accwaa if they need to be amended or new TS requirements need to be proposed in order to demonstrate adequate compliance of the TLAAs in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii). Otherwise, TS changes that are determined as being necessary to disposition TLAAs in accordance with the requirements of

The 10 CFR 54.21(c)(1)(i), (ii), or (iii) should be included in the SLRA as part of TS change requests under 10 CFR 54.22. This may include TS changes that may be needed for P-T limit TLAAs controlled by PTLR processes, if it is determined that the current P-T limit methodologies approved and invoked by the current Administrative Controls TS requirements cannot generate P-T limits for the subsequent period of extended operation that will comply with the P-T limit requirements in 10 CFR Part 50 (TN249), Appendix G (Ref. 2), and Appendix G of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section XI edition of record for the facility.

5.1.3 Review Procedures

The reviewer should review the applicant's operating license, including the TS that are included as part of the operating license, and procedures to make certain that the applicant has identified all appropriate TS changes or additions that may impact AMPs or TLAAs during the subsequent period of extended operation. If it is determined that new TS requirements, or new operating license conditions are needed to manage specific aging effects, or that changes to the existing TS requirements need to be amended in order to manage such aging effects, the reviewer determines that those license amendments are submitted with the SLRA for U.S. Nuclear Regulatory Commission (NRC) approval in accordance with the requirement in 10 CFR 54.22 (TN4878).

Examples of existing TS requirements that may be used to manage the effects of aging include but are not limited to: (i) preventative maintenance and periodic visual inspection requirements for plant systems located outside of containment, (ii) diesel fuel oil monitoring requirements or surveillance requirements that are listed in the administrative controls sections of the TS, which may form the basis for Fuel Oil Chemistry Programs used to manage loss of material due to general, pitting, crevice, and microbiologically-induced corrosion in emergency diesel fuel oil system components, and (iii) requirements in the TS that govern the applicant's updates to the P-T limits of their plants that constitute part of the mandatory bases for managing and analyzing loss of fracture toughness due to neutron irradiation embrittlement in ferritic steel components of the RV and reactor coolant pressure boundary. This latter example is a TLAA.

5.1.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section, and whether the NRC staff's evaluation supports one of the following three conclusions listed below that is to be included in the NRC staff's safety evaluation report, as applicable for the review of the SLRA:

On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided an acceptable basis for concluding that the SLRA does not need to include any new TS requirements or TS amendments to manage the effects of aging during the subsequent period of extended operation.

On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided a list of all new TS provisions or TS changes in the SLRA that are needed to manage the effects of aging during the subsequent period of extended operation, as required by 10 CFR 54.22 (TN4878). The NRC staff also concludes that these TS changes will be capable of managing the effects of aging in accordance the requirement in 10 CFR 54.21(a)(3).

Pursuant to the requirement in 10 CFR 54.22, as discussed above, the NRC staff concludes that the applicant has provided those new TS provisions or TS changes in the SLRA needed to manage (INSERT APPLICABLE AGING EFFECT), as evaluated in (INSERT NAME of TLAA) for the subsequent period of extended operation. The NRC staff also concludes that these TS changes adequately demonstrate that the (INSERT NAME of TLAA and then INSERT one of the Following Statements to finish off this conclusion):

- "will remain valid for the subsequent period of extended operation, as required by 10 CFR 54.21(c)(1)(i),"
- "has been adequately projected to the end of the subsequent period of extended operation, as required by 10 CFR 54.21(c)(1)(ii)," or
- "effects of (INSERT APPLICABLE AGING EFFECT AND MECHANISM) on the intended functions of the (INSERT APPLICABLE STRUCTURES OR COMPONENTS EVALUATED IN THE TLAA) will be adequately managed during the SLR period, as required by 10 CFR 54.21(c)(1)(iii).]

5.1.5 References

1. 10 CFR 54.22, "Contents of Application–Technical Specifications." Washington, DC: U.S. Nuclear Regulatory Commission. 2016. 10 CFR Part 54-TN4878
2. 10 CFR Part 50, Appendix G, "Fracture Toughness Requirements." Washington, DC: U.S. Nuclear Regulatory Commission. 2016. 10 CFR Part 50-TN249

APPENDIX A

GENERAL NRC STAFF POSITIONS AND GUIDANCE

APPENDIX A —GENERAL NRC STAFF POSITIONS AND GUIDANCE

A.1 Aging Management Review — Generic

(Branch Technical Position RLSB-1)

A.1.1 Background

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(a)(3) (TN4878), a license renewal application is required to demonstrate that the effects of aging on structures and components (SCs) subject to an aging management review (AMR) are adequately managed so their intended functions will be maintained consistent with the current licensing basis (CLB) for the subsequent period of extended operation. The purpose of this Branch Technical Position (BTP) (License Renewal and Standardization Branch [RLSB-1]) is to address the aging management demonstration that has not been addressed specifically in Sections 3.0 and 4.0 of this Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR).

The subsequent license renewal (SLR) process is not intended to demonstrate absolute assurance that SCs will not fail, but rather that there is reasonable assurance that they will perform such that the intended functions are maintained consistent with the CLB during the subsequent period of extended operation.

There are four types of aging management programs (AMPs): (i) prevention, (ii) mitigation, (iii) condition monitoring, and (iv) performance monitoring.

