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NUREG-2123
Volume 1

Safety Evaluation Report

Related to the License Renewal of Columbia Generating Station

Volume 1

Docket Number 50-397

Energy Northwest

Office of Nuclear Reactor Regulation

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ABSTRACT

This safety evaluation report (SER) documents the technical review of the Columbia Generating Station (Columbia), license renewal application (LRA) by the U.S. Nuclear Regulatory Commission (NRC) staff (the staff). By letter dated January 19, 2010, Energy Northwest (the applicant) submitted the LRA in accordance with Title 10, Part 54, of the *Code of Federal Regulations*, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants.” Energy Northwest requests renewal of the operating license (Facility Operating License Number NPF-21) for a period of 20 years beyond the current license period of December 20, 2023. Columbia is located approximately 12 miles north of Richland, WA. The NRC issued the construction permit on March 19, 1973, and the operating license for Columbia on April 13, 1984. The unit is a Mark II boiling-water reactor (BWR) design. General Electric Company supplied the nuclear steam supply system. Burns and Roe, Inc., designed the balance of plant, and Bechtel Power Corporation constructed the plant. The licensed power output of the unit is 3,886 megawatts thermal, with a gross electrical output of approximately 1,230 megawatts electric. This SER presents the status of the staff’s review of information submitted through January 4, 2012. The staff closed six open items previously identified in the SER with open items. SER Section 1.5 summarizes the closure of the open items.

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ABBREVIATIONS

AAI	applicant action item
AC	alternating current
ACI	American Concrete Institute
ACRS	Advisory Committee on Reactor Safeguards
ACSR	aluminum conductor steel reinforced
ADAMS	Agencywide Documents Access and Management System
ADS	automatic depressurization system
AERM	aging effect requiring management
AMP	aging management program
AMR	aging management review
ANSI	American National Standards Institute
AQ	augmented quality
AR	Action Request
ART	adjusted reference temperature
ASME	American Society of Mechanical Engineers
ASTM	American Standards for Testing and Materials
ATWS	anticipated transient without scram
B&PV	boiler and pressure vessel
B_4C	boron carbide
BADGER	Boron-10 Areal Density Gage for Evaluating Racks
BTP	Branch Technical Position
BWR	boiling-water reactor
BWRVIP	Boiling-Water Reactor Vessel and Internals Project
C	Celsius
CAS	control air system
CASS	cast austenitic stainless steel
CB&I	Chicago Bridge and Iron
CCH	control room chilled water
CEA	control element assembly
CEP	containment exhaust purge
CF	chemistry factor
CFR	Code of Federal Regulations
CI	confirmatory item
CIA	containment instrument air
CLB	current licensing basis
CMS	containment monitoring system
CN	containment nitrogen

CO	condensate (auxiliary)
CO_2	carbon dioxide
Columbia	Columbia Generating Station
CPR	condensate processing radioactive
CR	condition report
CRA	containment return air
CRD	control rod drive
CRDRL	control rod drive return line
CSP	containment supply purge
CSR	cable spreading room
CST	condensate storage tank
CUF	cumulative usage factor
CVB	containment vacuum breaker
CVN	Charpy-V notch
CW	circulating water
DBA	design basis accident
DBE	design basis event
DCW	diesel cooling water
DE	diesel (engine) exhaust
DEH	digital electro-hydraulic control system
DG	diesel generator
DLO	diesel lubricating oil
DO	dissolved oxygen
DOT	Department of Transportation
ΔRT_{NDT}	reference nil-ductility temperature caused by irradiation
DSA	diesel starting air
DW	demineralized water
EAF	environmentally-assisted fatigue
ECCS	emergency core cooling system
EDR	equipment drain radioactive
EFPY	effective full power years
EMA	equivalent margin analysis
EPRI	Electrical Power Research Institute
EQ	environmental qualification
ESF	engineered safety feature
F	Fahrenheit
FD	floor drain
FDR	floor drain radioactive

F_{en}	environmental life correction factors
FERC	Federal Energy Regulatory Commission
FIV	flow-induced vibrators
FPC	fuel pool cooling
FR	Federal Register
FSAR	final safety analysis report
ft	foot
ft^2	square foot
FW	feedwater
GALL	generic aging lessons learned
GE	General Electric
GEIS	generic environmental impact statement
GL	Generic Letter
HAZ	heat-affected zone
HCO	heating steam condensate
HELB	high-energy line break
HPCS	high-pressure core spray
HS	heating steam
HSV	heating steam vent
HVAC	heating, ventilation, and air conditioning
HWC	hydrogen water chemistry
I&C	instrumentation and control
IASCC	irradiation-assisted stress-corrosion cracking
ID	inside diameter
IGA	intergranular attack
IGSCC	intergranular stress-corrosion cracking
IN	Information Notice
in.	inch
INPO	Institute of Nuclear Plant Operation
IPA	integrated plant assessment
IR	infrared
ISG	interim staff guidance
ISI	inservice inspection
ISP	Integrated Surveillance Program
K_i	applied stress intensity
K_{ic}	fracture toughness based on crack initiation
kV	kilovolt

lb	pound
LBB	leak-before-break
LD	leak detection
LER	licensee event report
LOCA	loss of coolant accident
LPCI	low pressure coolant injection
LPCS	low-pressure core spray
LRA	license renewal application
LRIC	License Renewal Implementation Coordinator
LRP	leak reduction program
LTR	licensing topical report
LWR	light-water reactor
M	margin term
MEB	metal-enclosed bus
MEL	master equipment list
MIC	microbiologically-influenced corrosion
MRSM	maintenance rule scoping matrix
MS	main steam
MSIV	main steam isolation valve
MSLC	main steam leakage control
MWR	miscellaneous waste radioactive
MWt	megawatt thermal
NACE	National Association of Corrosion Engineers
NDE	non-destructive examination
NEI	Nuclear Energy Institute
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NMCA	noble metal chemical application
NPS	nominal pipe size
NRC	U.S. Nuclear Regulatory Commission
NSAC	Nuclear Safety Analysis Center
NSAS	nonsafety affecting safety
NSSS	nuclear steam supply system
nvt	measure of fluence in n/cm^2
NWC	normal water chemistry
OBE	operating-basis earthquake
OD	outside diameter
OEM	original equipment manufacturer

OI	open item
OQAPD	operational quality assurance program description
OTSG	once-through steam generator
P&ID	piping and instrumentation drawing
PDI	performance demonstrative initiative
PER	problem evaluation request
PFSS	post-fire safe shutdown
PGCC	Power Generation Control Cabinet
PM	preventive maintenance
ppb	parts per billion
ppm	parts per million
PS	process sampling
PSD	plant sanitary drain
PSR	process sampling radioactive
P-T	pressure-temperature
PVC	polyvinyl chloride
PWC	potable cold water
PWH	potable hot water
PWR	pressurized-water reactor
PWSCC	primary water stress-corrosion cracking
QA	quality assurance
QIDs	qualification information documents
RAI	request for additional information
RCC	reactor closed cooling water
RCIC	reactor core isolation cooling
RCPB	reactor coolant pressure boundary
RCS	reactor coolant system
RFO	refueling outage
RFW	reactor feedwater
RG	regulatory guide
RH	relative humidity
RHR	residual heat removal
RI-ISI	risk-informed inservice inspection
RP	regulatory position
RPS	reactor protection system
RPV	reactor pressure vessel
RRC	reactor recirculation
RT_{NDT}	reference nil-ductility temperature

RV	reactor vessel
RVI	reactor vessel internals
RVID	Reactor Vessel Integrity Database
RWCU	reactor water cleanup
SA	service air
SBO	station blackout
SC	structure and component
SCC	stress-corrosion cracking
SDV	scram discharge volume
SER	safety evaluation report
SFA	steam/feedwater application
SFP	spent fuel pool
SGT	standby gas treatment
SLC	standby liquid control
SPTM	suppression pool temperature monitoring
SRP-LR	Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants
SRRF	stress range reduction factor
SRV	safety relief valve
SSC	structure, system, and component
SSE	safe shutdown earthquake
SSP	Supplemental Surveillance Program
SSW	standby service water
TIP	traversing incore probe
TLAA	time-limited aging analysis
TMU	tower makeup water
TS	technical specification
TSW	plant service water
UFSAR	updated final safety analysis report
USE	upper-shelf energy
UT	ultrasonic testing
UV	ultraviolet
V	volt
VAC	volts alternating current
VIP	Vessel Internals Program
WCH	radwaste building chilled water
Zn	zinc

SECTION 1

INTRODUCTION AND GENERAL DISCUSSION

1.1 Introduction

This document is a safety evaluation report (SER) on the license renewal application (LRA) for Columbia Generating Station (Columbia), as filed by Energy Northwest (the applicant). By letter dated January 19, 2010, Energy Northwest submitted its application to the U.S. Nuclear Regulatory Commission (NRC) for renewal of the Columbia operating license for an additional 20 years. The NRC staff (the staff) prepared this report to summarize the results of its safety review of the LRA for compliance with Title 10, Part 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants,” of the *Code of Federal Regulations* (10 CFR Part 54). The NRC project manager for the license renewal review is Arthur D. Cunanan. Mr. Cunanan may be contacted by telephone at 301-415-3897 or by electronic mail at arthur.cunanan@nrc.gov. Alternatively, written correspondence may be sent to the following address:

Division of License Renewal
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
Attention: Arthur D. Cunanan, Mail Stop 011-F1

In its January 19, 2010, submission letter, the applicant requested renewal of the operating license issued under Section 103 (Operating License No. NPF-21) of the Atomic Energy Act of 1954, as amended, for a period of 20 years beyond the current license date of December 20, 2023. Columbia is located approximately 12 miles north of Richland, WA. The NRC issued the construction permit on March 19, 1973. The NRC issued the operating license for Columbia on April 13, 1984. The unit is a Mark II boiling-water reactor (BWR) design. General Electric Company supplied the nuclear steam supply system; Burns and Roe, Inc., designed the balance of plant; and Bechtel Power Corporation constructed the plant. The licensed power output of the unit is 3,886 megawatt thermal with a gross electrical output of approximately 1,230 megawatt electric. The updated final safety analysis report (UFSAR) shows details of the plant and the site.

The license renewal process consists of two concurrent reviews: a technical review of safety issues and an environmental review. The NRC regulations in 10 CFR Part 54 and 10 CFR Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions,” respectively, set forth requirements for these reviews. The safety review for the Columbia license renewal is based on the applicant’s LRA and on its responses to the staff’s requests for additional information (RAIs). The applicant supplemented the LRA and provided clarifications through its responses to the staff’s RAIs in audits, meetings, and docketed correspondence. Unless otherwise noted, the staff reviewed and considered information submitted through January 4, 2012. The staff may consider information received after that date depending on the progress of the safety review and the volume and complexity of the information. The public may view the LRA and all pertinent information and materials, including the UFSAR, at the NRC Public Document Room, located on the first floor of One White Flint North, 11555 Rockville Pike, Rockville, MD, 20852-2738, (301-415-4737/800-397-4209). The LRA may also be viewed at the Richland Public Library, 955 Northgate Drive, Richland, WA 99352 and at the Kennewick Branch of Mid-Columbia

Libraries, 1620 South Union Street, Kennewick, WA 99338. In addition, the public may find the LRA, as well as materials related to the license renewal review, on the NRC Web site at http://www.nrc.gov.

This SER summarizes the results of the staff's safety review of the LRA and describes the technical details considered in evaluating the safety aspects of the unit's proposed operation for an additional 20 years beyond the term of the current operating license. The staff reviewed the LRA in accordance with NRC regulations and the guidance in NUREG-1800, Revision 1, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants" (SRP-LR), dated September 2005.

SER Sections 2 through 4 address the staff's evaluation of license renewal issues considered during the review of the application. SER Section 5 is reserved for the report of the Advisory Committee on Reactor Safeguards (ACRS). The conclusions of this SER are in Section 6.

SER Appendix A is a table showing the applicant's commitments for renewal of the operating license. SER Appendix B is a chronology of the principal correspondence between the staff and the applicant regarding the LRA review. SER Appendix C is a list of principal contributors to the SER, and Appendix D is a bibliography of the references in support of the staff's review.

In accordance with 10 CFR Part 51, and as part of the environmental review, the staff is also preparing a draft plant-specific supplement to NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)." Issued separately from this SER, this supplement will discuss the environmental considerations for the license renewal of Columbia Generating Station.

1.2 License Renewal Background

Under the Atomic Energy Act of 1954, as amended, and NRC regulations, operating licenses for commercial power reactors are issued for 40 years and can be renewed for up to 20 additional years. The original 40-year license term was selected based on economic and antitrust considerations, rather than on technical limitations; however, some individual plant and equipment designs may have been engineered based on an expected 40-year service life.

In 1982, the staff anticipated interest in license renewal and held a workshop on nuclear power plant aging. This workshop led the NRC to establish and implement a comprehensive program plan for nuclear plant aging research. From the results of the nuclear plant aging research, a technical review group concluded that many aging phenomena are readily manageable and pose no technical issues precluding life extension for nuclear power plants. In 1986, the staff published a request for comment on a policy statement that would address major policy, technical, and procedural issues related to license renewal for nuclear power plants.

In 1991, the staff published 10 CFR Part 54, the License Renewal Rule (Volume 56, page 64943, of the *Federal Register* (56 FR 64943), dated December 13, 1991). The staff participated in an industry-sponsored demonstration program to apply 10 CFR Part 54 to a pilot plant and to gain the experience necessary to develop implementation guidance. To establish a scope of review for license renewal, 10 CFR Part 54 defined age-related degradation unique to license renewal. However, during the demonstration program, the staff found that adverse aging effects on plant systems and components are managed during the period of the initial license and that the scope of the review did not allow sufficient credit for management programs, particularly the implementation of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," which regulates management of plant-aging phenomena. As a result of this finding, the staff amended 10 CFR Part 54 in 1995. Published on May 8, 1995, in Volume 60, page 22461, of the *Federal Register* (60 FR 22461), the amended 10 CFR Part 54 establishes a regulatory process that is more stable and predictable than the previous 10 CFR Part 54. In particular, as amended, 10 CFR Part 54 focuses on the management of adverse aging effects rather than on the identification of age-related degradation unique to license renewal. The staff made these rule changes to ensure that important systems, structures, and components (SSCs) will continue to perform their intended functions during the period of extended operation. In addition, the amended 10 CFR Part 54 clarifies and simplifies the integrated plant assessment process to be consistent with the revised focus on passive, long-lived structures and components (SCs).

Concurrent with these initiatives, the staff pursued a separate rulemaking effort (Volume 61, page 28467, of the *Federal Register* (61 FR 28467)), dated June 5, 1996, and amended 10 CFR Part 51 to focus the scope of the review of environmental impacts of license renewal in order to fulfill NRC responsibilities under the National Environmental Policy Act of 1969 (NEPA).

1.2.1 Safety Review

License renewal requirements for power reactors are based on two key principles:

- The regulatory process is adequate to ensure that the licensing bases of all currently operating plants maintain an acceptable level of safety, with the possible exception of the detrimental aging effects on the function of certain SSCs as well as a few other safety-related issues, during the period of extended operation.
- The plant-specific licensing basis must be maintained during the renewal term in the same manner and to the same extent as during the original licensing term.

In implementing these two principles, 10 CFR 54.4 defines the scope of license renewal as including SSCs that are safety-related, whose failure could affect safety-related functions, or that are relied on to demonstrate compliance with NRC regulations for fire protection, environmental qualification (EQ), pressurized thermal shock (PTS), anticipated transient without scram (ATWS), and station blackout (SBO).

Pursuant to 10 CFR 54.21(a), a license renewal applicant must review all SSCs within the scope of 10 CFR Part 54 to identify SCs subject to an aging management review (AMR). Those SCs subject to an AMR are those that perform an intended function without moving parts or without a change in configuration or properties (i.e., are "passive"), and are not subject to replacement based on a qualified life or specified time period (i.e., are "long lived"). As required by 10 CFR 54.21(a), an applicant for a renewed license must demonstrate that aging effects will be managed in such a way that the intended function(s) of those SSCs will be maintained, consistent with the current licensing basis (CLB), for the period of extended operation; however, active equipment is considered adequately monitored and maintained by existing programs. In other words, detrimental aging effects that may affect active equipment are readily detectable and can be identified and corrected through routine surveillance, performance monitoring, and maintenance. Surveillance and maintenance programs for active equipment, as well as other maintenance aspects of plant design and licensing basis, are required throughout the period of extended operation.

Pursuant to 10 CFR 54.21(d), each LRA is required to include a UFSAR supplement that must have a summary description of the applicant's programs and activities for managing aging effects and the evaluation of time-limited aging analyses (TLAAs) for the period of extended operation.

License renewal also requires TLAA identification and updating. During the plant design phase, certain assumptions are made about the length of time the plant can operate. These assumptions are incorporated into design calculations for several plant SSCs. In accordance with 10 CFR 54.21(c)(1), the applicant must show that these calculations will remain valid for the period of extended operation, project the analyses to the end of the period of extended operation, or demonstrate that effects of aging on these SSCs can be adequately managed for the period of extended operation.

In 2005, the staff developed and issued Regulatory Guide (RG) 1.188, “Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses.” This RG endorses Nuclear Energy Institute (NEI) 95-10, Revision 6, “Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule,” issued in June 2005 by NEI. NEI 95-10 details an acceptable method of implementing the Rule. The staff also used the SRP-LR to review this application.