Prevention programs preclude the effects of aging. For example, Coating Programs prevent external corrosion of a tank.

Mitigation programs attempt to slow the effects of aging. For example, Water Chemistry Programs mitigate internal corrosion of piping.

Condition monitoring programs inspect for the presence and extent of aging effects or perform tests that monitor potential changes in a components or structure's material condition. Examples of programs that involve inspections are the visual examination of concrete structures for cracking and the ultrasonic examination of pipe wall for flow-accelerated corrosion induced wall thinning. Examples of programs that involve material testing are reactor pressure vessel material surveillance capsule testing programs that monitor for embrittlement of the ferritic reactor pressure vessel components and material testing programs that monitor for degradation in spent fuel pool neutron absorption materials.

Performance monitoring programs test the ability of a structure or component to perform its intended function(s). For example, the ability of the tubes on heat exchangers to transfer heat is tested.

More than one type of AMP may be implemented to make sure that aging effects are managed appropriately. For example, in managing internal corrosion of piping, a mitigation program (Water Chemistry Program) may be used to minimize susceptibility to corrosion. However, it may also be necessary to have a condition monitoring program (ultrasonic inspection) to verify that corrosion is indeed insignificant. In addition, some AMPs may incorporate more than one of the activities of prevention, mitigation, condition monitoring, or performance monitoring. For example, open cycle cooling water programs may incorporate combinations of inspection (condition monitoring) and flow testing (performance monitoring) activities.

A.1.2 Branch Technical Position

A.1.2.1 Applicable Aging Effects

1. The determination of applicable aging effects is based on degradation mechanisms that have occurred and those that potentially could cause SC degradation. The materials, environment, stresses, service conditions, operating experience (OE), and other relevant information should be considered in identifying applicable aging effects. The effects of aging on the intended function(s) of SCs also should be considered.

2. Relevant aging information may be contained in, but is not limited to, the following documents: (i) plant-specific maintenance and inspection records; (ii) plant-specific site deviation or issue reports; (iii) plant-specific U.S. Nuclear Regulatory Commission (NRC) and Institute of Nuclear Power Operations (INPO) inspection reports; (iv) plant-specific licensee self-assessment reports; (v) plant-specific and other licensee event reports; (vi) NRC, INPO, and vendor generic communications; and (vii) generic safety issues or unresolved safety issues; NUREG reports; and Electric Power Research Institute (EPRI) reports.

3. If OE or other information indicates that a certain aging effect may be applicable and an applicant determines that it is not applicable to its specific plant, the reviewer may question the absence of this aging effect if the applicant has not provided a sufficient basis in its subsequent license renewal application (SLRA). For example, the question could cite a previous application review, NRC generic communications, engineering judgment, relevant research information, or other industry experience as the basis for the question. Simply citing that the aging effect is listed in the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report is not a sufficient basis. For example, it may be that the aging effect is applicable to a pressurized water reactor (PWR) component, but the applicant’s plant is a boiling water reactor (BWR) and does not have such a component. In this example, using the GALL-SLR Report merely as a checklist is not appropriate.

4. An aging effect may not have been identified in the GALL-SLR Report, if it arises out of industry experience after the issuance of the GALL-SLR Report. The reviewer should make sure that the applicant has evaluated the latest industry experience to identify all applicable aging effects.

5. An aging effect should be identified as applicable for SLR even if there is a prevention or mitigation program associated with that aging effect. For example, water chemistry, a coating, or use of cathodic protection could prevent or mitigate corrosion, but corrosion should be identified as applicable for SLR, and the AMR should consider the adequacy of the AMP referencing water chemistry, coating, or cathodic protection.

6. Specific identification of aging mechanisms is not a requirement; however, it is an option to identify specific aging mechanisms and the associated aging effects in the integrated plant assessment.

7. The applicable aging effects to be considered for SLR include those that could result from normal plant operation, including plant or system operating transients and plant shutdown. Specific aging effects from abnormal events need not be postulated for SLR. However, if an abnormal event has occurred at a particular plant, its contribution to the aging effects on SCs for SLR should be considered for that plant. For example, if a resin intrusion has

occurred in the reactor coolant system at a particular plant, the contribution of this resin intrusion event to aging should be considered for that plant.

Design basis events are abnormal events; they include design basis pipe break, loss of coolant accident, and safe shutdown earthquake. Potential aging effects resulting from design basis events are addressed, as appropriate, as part of the plant's CLB. There are other abnormal events which should be considered on a case-by-case basis. For example, abuse due to human activity is an abnormal event; aging effects from such abuse need not be postulated for SLR. When a safety-significant piece of equipment is accidentally damaged by a licensee, the licensee is required to take immediate corrective action under existing procedures (see 10 CFR Part 50 [TN249], Appendix B) to make sure that the functionality of the equipment is maintained. If the equipment degradation is not due to aging; corrective action is not necessary solely for the subsequent period of extended operation. However, leakage from bolted connections should not be considered as abnormal events. Although bolted connections are not supposed to leak, experience shows that leaks do occur, and the leakage could cause corrosion. In addition, condensation frequently occurs during humid periods of normal plant operation and can also occur during plant shutdown when normally hot components might be below the dew point. The aging effects from leakage of bolted connections and condensation occurring during humid periods of normal plant operations should be evaluated for SLR. Condensation during plant shutdowns could result in aging effects such as reduced thermal insulation resistance due to moisture intrusion and should be evaluated for SLR. It is less likely that condensation during plant shutdowns would result in loss of material, unless plant-specific OE dictates otherwise (e.g., as a result of extended plant shutdowns).