In its LRA, the applicant stated that it used the process defined in NUREG-1801, “Generic Aging Lessons Learned (GALL) Report,” dated September 2005. The GALL Report provides a summary of staff-approved aging management programs (AMPs) for the aging of many SCs subject to an AMR. An applicant’s willingness to commit to carrying out these staff-approved AMPs could potentially reduce the time, effort, and resources in reviewing an applicant’s LRA and, thereby, improve the efficiency and effectiveness of the license renewal review process. The report is also a reference for both applicants and staff reviewers to quickly identify AMPs and activities that can provide adequate aging management during the period of extended operation. It is incumbent on the applicant to ensure that the conditions and operating experience at the plant are bounded by the conditions and operating experience for which the GALL Report was evaluated. If these bounding conditions are not met, the applicant should address the additional effects of aging and augment its aging management program (AMP) as appropriate.

1.2.2 Environmental Review

In December 1996, the staff revised the environmental protection regulations to facilitate the environmental review for license renewal. The staff prepared the GEIS to document its evaluation of the possible environmental impacts associated with renewing licenses of nuclear power plants. For certain types of environmental impacts, the GEIS establishes generic findings applicable to all nuclear power plants. These generic findings are codified in Appendix B to Subpart A of 10 CFR Part 51. Pursuant to 10 CFR 51.53(c)(3)(i), an applicant for license renewal may incorporate these generic findings in its environmental report. In accordance with 10 CFR 51.53(c)(3)(ii), an environmental report must also include analyses of environmental impacts that must be evaluated on a plant-specific basis (i.e., Category 2 issues).

In accordance with NEPA and the requirements of 10 CFR Part 51, the staff performed a plant-specific review of the environmental impacts of license renewal, including whether or not the GEIS had considered new and significant information. As part of its scoping process, the staff held two public meetings on April 6, 2010, at the Richland Public Library in Richland, WA, to identify plant-specific environmental issues that might impact Columbia. The staff issued the draft site-specific GEIS supplement on August 23, 2011. After considering comments on the draft, the staff will prepare and publish a final plant-specific GEIS supplement separately.

1.3 Principal Review Matters

Part 54 of 10 CFR describes the requirements for renewing operating licenses for nuclear power plants. The staff performed its technical review of the LRA in accordance with NRC guidance and 10 CFR Part 54 requirements. Section 54.29 of 10 CFR sets forth the standards for renewing a license. This SER describes the results of the staff's safety review.

Pursuant to 10 CFR 54.19(a), the NRC requires a license renewal applicant to submit general information. The applicant provided this general information in LRA Section 1, which it submitted by letter, dated January 19, 2010. The staff reviewed LRA Section 1 and found that the applicant had submitted the information required by 10 CFR 54.19(a).

Pursuant to 10 CFR 54.19(b), the staff requires that each LRA include "conforming changes to the standard indemnity agreement, 10 CFR 140.92, Appendix B, to account for the expiration term of the proposed renewed license." The applicant stated the following in LRA Section 1.1.8 on this issue:

> Per 10 CFR 54.19(b), license renewal applications are required to include "conforming changes to the standard indemnity agreement, 10 CFR 140.92, Appendix B, to account for the expiration term of the proposed renewed license." The current indemnity agreement (No. B-94) for Columbia states, in Article VII, that the agreement shall terminate at the time of expiration of the license specified in Item 3 of the Attachment (to the agreement). Item 3 of the Attachment to the indemnity agreement, as revised by Amendment No. 1, lists Columbia operating license NPF-21. Energy Northwest requests that conforming changes be made to Article VII of the indemnity agreement, and Item 3 of the Attachment to that agreement, specifying the extension of agreement to the expiration date of the renewed Columbia facility operating license sought in this application. In addition, should the license number be changed upon issuance of the renewal license, Energy Northwest requests that conforming changes be made to Item 3 of the Attachment to the indemnity agreement and to other sections of the agreement as deemed appropriate.

The staff intends to maintain the original license number upon issuance of the renewed license, if approved. Therefore, conforming changes to the indemnity agreement need not be made, and the 10 CFR 54.19(b) requirements have been met. Pursuant to 10 CFR 54.21, the staff requires that each LRA contain the following:

- an integrated plant assessment (IPA)
- a description of any CLB changes during the staff's review of the LRA
- an evaluation of TLAAs
- a UFSAR supplement

LRA Sections 3 and 4 and Appendix B address the license renewal requirements of 10 CFR 54.21(a), 10 CFR 54.21(b), and 10 CFR 54.21(c). LRA Appendix A satisfies the license renewal requirements of 10 CFR 54.21(d).

Pursuant to 10 CFR 54.21(b), the staff requires that each year following submission of the LRA, and at least 3 months before the scheduled completion of the staff's review, the applicant submit an LRA amendment identifying any CLB changes of the facility that materially affect the contents of the LRA, including the UFSAR supplement.

Pursuant to 10 CFR 54.22, the staff requires that an applicant's LRA include changes or additions to the technical specifications necessary to manage aging effects during the period of extended operation. In LRA Appendix D, the applicant stated that, “no Technical Specification Changes are necessary to manage the effects of aging during the period of extended operation.”

The staff evaluated the technical information required by 10 CFR 54.21 and 10 CFR 54.22 in accordance with NRC regulations and the guidance of the SRP-LR. SER Sections 2, 3, and 4 document the staff’s evaluation of the technical information in the LRA.

As required by 10 CFR 54.25, the ACRS will issue a report to document its evaluation of the staff’s LRA review and associated SER. SER Section 5 will incorporate the ACRS report once it is issued. SER Section 6 will document the findings required by 10 CFR 54.29.

1.4 Interim Staff Guidance

License renewal is a living program. The staff, industry, and other interested stakeholders gain experience and develop lessons learned with each renewed license. The lessons learned address the NRC’s safety goal of ensuring adequate protection of public health and safety and the environment. Interim staff guidance (ISG) is documented for use by the staff, industry, and other interested stakeholders until incorporated into such license renewal guidance documents as the SRP-LR and the GALL Report.

The GALL Report, Revision 2, dated December 2010, have incorporated all current and proposed ISGs up to that date.

1.5 Summary of the Open Items

As a result of its review of the LRA, including additional information submitted through January 4, 2012, the staff closed the six open items (OIs), previously identified in the "Safety Evaluation Report with Open Items Related to the License Renewal of Columbia Generating Station" (ADAMS Accession No. ML11349A022). .

OI 3.0.3.3.7
SER Section 3.0.3.3.7— High-Voltage Porcelain Insulators

The staff noted that the applicant did not include the high-voltage station post insulators at the 230 kV ASHE A809 Breaker located in the Ashe Substation even though this breaker provides an alternate path of power during a station blackout. The applicant stated that it did not include these station post insulators because it concluded the spray drift phenomenon would not occur due to the significant distance from the circulating water system cooling towers.

During discussions with the inspection team, the applicant provided a cooling tower drift study that identified that hard water deposits on the 500 kV breaker station post insulators had allowed arcing to occur. The study did not demonstrate that the 230 kV station post insulators would remain unaffected. Further, the applicant could not provide any other information to support its conclusions. Consequently, the applicant issued Action Requests 228661 and 228673 to resolve this concern. The applicant indicated that it would either establish appropriate coating or cleaning tasks or develop information that would demonstrate why the phenomenon would not affect the 230 kV switchyard station post insulators. In its August 11, 2011, response, the applicant provided the additional information to address the staff's concern. The staff reviewed and accepted the applicant's response, as documented in SER Section 3.0.3.3.7. Open item OI 3.0.3.3.7 is closed.

OI B.1.4-1
SER Section 3.0.2.1 – Operating Experience

The applicant did not fully describe how it will use future operating experience to ensure that the AMPs will remain effective for managing the aging effects during the period of extended operation. While the majority of the program descriptions contain statements indicating that future operating experience will be used to adjust the programs as appropriate, the details of this process are not fully described. In addition, some program descriptions contain no such statements and, for these AMPs, it is not clear whether the applicant intends to implement actions to monitor operating experience on an ongoing basis and use it to ensure the continued effectiveness of these AMPs. Further, the LRA does not state whether new AMPs will be developed, as necessary. In its December 16, 2011, response, the applicant provided the additional information to address the staff's concern. The staff reviewed and accepted the applicant's response, as documented in SER Section 3.0.5.2. Open item OI B.1.4-1 is closed.

OI 4.2-1
SER Section 4.2.2 – Upper-Shelf Energy

The applicant provided the projected upper shelf energy (USE) to 54 effective full power years (EFPY) for the N12 nozzle forgings in its LRA supplement stating that the unirradiated (initial) transverse USE of 62 ft-lbs and copper content of 0.27 percent used in the calculation of projected USE for the N12 nozzles are based on the results of a statistical analysis of data by the original equipment manufacturer for SA-508 Class 1 forging material. The applicant states that the requirement for 50 ft-lbs minimum USE at the end of vessel life is met for the current license period and for the period of extended operation for the N12 nozzle forgings. Therefore, the applicant states that the USE will not drop below 50 ft-lbs prior to the period of extended operation.