An aging effect due to an abnormal event does not preclude that aging effect from occurring during normal operation for the subsequent period of extended operation. For example, a certain PWR licensee observed clad cracking in its pressurizer, and attributed that to an abnormal dry out of the pressurizer. Although dry out of a pressurizer is an abnormal event, the potential for clad cracking in the pressurizer during normal operation should be evaluated for the SLR. This is because the pressurizer is subject to extensive thermal fluctuations and water level changes during plant operation, which may result in clad cracking given sufficient operating time. The abnormal dry out of the pressurizer at that certain plant may merely accelerate the rate of the aging effect.

A.1.2.2 Aging Management Program for Subsequent License Renewal

1. An acceptable AMP should consist of the 10 elements described in Table A.1, as appropriate. These program elements are discussed further in Section A.1.2.3 below.
2. All programs and activities that are credited for managing a certain aging effect for a specific SC should be described. These programs and activities may be evaluated together for the 10 elements described in Table A.1, as appropriate.
3. The risk significance of a SC could be considered in evaluating the robustness of an AMP. Probabilistic arguments may be used to develop an approach for aging management adequacy. However, use of probabilistic arguments alone is not an acceptable basis for concluding that for those SCs subject to an AMR, the effects of aging will be adequately managed in the subsequent period of extended operation. Thus, risk significance may be considered in developing the details of an AMP for the structure or component for SLR, but may not be used to conclude that no AMP is necessary for SLR.
4. For programs that rely on NRC-endorsed technical or topical reports (TRs), the scope of the AMP includes the applicant's bases for resolving or addressing any NRC limitations or

applicant/licensee action items that are placed on the activities for implementing a given report's methodology. These limitations or action items are identified in the NRC's safety evaluation on the TR's methodology and recommended activities. If it is determined that the response to a specific applicant action item will result in the need for augmentation of specific programmatic criteria beyond those activities recommended in the applicable TR, the applicant should define the AMP accordingly to identify the AMP program element or elements that are impacted by the basis for responding to the applicable action item and the adjustments that will need to be made to the TR guidance recommendations, as defined in the impacted program elements for the AMP and applicable to the CLB and design basis for the facility. It is also recommended that the applicants provide their basis for resolving the specific limitations or action items in Appendix C of their SLRAs.

A.1.2.3 Aging Management Program Elements

Scope of Program

The specific program necessary for SLR should be identified. The scope of the program should include the specific SCs, the aging of which the program manages.

Preventive Actions

1. The activities for prevention and mitigation programs should be described. These actions should mitigate or prevent aging degradation.
2. Some condition or performance monitoring programs do not rely on preventive actions and thus, this information need not be provided.
3. In some cases, condition or performance monitoring programs may also rely on preventive actions. Thus, specific prevention activities should be specified.

Parameters Monitored or Inspected

1. This program element should identify the aging effects that the program manages and should provide a link between the parameter or parameters that will be monitored and how the monitoring of these parameters will ascertain adequate aging management.
2. For a condition monitoring program, the parameter monitored or inspected should be capable of detecting the presence and extent of aging effects. Some examples are measurements of wall thickness and detection and sizing of cracks.
3. For a performance monitoring program, a link should be established between the degradation of the particular structure or component-intended function(s) and the parameter(s) being monitored. An example of linking the degradation of a passive component-intended function with the performance being monitored is linking the fouling of heat exchanger tubes with the heat transfer-intended function as identified by a change in the differential temperature across the heat exchanger tubes. This could be monitored by periodic heat balances. Since this example deals only with one intended function of the tubes (heat transfer), additional programs may be necessary to manage other intended function(s) of the tubes, such as pressure boundary. Thus, a performance monitoring program must make sure that the SCs are capable of performing their intended functions by using a combination of performance monitoring and evaluation (if outside acceptable limits of acceptance criteria) that demonstrate that a change in performance characteristic is a result of an age-related degradation mechanism.

4. For prevention or mitigation programs, the parameters monitored should be the specific parameters being controlled to achieve prevention or mitigation of aging effects. An example is the coolant oxygen level that is being controlled in a Water Chemistry Program to mitigate pipe cracking.

Detection of Aging Effects

1. Detection of aging effects should occur before there is a loss of the SC-intended function(s). The parameters to be monitored or inspected should be appropriate to make sure that the SC-intended function(s) will be adequately maintained for SLR under all CLB design conditions. Thus, the discussion for the "detection of aging effects" program element should address: (i) how the program element would be capable of detecting or identifying the occurrence of age-related degradation or an aging effect prior to a loss of SC-intended function or (ii) for preventive/mitigative programs, how the program would be capable of preventing or mitigating their occurrence prior to a loss of a SC-intended function. The discussion should provide information that links the parameters to be monitored or inspected to the aging effects being managed.