The staff reviewed the applicant's response and had concerns that the applicant did not provide a technical basis on the unirradiated (initial) transverse USE of 62 ft-lbs and copper content of 0.27 percent used in the calculation of projected USE for the N12 nozzles. The applicant should provide this basis and demonstrate that the USE value for the N12 nozzle forgings will not pass below 50 ft-lbs prior to the period of extended operation for verification by the staff. In its November 1, 2011, response, as supplemented by information provided on December 6, 2011, the applicant provided the additional information to address the staff's concern. The staff reviewed and accepted the applicant's response, as documented in SER Section 4.2.2.2. Open item OI 4.2-1 is closed.

OI 4.3-1
SER Section 4.3 – Metal Fatigue

The applicant stated that it addresses the effects of the coolant environment on component fatigue life by assessing the impact of the reactor coolant environment on a sample of critical components identified in NUREG/CR-6260, "Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components," March 1995.

However, the staff noted that the applicant's plant-specific configuration may contain additional locations (including, but not limited to, those provided in LRA Tables 4.3-3 and 4.3-5) that may need to be analyzed for the effects of the reactor coolant environment other than those identified in NUREG/CR-6260. This may include locations that are limiting or bounding for the applicant's particular plant-specific configuration or that have calculated environmentally-adjusted fatigue (EAF) values that are greater than those calculated EAF values by the applicant for locations that correspond to those identified in NUREG/CR-6260. In its December 16, 2011, response, as supplemented by information provided on January 4, 2012, the applicant provided the additional information to address the staff's concern. The staff reviewed and accepted the applicant's response, as documented in SER Section 4.3.5.2. Open item OI 4.3-1 is closed.

OI 4.7.4-1
SER Section 4.7.4 – Core Plate Rim Hold-Down Bolts

The staff noted that the applicant had submitted a TLAA for the core plate rim hold-down bolts but had not selected one of the three options of 10 CFR 54.21(c)(1) to demonstrate its evaluation of the TLAA. Also, the applicant did not provide an AMR line item for the core plate rim hold-down bolts with the aging effect of loss of preload due to stress relaxation. Further, the applicant stated that it intended to deviate from BWRVIP-25 inspection guidelines, which could result in inadequate management of the aging effect. In its November 4, 2011, response, the applicant provided the additional information to address the staff's concern. The staff reviewed and accepted the applicant's response, as documented in SER Sections 3.0.3.1.6 and 4.7.4. Open item OI 4.7.4-1 is closed.

OI 4.7.5-1
SER Section 4.1.2.9 – Fatigue Analysis of Polar Crane

The applicant states that the analysis of the polar crane does not meet the definition of a TLAA. However, the staff believes the analysis of the polar crane does meet the definition of a TLAA because the polar crane has a design limit of cycles in the Crane Manufacturers Association of America (CMAA) 70 specification of 20,000 to 100,000 lifts, and an "assumed design assessment" of the number of lifts compared to the CMAA 70 specification. In its October 5, 2011, response, as supplemented by information provided on November 16, 2011, the applicant provided the additional information to address the staff's concern. The staff reviewed and accepted the applicant's response, as documented in SER Section 4.7.5. Open item OI 4.7.5-1 is closed.

1.6 Summary of Confirmatory Items

As a result of its review of the LRA, including additional information submitted through January 4, 2012, the staff identified no confirmatory items (CI).

1.7 Summary of Proposed License Conditions

Following the staff’s review of the LRA, including subsequent information and clarifications provided by the applicant, the staff identified three additional proposed license conditions related to license renewal.

The first license condition states that the information in the UFSAR supplement, submitted pursuant to 10 CFR 54.21(d), as revised during the license renewal application review process, is henceforth part of the UFSAR which will be updated in accordance with 10 CFR 50.71(e). As such, the licensee may make changes to the programs and activities described in the supplement provided the licensee evaluates such changes pursuant to the criteria set forth in 10 CFR 50.59 and otherwise complies with the requirements in that section.

The second license condition states that Appendix A of the Safety Evaluation Report Related to the License Renewal of Columbia and the licensee's UFSAR supplement submitted pursuant to

10 CFR 54.21(d), describes certain future programs and activities to be completed before the period of extended operation. Energy Northwest shall complete these activities no later than December 20, 2023, and shall notify the NRC in writing when implementation of these activities is complete.

The third license condition requires the applicant to install wedges on or before December 20, 2021, and to submit a report to NRC staff summarizing the results of the installation of wedges and, if applicable, corrective action.

SECTION 2

STRUCTURES AND COMPONENTS SUBJECT TO AGING MANAGEMENT REVIEW

2.1 Scoping and Screening Methodology

2.1.1 Introduction

Title 10, Section 54.21, "Contents of Application—Technical Information," of the *Code of Federal Regulations* (10 CFR 54.21), requires that each license renewal application (LRA) must contain an integrated plant assessment (IPA). The IPA must list and identify all of the structures, systems, and components (SSCs) within the scope of license renewal and all structures and components (SCs) subject to an aging management review (AMR), in accordance with 10 CFR 54.4.

LRA Section 2.1, "Scoping and Screening Methodology," describes the scoping and screening methods used to identify the SSCs at the Columbia Generating Station (Columbia) that are within the scope of license renewal and the SCs that are subject to an AMR. The staff reviewed the scoping and screening methods applied by Energy Northwest (the applicant) to determine whether it meets the scoping requirements of 10 CFR 54.4(a) and the screening requirements of 10 CFR 54.21.

In developing the scoping and screening methods for the LRA, the applicant stated that it considered the following documents:

- 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants" (the Rule)
- Nuclear Energy Institute (NEI) 95-10, Revision 6, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54—The License Renewal Rule," (NEI 95-10)
- correspondence between the U.S. Nuclear Regulatory Commission (NRC), other applicants, and the NEI

2.1.2 Information Sources Used for Scoping and Screening

In LRA Sections 2 and 3 the applicant provided the technical information required by 10 CFR 54.4, "Scope," and 10 CFR 54.21(a). This safety evaluation report (SER) with open items, contains sections entitled "Summary of Technical Information in the Application," which provides informational summaries of technical information provided in the LRA.

In LRA Section 2.1, the applicant described the process used to identify the SSCs that meet the license renewal scoping criteria under 10 CFR 54.4(a) and the process used to identify the SCs that are subject to an AMR, as required by 10 CFR 54.21(a)(1). The applicant provided the results of the process used for identifying the SCs subject to an AMR in the following LRA Sections:

- LRA Section 2.2, "Plant-Level Scoping Results"

- LRA Section 2.3, “Scoping and Screening Results: Mechanical Systems”
- LRA Section 2.4, “Scoping and Screening Results: Structures”
- LRA Section 2.5, “Scoping and Screening Results: Electrical and Instrumentation and Control Systems”

In LRA Section 3.0, “Aging Management Review Results,” the applicant described its aging management results as follows:

- LRA Section 3.1, “Aging Management of Reactor Vessel, Internals, and Reactor Coolant System”
- LRA Section 3.2, “Aging Management of Engineered Safety Features”
- LRA Section 3.3, “Aging Management of Auxiliary Systems”
- LRA Section 3.4, “Aging Management of Steam and Power Conversion Systems”
- LRA Section 3.5, “Aging Management of Containments, Structures, and Component Supports”
- LRA Section 3.6, “Aging Management of Electrical and Instrumentation and Control Systems”

In LRA Section 4.0, “Time-Limited Aging Analyses,” the applicant identified and described the evaluation of time-limited aging analyses (TLAAs).

2.1.3 Scoping and Screening Program Review

The staff evaluated the LRA scoping and screening methodology in accordance with the guidance contained in NUREG-1800, Revision 1, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants,” (SRP-LR), Section 2.1, “Scoping and Screening Methodology.” The following regulations form the basis for the acceptance criteria of the scoping and screening methodology review:

- 10 CFR 54.4(a), 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 SSCs within the scope of the Rule
- 10 CFR 54.21(a)(1) and (a)(2), as they relate to the methods used by the applicant to identify plant SCs subject to an AMR

As part of the review of the applicant’s scoping and screening methodology, the staff used guidance contained in the SRP-LR and reviewed the activities described in the following sections of the LRA:

- Section 2.1, to ensure that the applicant described a process for identifying SSCs that are within the scope of license renewal in accordance with the requirements of 10 CFR 54.4(a)
- Section 2.2, to ensure that the applicant described a process for determining the SCs that are subject to an AMR in accordance with the requirements of 10 CFR 54.21(a)(1) and (a)(2)

In addition, the staff conducted a scoping and screening methodology audit at Columbia, during the week of May 10–13, 2010. The scoping and screening methodology audit focused on ensuring that the applicant had developed and implemented adequate guidance to carry out the scoping and screening of SSCs in accordance with the methods described in the LRA and the requirements of the Rule. First, the staff reviewed implementation of the project-level guidelines and topical reports describing the applicant's scoping and screening methodology. Second, the staff conducted detailed discussions with the applicant on the implementation and control of the license renewal program. Third, the staff reviewed the administrative control documentation used by the applicant during the scoping and screening process. Fourth, the staff reviewed the quality practices used by the applicant to develop the LRA. Finally, the staff reviewed the training and qualification of the LRA development team.