2. Nuclear power plants are licensed based on redundancy, diversity, and defense-in-depth principles. A degraded or failed component reduces the reliability of the system, challenges safety systems, and contributes to plant risk. Thus, the effects of aging on a SC should be managed to secure its availability to perform its intended function(s) as designed when called upon. In this way, all system level intended function(s), including redundancy, diversity, and defense-in-depth consistent with the plant's CLB, would be maintained for SLR. A program based solely on detecting SC failure should not be considered as an effective AMP for SLR.

3. This program element describes "when," "where," and "how" program data are collected (i.e., all aspects of activities to collect data as part of the program).

4. For condition monitoring programs, the method or technique (such as visual, volumetric, or surface inspection), frequency, and timing of new, one-time inspections may be linked to plant-specific or industry-wide OE. The discussion provides justification, including codes and standards referenced, that the technique and frequency are adequate to detect the aging effects before a loss of SC-intended function. A program based solely on detecting SC failures is not considered an effective AMP.

   For a condition monitoring program, when sampling is used to represent a larger population of SCs, applicants provide the basis for the inspection population and sample size. The inspection population is based on such aspects of the SCs as similarity of materials of construction, fabrication, procurement, design, installation, environment, operating conditions, and aging effects. The sample size is based on various aspects of the SCs such as specific aging effect, location, existing technical information, system and structure design, materials of construction, environment, operating conditions, and previous failure history. The samples are biased toward locations most susceptible to the specific aging effect of concern in the subsequent period of extended operation. For multiunit sites, sample data are collected from at all units. Provisions for expanding the sample size when degradation is detected in the initial sample are included.

5. For a performance monitoring program, the "Detection of Aging Effects" program element should discuss and establish the monitoring methods that will be used for performance monitoring. In addition, the "Detection of Aging Effects" program element should also

establish and justify the frequency that will be used to implement these performance monitoring activities.

6. For a prevention or mitigation program, the “Detection of Aging Effects” program element should discuss and establish the monitoring methods that the program will use to monitor for the preventive or mitigative parameters that the program controls and should justify the frequency of performing these monitoring activities.

Monitoring and Trending

1. Monitoring and trending activities should be described, and they should provide a prediction of the extent of degradation and thus effect timely corrective or mitigative actions. Plant-specific and/or industrywide OE may be considered in evaluating the appropriateness of the technique and frequency. Results of inspections in the prior period of extended operation are used to provide input to trending results.

2. This program element describes “how” the data collected are evaluated. This includes an evaluation of the results against the acceptance criteria. Although aging indicators may be quantitative or qualitative, aging indicators should be quantified to the extent possible, to allow trending. The parameter or indicator trended should be described. The methodology for analyzing the inspection or test results against the acceptance criteria should be described. Trending is a comparison of the current monitoring results with previous monitoring results in order to make predictions for the future.

3. For periodic programs, where practical, identified degradation is projected until the next scheduled inspection, the results are evaluated against acceptance criteria to confirm that the timing of subsequent inspections maintain the components’ intended functions throughout the subsequent period of extended operation based on the projected rate of degradation. For sampling-based inspections, results are evaluated against acceptance criteria to confirm that the sampling bases (e.g., selection, size, frequency) will maintain the components’ intended functions throughout the subsequent period of extended operation based on the projected rate and extent of degradation.

Acceptance Criteria

1. The quantitative or qualitative acceptance criteria of the program and its basis should be described. For observed degradation during current inspections, the acceptance criteria, against which the need for corrective actions are evaluated, should ensure that the SC-intended function(s) are maintained consistent with all CLB design conditions during the subsequent period of extended operation. The program should include a methodology for analyzing the results against applicable acceptance criteria.

2. Where it is practical to project observed degradation to the end of the subsequent period of extended operation, the projected degradation is evaluated to determine if it could impact the intended function of a system, structure, or component (SSC). Additional considerations are appropriate for one-time inspections such as whether the projected degradation could result in a potential leak.

3. Acceptance criteria could be specific numerical values, or could consist of a discussion of the process for calculating specific numerical values of conditional acceptance criteria to ensure that the SC-intended function(s) will be maintained under all CLB design conditions. Information from available references may be cited.

4. It is not necessary to justify any acceptance criteria taken directly from the design basis information that is included in the Final Safety Analysis Report (FSAR), plant Technical

Specifications, or other codes and standards incorporated by reference into NRC regulations; they are a part of the CLB. Nor is it necessary to justify the acceptance criteria that have been established in either NRC-accepted or NRC-endorsed methodology, such as those that may be given in NRC-approved or NRC-endorsed topical reports or NRC-endorsed codes and standards; the acceptance criteria referenced in these types of documents have been subject to an NRC review process and have been approved or endorsed for their application to an NRC-approved or NRC-endorsed evaluation methodology. Also, it is not necessary to discuss CLB design loads if the acceptance criteria do not permit degradation because a SC without degradation should continue to function as originally designed. Acceptance criteria for observed degradation during current inspections, which do permit degradation, are based on maintaining the intended function under all CLB design loads.