The staff evaluated the quality attributes of the applicant's aging management program (AMP) activities described in Appendix A, "Final Safety Analysis Report Supplement," and Appendix B, "Aging Management Programs," of the LRA. On a sampling basis, the staff performed a system review of the service water; emergency diesel generators (DGs) and support systems; and the turbine building, including a review of the scoping and screening results reports and supporting design documentation used to develop the reports. The purpose of the staff's review was to ensure that the applicant had appropriately implemented the methodology outlined in the administrative controls and to verify that the results are consistent with the current licensing basis (CLB) documentation.

2.1.3.1 Implementing Procedures and Documentation Sources Used for Scoping and Screening

The staff reviewed the applicant's scoping and screening implementing procedures as documented in the Scoping and Screening Methodology Audit report, dated August 19, 2010 (ADAMS Accession No. ML102160357), to verify that the process used to identify SCs subject to an AMR was consistent with the SRP-LR. Additionally, the staff reviewed the scope of CLB documentation sources and the process used by the applicant to ensure that applicant's commitments, as documented in the CLB and relative to the requirements of 10 CFR 54.4 and 10 CFR 54.21, were appropriately considered and that the applicant adequately implemented its procedural guidance during the scoping and screening process.

2.1.3.1.1 Summary of Technical Information in the Application

In LRA Section 2.1, the applicant addressed the following information sources for the license renewal scoping and screening process:

- Maintenance Rule Scoping Matrix (MRSM)
- Updated Final Safety Analysis Report (UFSAR)
- civil-structural and plant layout drawings
- design basis and requirements documentation (e.g., design specifications, calculations, technical reports)
- analyses for post-fire safe shutdown (PFSS), fire hazards, station blackout (SBO) coping, environmental qualification (EQ), and anticipated transients without scram (ATWS)

- the computerized database of Columbia equipment identification numbers (the master equipment list (MEL))
- flow diagrams
- electrical drawings
- civil and architectural arrangement drawings and site plans
- docketed correspondence, including NRC SERs
- other pertinent references, including the CLB

2.1.3.1.2 Staff Evaluation

Scoping and Screening Implementing Procedures. The staff reviewed the applicant’s scoping and screening methodology implementing procedures—including license renewal guidelines, documents, and reports, as documented in the scoping and screening methodology audit report, to ensure the guidance is consistent with the Rule, the SRP-LR, and Regulatory Guide (RG) 1.188, "Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses," which endorses the use of NEI 95-10. The staff finds the overall process used to implement the 10 CFR Part 54 requirements, described in the implementing procedures and AMRs, is consistent with the Rule, the SRP-LR, and industry guidance.

The applicant’s implementing procedures contain guidance for determining plant SSCs within the scope of the Rule and for determining which SCs within the scope of license renewal are subject to an AMR. During the review of the implementing procedures, the staff focused on the consistency of the detailed procedural guidance compared with information in the LRA, the implementation of NRC staff positions documented in the SRP-LR, and the information in the applicant’s responses, dated July 16, 2010, to the staff’s requests for additional information (RAIs) dated June 9, 2010.

After reviewing the LRA and supporting documentation, the staff finds the scoping and screening methodology instructions are consistent with the methodology description provided in LRA Section 2.1. The staff determines the applicant’s methodology has sufficient detail to provide concise guidance on the scoping and screening implementation process during the LRA activities.

Sources of CLB Information. The staff reviewed the scope and depth of the applicant's CLB review to verify that the methodology is sufficiently comprehensive in identifying SSCs within the scope of license renewal, as well as SCs requiring an AMR. Pursuant to 10 CFR 54.3(a), the CLB is "the set of NRC requirements applicable to a specific plant and a licensee's written commitments for ensuring compliance with and operation within applicable NRC requirements and the plant-specific design basis (including all modifications and additions to such commitments over the life of the license) that are docketed and in effect." The CLB includes applicable NRC regulations, orders, license conditions, exemptions, technical specifications, and design-basis information (documented in the most recent UFSAR). The CLB also includes licensee commitments remaining in effect that were made in docketed licensing correspondence such as licensee responses to NRC bulletins, generic letters, and enforcement actions; as well as licensee commitments documented in NRC safety evaluations or licensee event reports.

During the scoping and screening methodology audit, the staff reviewed pertinent information sources, used by the applicant, including the UFSAR, design basis information, and license renewal drawings. In addition, the applicant’s license renewal process identified additional sources of plant information pertinent to the scoping and screening process, including the master equipment database, controlled drawings, and technical correspondence, analyses and reports. The staff confirmed that the applicant's detailed license renewal program guidelines specified the use of the CLB source information in developing scoping evaluations.

The master equipment database, UFSAR, design basis information, and plant drawings were the applicant's primary repository for system identification and component safety classification information. During the scoping and screening methodology audit, the staff reviewed the applicant's administrative controls for the master equipment database, design basis information, and other information sources used to verify system information. These controls are described, and implementation is governed, by plant administrative procedures. Based on a review of the administrative controls and a sample of the system classification information contained in the applicable documentation, the staff determined that the applicant has established adequate measures to control the integrity and reliability of system identification and safety classification data. The staff concluded that the information sources used by the applicant during the scoping and screening process provided a sufficiently controlled source of system and component data to support scoping and screening evaluations.

During the staff's review of the applicant's CLB evaluation process, the applicant explained the incorporation of updates to the CLB and the process used to ensure those updates are adequately incorporated into the license renewal process. The staff determined that LRA Section 2.1 provides a description of the CLB and relates documents used during the scoping and screening process that are consistent with the guidance contained in the SRP-LR.

In addition, the staff reviewed the implementing procedures and results reports used to support identification of SSCs that the applicant relied on to demonstrate compliance with the safety-related criteria, nonsafety-related criteria, and the regulated events criteria pursuant to 10 CFR 54.4(a). The applicant's license renewal program guidelines provided a listing of documents used to support scoping and screening evaluations. The staff finds these design documentation sources to be useful for ensuring that the initial scope of SSCs identified by the applicant is consistent with the plant's CLB.

2.1.3.1.3 Conclusion

On the basis of its review of LRA Section 2.1, the detailed scoping and screening implementing procedures, and the results from the scoping and screening methodology audit, the staff concluded that the applicant's scoping and screening methodology considers CLB information in a manner consistent with the Rule, the SRP-LR, and NEI 95-10 guidance and, therefore, is acceptable.

2.1.3.2 Quality Controls Applied to License Renewal Application Development

2.1.3.2.1 Staff Evaluation

The staff reviewed the quality assurance controls used by the applicant to ensure that scoping and screening methodologies used in the LRA were adequately implemented. The applicant applied the following quality assurance processes during the LRA development:

- The applicant developed written instructions, guidelines, and position papers to direct implementation of the scoping and screening methodology, control LRA development, and describe training requirements and documentation.

- The applicant prepared the LRA and LRA implementing procedures, which were subsequently reviewed by the applicant's license renewal project personnel, subject matter experts, and independent technical reviewers.
- The applicant's technical lead and license renewal project manager reviewed and accepted the license renewal implementing procedure and the LRA.
- The applicant's team applied lessons learned from other license renewal activities to their scoping and screening methodology.
- Industry peers, independent consultants, the applicant's quality assurance manager, the Plant Oversight Committee, and the Corporate Nuclear Safety Review Board examined the LRA.
- The applicant documented the comments and resolutions received through the review process in comment and resolution forms. The scoping and screening methodology audit team reviewed the applicant's sample comment resolution and determined the applicant's comment resolution process is consistent and adequate.
- The applicant used a documented instruction to track and capture any identified issues for resolution.

The staff reviewed the applicant's written procedures and documentation of assessment activities and determined that the applicant had developed adequate procedures to control the LRA development and assess the results of the activities.

2.1.3.2.2 Conclusion

On the basis of its review of pertinent LRA development guidance, discussion with the applicant's license renewal staff, and review of the applicant's documentation of the activities performed to assess the quality of the LRA, the staff concluded that the applicant's quality assurance activities meet current regulatory requirements. The staff also determines that LRA development activities were performed in accordance with the applicant's license renewal program requirements.

2.1.3.3 Training

2.1.3.3.1 Staff Evaluation

The staff reviewed the applicant's training process to ensure the guidelines and methodology for the scoping and screening activities were applied in a consistent and appropriate manner. The applicant required training for all personnel participating in the development of the LRA and used only trained and qualified personnel to prepare the scoping and screening implementing procedures and reports. The following training was provided:

- Training was required for the license renewal project personnel, which followed documented and written guidance.
- Initial training was provided to license renewal project personnel involved in developing license renewal process instructions.
- Process training was provided for license renewal project personnel for developing LRA implementing procedure and the LRA.

- General orientation training and specialized training was provided to the applicant's managers and subject matter experts as appropriate.