<u>Corrective Actions</u>

1. Results that do not meet the acceptance criteria are addressed in the applicant’s corrective action program under those specific portions of the quality assurance (QA) program that are used to meet Criterion XVI, “Corrective Action,” of 10 CFR Part 50 (TN249), Appendix B. Section A.2 in Appendix APPENDIX A describes how an applicant may apply its 10 CFR Part 50, Appendix B, Quality Assurance Program to fulfill the corrective actions element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

2. Actions to be taken when the acceptance criteria are not met should be described in appropriate detail or referenced to source documents. Corrective actions, including causal evaluations, root cause determination, and prevention of recurrence, should be timely. For monitored programmatic parameters that fail to meet defined acceptance criteria or standards, corrective action is taken prior to a loss of intended function of the affected structure or component.

3. If corrective actions permit analysis without repair or replacement, the analysis should make sure that the SC-intended function(s) are maintained consistent with the CLB.

4. For plant-specific programs that rely on NRC-endorsed TRs, the corrective actions are implemented in accordance with corrective actions recommended in the applicable reports, or the applicant’s 10 CFR Part 50, Appendix B, QA process, as applicable.

5. For sampling-based programs, additional inspections are conducted for each inspection that did not meet acceptance criteria. The program specifies the number of additional inspections. If subsequent inspections do not meet acceptance criteria, an extent of condition and extent of cause analysis is conducted to determine the further extent of inspections.

6. For one-time based programs, when an aging effect identified during an inspection does not meet acceptance criteria or projected results of the inspections of a material, environment, and aging effect combination does not meet acceptance criteria; a periodic inspection program is developed for the specific combination(s) of material, environment, and aging effect.

7. For periodic condition monitoring programs where any projected inspection results will not meet acceptance criteria prior to the next scheduled inspection, the bases for the inspection frequency are verified and adjusted as necessary.

Confirmation Process

1. The confirmation process should be described. The process makes certain that appropriate corrective actions have been completed and are effective.
2. The confirmation process is addressed through those specific portions of the QA program that are used to meet Criterion XVI, “Corrective Action,” of 10 CFR Part 50, Appendix B. Section A.2 in Appendix APPENDIX A describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA Program to fulfill the confirmation process element of this AMP for both safety-related and nonsafety-related SSCs within the scope of this program.
3. When significant conditions adverse to quality are identified, there should be follow-up activities to confirm that the corrective actions have been completed, a root cause determination was performed, and recurrence will be prevented.
4. For plant-specific condition monitoring programs that rely on the augmented inspection and evaluation methodologies in NRC-endorsed TRs, the confirmation controls for these programs associated with corrective actions are implemented in accordance with the existing site 10 CFR 50 Appendix B, QA Programs, or their equivalent, as applicable. Additional confirmatory controls may apply as identified in the TRs or in other industry reports or guidelines, such as those developed by (but not limited to) Nuclear Energy Institute (NEI), the EPRI Boiling Water Reactor Vessel and Internals Project (BWRVIP), EPRI Materials Reliability Program (MRP), BWR Owners Group, PWR Owners Group, or industry vendors, such as AREVA, Westinghouse, or General Electric (GE) or GE Hitachi.

Administrative Controls

1. The administrative controls of the program should be described. Administrative controls provide a formal review and approval process.
2. Administrative controls are addressed through the QA Program that is used to meet the requirements of 10 CFR Part 50 (TN249), Appendix B, associated with managing the effects of aging (e.g., document control, special processes, and test control). Section A.2 in Appendix APPENDIX A describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA Program to fulfill the administrative controls element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.
3. For plant-specific condition monitoring programs that rely on the augmented inspection and evaluation methodologies in NRC-endorsed TRs, the administrative controls for these programs, including their implementing procedures and review and approval processes, are implemented in accordance with the existing site 10 CFR 50 Appendix B, QA Programs, or their equivalent, as applicable. Additional administrative controls criteria may apply as identified in the TRs or in other industry reports or guidelines, such as those developed by (but not limited to) NEI, the EPRI Boiling Water Reactor Vessel and Internals Project, EPRI MRP, BWR Owners Group, PWR Owners Group, or industry vendors, such as AREVA, Westinghouse, or GE or GE Hitachi.

Operating Experience

1. Consideration of future plant-specific and industry OE relating to AMPs should be discussed (See Section A.4 in Appendix APPENDIX A). Reviews of OE by the applicant in the future may identify areas where AMPs should be enhanced or new programs developed. An applicant should commit to a future review of plant-specific and industry OE to confirm the effectiveness of its AMPs or indicate a need to develop new AMPs. This information should provide objective evidence to support the conclusion that the effects of aging will be

managed adequately so that the SC-intended function(s) will be maintained during the subsequent period of extended operation.

2. Currently available OE with existing programs should be discussed. The discussion should note any changes to the programs during the first period of extended operation. The OE of existing programs, including past corrective actions resulting in program enhancements or additional programs, should be considered. A past failure would not necessarily invalidate an AMP because the feedback from OE should have resulted in appropriate program enhancements or new programs. This information can show where an existing program has succeeded and where it has not been fully effective in intercepting aging degradation in a timely manner. This information should provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the SC-intended function(s) will be maintained during the subsequent period of extended operation.

3. Currently available OE, including relevant research and development applicable to new programs should also be discussed. For new AMPs that have yet to be implemented at an applicant's facility, the programs have not yet generated any OE. However, there may be other relevant plant-specific or generic industry OE that is relevant to the program elements, even though the OE was not identified through implementation of the new program. Thus, when developing the elements for new programs, an applicant should consider the impact of relevant OE from implementation of its existing AMPs and from generic industry OE.

4. For plant-specific condition monitoring programs that rely on the augmented inspection and evaluation methodologies in NRC-endorsed TRs, the administrative controls for dispositioning OE in these programs are implemented in accordance with the existing site 10 CFR 50 Appendix B, QA Programs, or their equivalent, as applicable. Additional administrative controls criteria may apply as identified in the TRs or in other industry reports or guidelines, such as those developed by (but not limited to) NEI, the EPRI Boiling Water Reactor Vessel and Internals Project, EPRI MRP, BWR Owners Group, PWR Owners Group, or industry vendors, such as AREVA, Westinghouse, or GE or GE Hitachi.

A.1.3 References

1. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54–The License Renewal Rule." (TN4878) Revision 6. Agencywide Documents Access and Management System (ADAMS) Accession No. ML051860406. Washington, DC: Nuclear Energy Institute. June 2005.

Table A.1 Elements of an Aging Management Program for Subsequent License Renewal

Element	Description
1. Scope of program	Scope of program includes the specific structures and components (SCs) subject to an aging management review for subsequent license renewal.
2. Preventive actions	Preventive actions should prevent or mitigate aging degradation.
3. Parameters monitored or inspected	Parameters monitored or inspected should be linked to the degradation of the particular SC-intended function(s).
4. Detection of aging effects	Detection of aging effects should occur before there is a loss of SC-intended function(s). This includes aspects such as method or technique (e.g., visual, volumetric, surface inspection), frequency, sample size, data collection, and timing of new/one-time inspections to ensure timely detection of aging effects.
5. Monitoring and trending	Monitoring and trending should provide predictability of the extent of degradation, and timely corrective or mitigative actions.
6. Acceptance criteria	Acceptance criteria, against which the need for corrective action will be evaluated, should ensure that the SC-intended function(s) are maintained under all current licensing basis design conditions during the subsequent period of extended operation.
7. Corrective actions	Corrective actions, including root cause determination and prevention of recurrence, should be timely.
8. Confirmation process	Confirmation process should ensure that corrective actions have been completed and are effective.
9. Administrative controls	Administrative controls should provide a formal review and approval process.
10. Operating experience (OE)	The OE applicable to the aging management program (AMP), including past corrective actions resulting in program enhancements or additional programs, should provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the SC-intended function(s) will be maintained during the subsequent period of extended operation. The OE with existing programs should be discussed. In addition, the ongoing review of both plant-specific and industry OE, including relevant research and development ensures that the AMP is effective in managing the aging effects for which it is credited. The AMP is either enhanced or new AMPs are developed, as appropriate, when it is determined through the evaluation of OE that the effects of aging may not be adequately managed.

AMP = aging management program; OE = operating experience; SC = structures and components.

A.2 Quality Assurance for Aging Management Programs

(Branch Technical Position IQMB-1)

A.2.1 Background

The subsequent license renewal application is required to demonstrate that the effects of aging on SCs subject to an AMR will be managed adequately to make sure that their intended functions are maintained consistent with the current licensing basis of the facility for the subsequent period of extended operation. Therefore, those aspects of the AMR process that affect quality of safety-related SSCs are subject to the QA requirements of 10 CFR Part 50 Appendix B. For nonsafety-related SCs subject to an AMR, the existing 10 CFR Part 50 (TN249), Appendix B QA Program may be used by the applicant to address the elements of corrective actions, the confirmation process, and administrative controls, as described in BTP RLSB-1 (Section A.1 in AppendixAPPENDIX A of this SRP-SLR). The confirmation process ascertains that appropriate corrective actions have been completed and are effective. Administrative controls should provide for a formal review and approval process. The GALL-SLR Report describes how a SLR applicant can rely on the existing requirements in 10 CFR Part 50 Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” to satisfy these program elements/attributes. The purpose of this BTP (IQMB 1) is to describe an acceptable process for implementing the corrective actions, the confirmation process, and administrative controls of aging management programs for SLR.

A.2.2 Branch Technical Position

1. Safety-related SCs are subject to 10 CFR Part 50 Appendix B requirements, which are adequate to address all quality-related aspects of an AMP consistent with the CLB of the facility for subsequent period of extended operation.

2. For nonsafety-related SCs that are subject to an AMR for SLR, an applicant has the option to expand the scope of its 10 CFR Part 50 Appendix B program to include these SCs and to address corrective actions, the confirmation process, and administrative controls for aging management during the subsequent period of extended operation. The reviewer verifies that the applicant has documented such a commitment in the FSAR Supplement in accordance with 10 CFR 54.21(d) (TN4878).

3. If an applicant chooses an alternative means to address corrective actions, the confirmation process, and administrative controls for managing aging of nonsafety-related SCs that are subject to an AMR for SLR, the applicant’s proposal is reviewed on a case by-case basis following the guidance in BTP RLSB-1 (Section A.1 in Appendix APPENDIX A of this SRP-SLR).

A.2.3 References

1. 10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016. 10 CFR Part 50-TN249

2. NRC. NUREG–1800, (Ch. 3.3 – End) “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants.” ADAMS Accession No. ML012070409. Washington, DC: U.S. Nuclear Regulatory Commission. July 2001.