The staff reviewed the applicant’s written procedures and, on a sampling basis, reviewed completed qualification and training records for some of the applicant’s license renewal personnel. The staff determined that the applicant had developed and implemented adequate procedures to control the training of personnel performing LRA activities.

2.1.3.3.2 Conclusion

On the basis of discussions with the applicant’s license renewal project personnel responsible for the scoping and screening process and its review of selected documentation in support of the process, the staff concluded that the applicant’s personnel are adequately trained to implement the scoping and screening methodology described in the applicant’s implementing procedures and the LRA.

2.1.3.4 Scoping and Screening Program Review Conclusion

On the basis of a review of information provided in LRA Section 2.1, a review of the applicant’s detailed scoping and screening implementing procedures, discussions with the applicant’s license renewal personnel, and the results from the scoping and screening methodology audit, the staff concluded that the applicant’s scoping and screening program is consistent with the SRP-LR and the requirements of 10 CFR Part 54 and, therefore, is acceptable.

2.1.4 Plant Systems, Structures, and Components Scoping Methodology

LRA Section 2.1 describes the applicant’s methodology used to scope SSCs pursuant to the requirements of the 10 CFR 54.4(a) criteria. The LRA states that the scoping process categorized the entire plant in terms of major systems and structures with respect to license renewal. According to the LRA, major systems and structures were evaluated against criteria provided in 10 CFR 54.4(a)(1), 10 CFR 54.4(a)(2), and 10 CFR 54.4(a)(3) to determine whether the item should be considered within the scope of license renewal. The LRA states that the scoping process identified the SSCs that are safety-related and perform or support an intended function for responding to a design basis event (DBE); are nonsafety-related but their failure could prevent accomplishment of a safety-related function; or support a specific requirement for one of the five regulated events applicable to license renewal.

2.1.4.1 Application of the Scoping Criteria in Title 10, Part 54.4(a)(1) of the Code of Federal Regulations

2.1.4.1.1 Summary of Technical Information in the Application

LRA Section 2.1.1.1, “Safety-Related Scoping Criteria,” states the following:

As defined by 10 CFR 54.4(a)(1), all SSCs relied upon to remain functional during and following design basis events are evaluated as safety-related and are within the scope of license renewal.

Section 3.2.4 of the UFSAR identifies the following quality assurance classifications used by Columbia:

- Quality Class I —Any nuclear system, structure, subassembly, component, or design characteristic that prevents or mitigates the consequences of postulated accidents that could cause undue risk to the health and safety of the public. All engineered safety features (ESFs) fall within this category. All Quality Class I items meet the applicable provisions of 10 CFR Part 50 Appendix B.
- Quality Class II+ —Any SSCs having no safety-related function but requiring quality augmentation either as a result of NRC requirements or as committed to by Columbia. Quality augmentation may include such requirements as EQ, seismic qualification, or other quality affecting activities specifically committed.
- Quality Class II —Any system, structure, subassembly, component, or design characteristic that could cause a safety hazard to plant personnel, an extended reduction in unit output, an unscheduled unit trip, or equipment damage.
- Quality Class G —Any non-nuclear system, structure, subassembly, component, or design characteristic to which quality assurance requirements are assigned in accordance with the consequences of failure, operating costs, or procurement costs.

Comparison of the UFSAR quality assurance classifications to the criteria of 10 CFR 54.4(a)(1) shows that Columbia Quality Class I encompasses the systems and equipment that meet the criteria of 10 CFR Part 54.4(a)(1). Quality Class II, II+, and G encompass the systems and equipment that meet the criteria of 10 CFR 54.4(a)(2) and 10 CFR 54(a)(3).

UFSAR Table 3.2-1 provides a listing of major components and identifies the quality class for each component. Interfaces between components of different classifications are shown by notes on the system flow diagrams contained in the UFSAR. Safety-related piping and components identified on the system flow diagrams are designated as Quality Class I, which includes American Society for Mechanical Engineers (ASME) Code, Section III, Class 1, 2, and 3.

Because of the similarities in the scoping requirements for the Maintenance Rule and the License Renewal Rule, the MRSM was the initial input for the identification of safety-related systems and structures and their intended safety functions. The UFSAR and its cited references identify the basis for the Columbia DBEs and describe the quality classification of the plant SSCs. Additionally, the MEL, which is a computerized database of Columbia equipment identification numbers and related component information that is searchable through Passport, identifies safety-related components with an “SR” designation in the “Safety Class” field.

2.1.4.1.2 Staff Evaluation

Pursuant to 10 CFR 54.4(a)(1), the applicant must consider all safety-related SSCs relied upon to remain functional during and following a DBE to ensure the following functions:

- the integrity of the reactor coolant pressure boundary
- the ability to shut down the reactor and maintain it in a safe shutdown condition
- 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), 10 CFR 50.67(b)(2), or 10 CFR 100.11

With regard to identification of DBEs, Section 2.1.3 of the SRP-LR states the following:

> The set of DBEs as defined in the Rule is not limited to Chapter 15 (or equivalent) of the [updated final safety analysis report] 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 [HELB]. 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 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).

During the scoping and screening methodology audit, the applicant stated that it evaluated the types of events listed in NEI 95-10 (i.e., anticipated operational occurrences, design basis accidents (DBAs), external events and natural phenomena) that were applicable to Columbia. The staff reviewed the applicant's implementing procedure, which described all design basis conditions in the CLB and addressed all events defined by 10 CFR 50.49(b)(1) and 10 CFR 54.4(a)(1). The UFSAR and implementing procedure discussed events such as internal and external flooding, tornados, and missiles. The staff concluded that the applicant's evaluation of DBEs was consistent with the SRP-LR.

The applicant also stated that it performed scoping of SSCs for the 10 CFR 54.4(a)(1) criterion in accordance with the license renewal implementing procedures that guide the preparation, review, verification, and approval of the scoping evaluations to ensure the adequacy of the results for the scoping process. The staff reviewed the implementing procedures governing the applicant's evaluation of safety-related SSCs and sampled the applicant's reports of the scoping results to ensure that the applicant applied the methodology in accordance with the implementing procedures. In addition, the staff discussed the methodology and results with the applicant's personnel who were responsible for these evaluations.

The staff reviewed the applicant's evaluation of the Rule and CLB definitions pertaining to 10 CFR 54.4(a)(1) and determined that the Columbia CLB definition of safety-related met the definition of safety-related specified in the Rule. The staff reviewed a sample of the license renewal scoping results for the service water, emergency DGs and support systems, and the turbine building to provide additional assurance that the applicant adequately implemented their scoping methodology with respect to 10 CFR 54.4(a)(1). The staff verified that the applicant developed the scoping results for each of the sampled systems consistently with the methodology, identified the SSCs credited for performing intended functions, and adequately described the basis for the results as well as the intended functions. The staff also confirmed that the applicant had identified and used pertinent engineering and licensing information to identify the SSCs required to be within the scope of license renewal in accordance with the 10 CFR 54.4(a)(1) criteria.

During the scoping and screening methodology audit, performed onsite May 10–13, 2010, the staff reviewed the LRA and 10 CFR 54.4(a) implementing procedures, had discussions with the applicant and determined that additional information would be required to complete its review. The staff determined that the applicant had correctly identified safety-related components and cables located in the turbine building. However, the applicant stated that it had performed an evaluation, as documented in license renewal implementing procedures and reports, that concluded the nonsafety-related SSCs in the proximity of, or attached to, the safety-related components and cables were not required to be included within the scope of license renewal because the safety-related components and cables had been evaluated to be fail-safe.

In RAI 2.1-1(A) dated June 9, 2010, the staff requested that the applicant provide the details of the evaluation and basis for the conclusion that nonsafety-related SSC's, in the proximity of, or attached to, safety-related components and cables, are not required to be included within the scope of license renewal in accordance with 10 CFR 54.4(a)(2).

The applicant responded to RAI 2.1-1(A) by letter dated July 16, 2010, which stated, in part, the following:

> The [reactor protection system] RPS and [main steam isolation valve] MSIV isolation logic sensor inputs are "fail-safe" components, in accordance with NEI 95-10 [Appendix F Section 5.2.3.1], loss of the RPS and MSIV isolation logic sensor inputs during a postulated event would not result in loss of capability to bring the plant to a cold shutdown or mitigate the radiological consequences of such an event, even assuming a single failure among the safety systems that remain unaffected. Therefore, there are no credible [nonsafety-related] NSR failures that could prevent the [main steam] MS System and the RPS from performing their safety-related functions.
>
> The safety-related MSIV isolation logic sensor inputs, the safety-related components of the Miscellaneous Drains (MD) System and the safety related MS valves located in the Turbine Generator Building are classified as safety related because of an NRC commitment but do not perform a 10 CFR 54.4(a)(1) function. Therefore, nonsafety-related SSCs inside the Turbine Generator Building do not have a plausible potential for failure to impair or prevent these components from performing a function defined in 10 CFR 54.4(a)(1).
>
> Therefore, [nonsafety-related] NSR SSCs inside the Turbine Generator Building do not have a plausible potential for failure to impair or prevent the accomplishment of a 10 CFR 54.4(a)(1) function by physical interaction, do not satisfy the nonsafety affecting safety (NSAS), 10 CFR 54.4(a)(2) scoping criterion and are not within the scope of license renewal.

The staff reviewed the applicant's response to RAI 2.1-1(A) and determined that the applicant had described the process used to evaluate the functions of components, identified as safety-related in the plant equipment (Passport) database and located in the turbine building, to determine whether nonsafety-related SSCs located in the turbine building could affect the performance of a 10 CFR 54.4(a)(1) function and would, therefore, be required to be included within the scope of license renewal in accordance with 10 CFR 54.4(a)(2).. The staff determined that, during the scoping process, the applicant determined that the components identified as safety-related in the plant equipment database, were determined to be fail-safe and that the loss of the safety-related component would not cause the loss of the system 10 CFR 54.4(a)(1) intended function. Otherwise, these components were categorized as safety-related in the plant equipment database on the basis of a commitment to the NRC but did not perform a 10 CFR 54.49(a)(1) function.

The staff reviewed the applicant's response, along with information contained in the LRA, and determined that the applicant's response to RAI 2.1-1(A) is acceptable because the applicant had evaluated the components located in the turbine building that were identified as safety-related in the plant equipment data base, and determined that the failure of these components would not impact the ability of the system to perform a 10 CFR 54.4(a)(1) function. As a result, the applicant concluded that the failure of nonsafety-related SSCs in the vicinity of the safety-related SSCs would not impact the performance of a 10 CFR 54.4(a)(1) function. The staff concluded that the applicant had provided a basis for not including nonsafety-related SSCs within the scope of license renewal in accordance with 10 CFR 54.4(a)(2) and, therefore, finds the applicant's response acceptable. RAI 2.1-1(A) is resolved.

2.1.4.1.3 Conclusion

On the basis of the review of the LRA, the review of implementing procedures, sample reviews of scoping results, discussion with the applicant, and the information provided in the response to RAI 2.1-1(A), the staff concluded that the applicant's methodology for identifying systems and structures meeting the scoping criteria pursuant to 10 CFR 54.4(a)(1) is acceptable.

2.1.4.2 Application of the Scoping Criteria in Title 10, Part 54.4(a)(2) of the Code of Federal Regulations

2.1.4.2.1 Summary of Technical Information in the Application

LRA Section 2.1.1.2, "Non-Safety Affecting Safety Scoping Criteria," states the following:

> 10 CFR 54.4(a)(2) requires that non-safety related (NSR) SSCs whose failure could prevent satisfactory accomplishment of a safety function as defined in 10 CFR 54.4(a)(1), referred to as non-safety affecting safety (NSAS), be included in the scope of license renewal. In order to provide reasonable assurance that all such systems are identified, it is necessary to consider the impact of failures of NSR SSCs as either functional or spatial. Appendix F of NEI 95-10 contains guidance on scoping for NSAS. The Columbia methodology is consistent with this guidance.
>
> For license renewal considerations, a functional NSAS failure is the failure of an NSR SSC to perform its normal function, which adversely affects the successful accomplishment of a safety function.
>
> A spatial NSAS failure is the loss of structural or pressure boundary integrity of an NSR SSC that is connected to or located near (in physical proximity to) a safety-related SSC, which adversely affects the successful accomplishment of a safety function of the safety-related SSC.

LRA Section 2.1.1.2.1, "Functional Failures of Nonsafety-related SSCs," states the following, in relation to nonsafety-related SSCs providing functional support to safety-related SSCs:

> NSR SSCs that are credited to remain functional in support of a safety function, as defined in 10 CFR 54.4(a)(1), satisfy the NSAS license renewal scoping criteria of 10 CFR 54.4(a)(2).
>
> The applicable sections of the UFSAR, MRSM, and design basis requirements documents provide the system and structure functional information to address these considerations.
>
> The SSCs that perform intended functions credited in the current licensing basis that meet the NSAS criteria of 10 CFR 54.4(a)(2) are identified in Sections 2.3, 2.4, and 2.5.

LRA Section 2.1.1.2.2, "Spatial Failures of Nonsafety-Related SSCs," states the following, in relation to spatial failures of nonsafety-related SSCs:

NSR systems and NSR portions of safety-related systems satisfy the NSAS scoping criterion if there is a potential for spatial interactions with safety-related equipment. That is, the degradation and failure of an NSR SSC that is directly connected to or located in the vicinity of safety-related SSCs creates the potential for interaction between the SSCs due to physical impact (including pipe whip, jet impingement, missiles), flooding, spray, or leakage that could adversely impact the safety-related function of a safety-related SSC. Spatial failures that meet the NSAS scoping criterion include both NSR SSCs in the general vicinity of, but not connected to, safety-related equipment, and NSR SSCs directly connected to safety-related SSCs (e.g., code breaks).

Certain mitigative features, such as missile barriers, flood barriers, and spray shields, are credited in the current licensing basis for the protection of safety-related SSCs from spatial interaction. These protective features are included in the scope of license renewal in accordance with Section 2.1.1.2.1 and are evaluated as structural components. In addition, the preventive option described in Appendix F of NEI 95-10 is used to determine the scope of license renewal with respect to the protection of safety-related SSCs from spatial interactions that are not addressed in the current licensing basis. The identification of NSR systems and portions of systems that are in the license renewal scope under 10 CFR 54.4(a)(2) due to a potential for spatial interactions with safety-related equipment requires an evaluation based on equipment location and the consequences of an NSR component failure in that location, rather than on equipment function itself. A conservative “spaces” approach is used in this identification process because it focuses on an entire structure (e.g., Reactor Building) rather than on specific limited areas within a structure. In this approach, all fluid-containing components (liquid or steam) and components associated with safety-related to NSR interfaces are evaluated for potential spatial interactions, with no rooms or areas or area-to-area transitions overlooked.

Structural components (such as hangers, supports, conduit, cable trays, barriers, and other protective features) are included in the scope of license renewal if they are located in, or are a part of, a plant structure that contains systems or components that satisfy one or more of the license renewal scoping criteria (and distinction between safety-related and NSR structural components is not necessary). NSR mechanical systems and components are included in the scope of license renewal, due to the potential for spatial failures, if they are directly connected to or located in the same structure as safety-related systems and components, and if their failure would impact a safety function. Consistent with the related discussions in NEI 95-10 Appendix F, failure of NSR mechanical components that are not directly connected and do not contain a fluid (liquid or steam), will not result in spatial interaction as there is no fluid to leak, spray, or impinge on safety-related SSCs; and system pressure is such that there is no force that could cause significant movement of the failed component (e.g., pipe whip). This conclusion is confirmed by review of Columbia and industry operating experience.

For nonsafety-related piping that is directly connected to safety-related piping, the Seismic Category I design requirements are extended to the first seismic restraint beyond the defined boundaries. The seismic design is extended to the first point in the system that can be treated as an anchor to the plant structure. The nonsafety-related SCs in the scope of license renewal include those that comprise seismic anchors or equivalent anchors. An equivalent anchor is comprised of at least two rigid supports in each of three orthogonal directions. Seismic and equivalent anchors, and the associated piping and components for safety-related to nonsafety-related interfaces, satisfy the NSAS criterion if their failure would affect an attached safety-related component. The seismic anchor approach and the use of base-mounted equipment and flexible connection options, including the entire length of piping connected on both ends to safety-related piping and components, follows the guidance in NEI 95-10 Appendix F. Components were not excluded from the scope of license renewal based on duration of exposure to conditions resulting from failures (such as leakage or spray). Nonsafety-related mechanical components that satisfy the NSAS criterion for spatial considerations are determined by a review of the flow diagrams, which depict building demarcations and safety-related equipment, and the component data in the plant MEL database, which identifies component classification and location.

2.1.4.2.2 Staff Evaluation

Pursuant to 10 CFR 54.4(a)(2), the applicant must consider all nonsafety-related SSCs, whose failure could prevent the satisfactory accomplishment of safety-related functions, for SSCs relied on to remain functional during and following a DBE to ensure the following:

- the integrity of the reactor coolant pressure boundary
- the ability to shut down the reactor and maintain it in a safe shutdown condition
- 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), 10 CFR 50.67(b)(2), or 10 CFR 100.11.

Regulatory Guide (RG) 1.188, Revision 1, endorses the use of NEI 95-10, Revision 6. NEI 95-10 discusses the staff's position on 10 CFR 54.4(a)(2) scoping criteria to include nonsafety-related SSCs typically identified in the CLB; consideration of missiles, cranes, flooding, and HELBs; nonsafety-related SSCs connected to safety-related SSCs; nonsafety-related SSCs near safety-related SSCs; and mitigative and preventative options related to nonsafety-related and safety-related SSCs interactions.