A.3 Generic Safety Issues Related to Aging

(Branch Technical Position RLSB-2)

A.3.1 Background

Unresolved safety issues (USIs) and generic safety issues (GSIs) are identified and tracked in the NRC formal resolution process set forth in NUREG–0933, "Resolution of Generic Safety Issues," which is updated periodically. Appendix B to NUREG–0933 contains a listing of those issues that are applicable to operating and future plant. NUREG–0933 is a source of information on generic concerns identified by the NRC. Some of these concerns may be related to the effects of aging or TLAAs for SSCs within the scope of the SLR review. The purpose of this BTP RLSB 2 is to address the SLR treatment of an aging effect or a TLAA which is a subject of an USI or a GSI (60 *Federal Register* [FR] 22484).

A.3.2 Branch Technical Position

A.3.2.1 Treatment of GSIs

The License Renewal Rule requires that aging effects be managed to ensure that the SC-intended function(s) are maintained and that TLAAs are evaluated for SLR. Thus, all applicable aging effects of SCs subject to an AMR and all TLAAs must be evaluated, regardless of whether they are associated with GSIs or USIs. The agency's Generic Issues Program process for resolving GSIs is described in Management Directive 6.4, "Generic Issues Program," dated January 2, 2015, and SECY 07-0022, "Status Report on Proposed Improvements to the Generic Issues Program."

A.3.3 References

1. NRC. NUREG–0933, "Resolution of Generic Safety Issues." Supplement 34. Agencywide Documents Access and Management System (ADAMS) Accession No. ML11353A382. Washington, DC: U.S. Nuclear Regulatory Commission. December 2011.

2. NRC. SECY-07-0022, "Status Report on Proposed Improvements to the Generic Issues Program." ADAMS Accession No. ML003744861. Washington, DC: U.S. Nuclear Regulatory Commission. January 2007.

3. NRC. NUREG–1800, (Ch. 3.3 – End) "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants." ADAMS Accession No. ML012070409. Washington, DC: U.S. Nuclear Regulatory Commission. July 2001.

A.4 Operating Experience for Aging Management Programs

A.4.1 Background

The OE is a crucial element of an effective AMP. It provides the basis to support all other elements of the AMP and, as a continuous feedback mechanism, drives changes to these elements to ensure the overall effectiveness of the AMP. The OE should provide objective evidence to support the conclusion that the effects of aging are managed adequately so that the SCs-intended function(s) will be maintained during the subsequent period of extended operation. Under their current operating licenses, SLR applicants are required to implement programs for the ongoing review of OE, such as those established in accordance with Item I.C.5, "Procedures for Feedback of Operating Experience to Plant Staff," of NUREG–0737, "Clarification of TMI Action Plan Requirements" (TN6233).

A.4.2 Position

The systematic review of plant-specific and industry OE, including relevant research and development concerning aging management and age-related degradation ascertains that the SLR AMPs are, and will continue to be, effective in managing the aging effects for which they are credited. The AMPs should either be enhanced or new AMPs developed, as appropriate, when it is determined through the evaluation of OE that the effects of aging may not be adequately managed. The AMPs should be informed by the review of OE on an ongoing basis, regardless of the AMP's implementation schedule.

Acceptable Use of Existing Programs

Programs and procedures relied upon to meet the requirements of 10 CFR Part 50, Appendix B (TN249) and NUREG–0737 (TN6233), Item I.C.5, may be used for the capture, processing, and evaluation of OE concerning age-related degradation and aging management during the term of a renewed operating license. As part of meeting the requirements of NUREG–0737, Item I.C.5, the applicant should actively participate in the 'INPO's OE program (formerly the Significant Event Evaluation and Information Network [SEEIN] program endorsed in NRC Generic Letter 82-04, "Use of INPO SEEIN Program") (NRC 1982-TN7993). These programs and procedures may also be used for the translation of recommendations from the OE evaluations into plant actions (e.g., enhancement of AMPs and development of new AMPs). While these programs and procedures establish a majority of the functions necessary for the ongoing review of OE, they are also subject to further review as discussed below.

Areas of Further Review

To make sure that the programmatic activities for the ongoing review of OE are adequate for SLR, the following points should be addressed:

- The programs and procedures relied upon to meet the requirements of 10 CFR Part 50 (TN249), Appendix B, and NUREG–0737 (TN6233), Item I.C.5, explicitly apply to and otherwise would not preclude the consideration of OE on age-related degradation and aging management. Such OE can constitute information on the SCs identified in the integrated plant assessment; their materials, environments, aging effects, and aging mechanisms; the AMPs credited for managing the effects of aging; and the activities, criteria, and evaluations integral to the elements of the AMPs. To satisfy this criterion, the applicant should use the option described in Section A.2.2 of SRP-SLR Appendix A.2, "Quality Assurance for Aging

Management Programs (Branch Technical Position IQMB 1)," to expand the scope of its 10 CFR Part 50, Appendix B, program to include nonsafety-related SCs.

- The license renewal interim staff guidance documents and revisions to the GALL-SLR Report (TN7791) should be considered as sources of industry OE and evaluated accordingly. There should be a process to identify such documents and process them as OE.
- All incoming plant-specific and industry OE should be screened to determine whether it may involve age-related degradation or impacts to aging management activities.
- A means should be established within the corrective action program to identify, track, and trend OE that specifically involves age-related degradation. There should also be a process to identify adverse trends and to enter them into the corrective action program for evaluation.
- Relevant research and development information should be reviewed to determine whether it might involve age-related degradation or impacts to aging management activities. Relevant foreign and domestic research and development would generally be subject to a consensus process, and would have used materials and test conditions typical of operating power reactors, including actual operating and environmental conditions. Examples of relevant research and development sources are: (a) industry consensus standards development organizations (e.g., American Society of Mechanical Engineers [ASME], Institute of Electrical and Electronics Engineers, American Concrete Institute, American Petroleum Institute, National Association of Corrosion Engineers [NACE], International Organization for Standardization); (b) EPRI; (c) generic communications issued by the staff based on research conducted by national laboratories used by the NRC; and (d) Nuclear Steam Supply System vendor and owner's groups.
- The OE including relevant research and development items identified as potentially involving aging, should receive further evaluation. This evaluation should specifically take into account the following: (i) SSCs, (ii) materials, (iii) environments, (iv) aging effects, (v) aging mechanisms, (vi) AMPs, and (vii) the activities, criteria, and evaluations integral to the elements of the AMPs. The assessment of this information should be recorded along with the OE evaluation. If it is found through evaluation that any effects of aging may not be adequately managed, then a corrective action should be entered into the 10 CFR Part 50, Appendix B, program to either enhance the AMPs or to develop and implement new AMPs.
- Assessments should be conducted on the effectiveness of the AMPs and activities. These assessments should be conducted on a periodic basis that is not to exceed once every 5 years. They should be conducted regardless of whether the acceptance criteria of the particular AMPs have been met. The assessments should also include evaluation of the AMP or activity against the latest NRC and industry guidance documents and standards that are relevant to the particular program or activity. If there is an indication that the effects of aging are not being adequately managed, then a corrective action is entered into the 10 CFR Part 50 (TN249), Appendix B, program to either enhance the AMPs or develop and implement new AMPs, as appropriate.
- Training on age-related degradation and aging management should be provided to those personnel responsible for implementing the AMPs and those personnel who may submit, screen, assign, evaluate, or otherwise process plant-specific and industry OE. The scope of training should be linked to the responsibilities for processing OE. This training should occur on a periodic basis and include provisions to accommodate the turnover of plant personnel.

- Guidelines should be established for reporting plant-specific OE on age-related degradation and aging management to the industry. This reporting should be accomplished through participation in the ’INPO’s OE program.
- Any enhancements necessary to fulfill the above criteria should be put in place no later than the date of issue of the renewed operating license and implemented on an ongoing basis throughout the term of the renewed license.

The programmatic activities for the ongoing review of plant-specific and industry OE concerning age-related degradation and aging management should be described in the SLRA, including the FSAR Supplement. Alternate approaches for the future consideration of OE are subject to NRC review on a case-by-case basis.

A.4.3 References

1. 10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.” Washington, DC: U.S. Nuclear Regulatory Commission. 2016. 10 10 CFR Part 50-TN249
2. Generic Letter 82-04, “Use of INPO SEE-IN Program.” ADAMS Accession No. ML031210688. Washington, DC: U.S. Nuclear Regulatory Commission. March 9, 1982. NRC 1982-TN7993
3. NUREG–0737, “Clarification of TMI Action Plan Requirements.” Washington, DC: U.S. Nuclear Regulatory Commission. November 1980. NRC 1980-TN6233
4. NUREG–1801, “Generic Aging Lessons Learned (GALL) Report.” Revision 2. ADAMS Accession No. ML103490041. Washington, DC: U.S. Nuclear Regulatory Commission. December 2010. NRC 2010-TN7791

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10. SUPPLEMENTARY NOTES

When finalized, this report will supersede NUREG-2192 (Rev. 0)

11. ABSTRACT (200 words or less)

Draft NUREG-2192, Revision 1, “Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants, Draft Report for Comment,” (SRP-SLR Rev. 1) provides guidance to NRC staff who perform safety reviews of applications to renew nuclear power plant licenses in accordance with 10 CFR Part 54.

The principal purposes of the SRP-SLR are to ensure the quality and uniformity of NRC staff reviews and to present a well-defined base from which to evaluate applicant programs and activities for the subsequent period of extended operation, following the first 20-year period of extended operation. The SRP-SLR also is intended to make regulatory information widely available to enhance communication with interested members of the public and the nuclear power industry and to improve public and industry understanding of the NRC staff’s review process.

This is a companion document to Draft NUREG–2191, Rev. 1, “Generic Aging Lessons Learned for Subsequent License Renewal, Draft Report for Comment,” (GALL-SLR Report, Rev. 1) and Draft NUREG-2221, Rev. 1, “Technical Bases for Changes in the Subsequent License Renewal Guidance Documents NUREG–2191 and NUREG–2192.” Comments on the revised documents will be considered, as appropriate, in the final versions of these documents.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)	13. AVAILABILITY STATEMENT
License Renewal Long-term Operations Aging Nuclear Safety Aging Mechanisms Aging Effects Aging Management Programs Subsequent License Renewal Second License Renewal Further Evaluations	unlimited 14. SECURITY CLASSIFICATION *(This Page)* unclassified *(This Report)* unclassified 15. NUMBER OF PAGES 16. PRICE

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