In addition, the staff's position (as discussed in the SRP-LR Section 2.1.3.1.2) is that applicants need not consider hypothetical failures but, rather, should base their evaluation on the plant's CLB, engineering judgment and analyses, and relevant operating experience. NEI 95-10 further describes operating experience as all documented plant-specific and industry-wide experience 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 safety operational event reports, and engineering evaluations. The staff reviewed LRA Section 2.1.1.2 in which the applicant described the scoping methodology for nonsafety-related SSCs pursuant to 10 CFR 54.4(a)(2). In addition, the staff reviewed the applicant's implementing procedure and results report, which documented the guidance and corresponding results of the applicant's scoping review pursuant to 10 CFR 54.4(a)(2). The applicant stated that it performed the review in accordance with the guidance contained in NEI 95-10, Revision 6, Appendix F.

The staff notes that Seismic Category I SSCs are designed to remain functional if the safe-shutdown earthquake (SSE) ground motion occurs.

Nonsafety-Related SSCs Required to Perform a Function that Supports Safety-Related SSCs: The staff determined that nonsafety-related SSCs required to remain functional to support a safety-related function had been reviewed by the applicant for inclusion within the scope of license renewal, in accordance with 10 CFR 54.4(a)(2). The staff reviewed the evaluating criteria discussed in LRA Section 2.1.1.2.1 and the applicant's 10 CFR 54.4(a)(2) implementing procedure. The staff confirmed that the applicant had reviewed the UFSAR, plant drawings, plant equipment database, and other CLB documents to identify the nonsafety-related SSCs that function to support safety-related SSCs and whose failure could prevent the performance of a safety-related intended function. The applicant also considered missiles, overhead handling systems, internal and external flooding, and HELBs. Accordingly, the staff finds that the applicant implemented an acceptable method for including nonsafety-related SSCs that perform functions that support safety-related intended functions within the scope of license renewal, as required by 10 CFR 54.4(a)(2).

Nonsafety-Related SSCs Directly Connected to Safety-Related SSCs: The staff confirmed that nonsafety-related SSCs, directly connected to SSCs, had been reviewed by the applicant for inclusion within the scope of license renewal, in accordance with 10 CFR 54.4(a)(2). The staff reviewed the evaluating criteria discussed in LRA Section 2.1.1.2.2 and the applicant's 10 CFR 54.4(a)(2) implementing procedure. The applicant reviewed the safety-related to nonsafety-related interfaces for each mechanical system to identify the nonsafety-related components located between the safety-to-nonsafety-related interface and license renewal structural boundary.

The staff determined that the applicant identified the nonsafety-related SSCs connected to safety-related SSCs and maintained the nonsafety-related SSCs structurally sound to maintain the integrity of the safety-related SSCs. The applicant also used a combination of the following to identify the portion of nonsafety-related piping systems to be included within the scope of license renewal:

- seismic anchors
- equivalent anchors
- bounding conditions described in NEI 95-10 Revision 6, Appendix F (base-mounted component, flexible connection, or inclusion of the entire piping run)

Nonsafety-Related SSCs with the Potential for Spatial Interaction with Safety-Related SSCs: The staff confirmed that nonsafety-related SSCs with the potential for spatial interaction with safety-related SSCs had been reviewed by the applicant for inclusion within the scope of license renewal in accordance with 10 CFR 54.4(a)(2). The staff reviewed the evaluating criteria discussed in the LRA Section 2.1.1.2.2 and the applicant's 10 CFR 54.4(a)(2) implementing procedure. The applicant considered various spatial interactions, which included physical impacts (pipe whip, jet impingement), harsh environments, flooding, spray, and leakage when evaluating the potential for spatial interactions between nonsafety-related systems and safety-related SSCs. The applicant used a "spaces" approach to identify the portions of nonsafety-related systems with the potential for spatial interaction with safety-related SSCs. The spaces approach focused on the interaction between nonsafety-related and safety-related SSCs that are located in the same space, which was defined for the purposes of the review, as a structure containing active or passive safety-related SSCs.

LRA Section 2.1.1.2.2 and the applicant's implementing procedure state that the applicant included mitigative features when considering the affect of nonsafety-related SSCs on safety-related SSCs for occurrences discussed in the CLB. The staff reviewed the applicant's CLB information—primarily contained in the UFSAR—related to missiles, crane load drops, flooding, and HELBs. The staff determined that the applicant also considered the features designed to protect safety-related SSCs from the effects of these occurrences through the use of mitigating features, such as floor drains (FDs) and curbs. The staff confirmed that the applicant included the mitigating features within the scope of license renewal, in accordance with 10 CFR 54.4(a)(2).

LRA Section 2.1.1.2.2 and the applicant's implementing procedure state that the applicant used a preventive approach, which considered the affect of nonsafety-related SSCs contained in the same space as safety-related SSCs. The staff determined that the applicant evaluated all nonsafety-related SSCs containing liquid or steam that were located in spaces containing safety-related SSCs. The applicant used a spaces approach to identify the nonsafety-related SSCs that were located within the same space as safety-related SSCs. As described in the LRA and for the purpose of the scoping review, a space was defined as a structure containing active or passive safety-related SSCs. In addition, the staff determined that following the identification of the applicable mechanical systems, the applicant identified its corresponding structures for potential spatial interaction, based on the staff's review of the CLB and plant walkdowns. Nonsafety-related systems and components that contain liquid or steam and are located inside structures that contain safety-related SSCs were included within the scope of license renewal, unless it was evaluated and determined not to contain safety-related SSCs. The staff also determined that, based on plant and industry-operating experience, the applicant excluded the nonsafety-related SSCs containing air or gas from the scope of license renewal, with the exception of portions that are attached to safety-related SSCs and required for structural support. The staff confirmed that the nonsafety-related SSCs which contain liquid or steam and are located within a space containing safety-related SSCs were included within the scope of license renewal, in accordance with 10 CFR 54.4(a)(2).

The staff determined that additional information would be required to complete its review. During the scoping and screening methodology audit, the staff reviewed the LRA and 10 CFR 54.4(a) implementing procedures and had discussions with the applicant to determine if the applicant identified additional nonsafety-related SSCs, with the potential to spatially interact with safety-related SSCs, and included them within the scope of license renewal in accordance with 10 CFR 54.4(a)(2). These additional nonsafety-related SSCs are located in corridors between buildings and were identified by the applicant during walkdowns—performed after the issuance of the LRA and before the scoping and screening methodology audit—but had not been identified in the LRA.

By letter dated June 9, 2010, the staff issued RAI 2.1-1(B), which requested the applicant to do the following:

- perform a review of the scoping methodology (as described in the LRA) and state why the methodology or its implementation precluded the identification of the nonsafety-related SSCs to be included within the scope of license renewal in accordance with 10 CFR 54.4(a)(2) before the issuance of the LRA
- describe any changes to the scoping methodology (as described in LRA), or its implementation, that resulted in the identification of additional nonsafety-related SSCs, not previously identified in the LRA, to be included within the scope of license renewal in accordance with 10 CFR 54.4(a)(2)

- list any additional SSCs that were included within the scope of license renewal as a result of the reviews discussed in this RAI

The applicant responded to RAI 2.1-1(B) by letter dated July 16, 2010, which states the following:

> The initial scoping and screening methodology focused on spaces containing safety related equipment. The spaces with safety related equipment were determined using plant drawings. The mechanical scoping focused on each in-scope space (e.g. Reactor Building or Control Structure) individually and did not fully consider the corridors between the spaces. The initial scoping process was performed independently by each of the License Renewal (LR) discipline leads (Civil, Electrical, and Mechanical). As no safety related components were identified in the Radwaste Building, no SSCs in that building had a 10 CFR 54.4(a)(2) function. The review shows that the scoping methodology is sound and it was the implementation of the scoping process that precluded the identification of the NSR SSCs to be in the scope of the LRA.
>
> Most of the drawings used for scoping show building boundaries for systems that span multiple buildings. Some drawings depict the corridors and others do not. Because the drawings were relied upon, the inconsistent use of showing corridors contributed to the scoping errors.
>
> Based on lessons learned, Energy Northwest reviewed the Columbia [10 CFR 54.4](a)(2) scoping methodology and implementation. The scoping implementation was changed to assemble the discipline leads to participate in cross-functional walkdowns of in-scope and out-of-scope spaces, focusing on the corridors between spaces. This review was performed by the LR Civil Lead, the LR Electrical Lead, and the LR nuclear steam supply system (NSSS) Mechanical Lead. Scoping errors were found in some of the corridors.
>
> Energy Northwest entered the scoping errors into the corrective action program. The extent of condition review reevaluated all structures that could possibly house 10 CFR 54.4(a)(1) equipment. Structures were evaluated to determine if any safety related equipment or cables were overlooked. Since design specifications prohibit routing safety related cables in non-seismic Class 1 buildings, only in-scope structures were reevaluated, with the exception that the turbine building was included because it is a modified non-seismic category 1 structure.
>
> The reviews revealed that steam from auxiliary steam (AS), heating steam (HS), heating steam vent (HSV), condensate (auxiliary) (CO), heating steam condensate (HCO), and sealing steam (SS) systems could impact cables with a 10 CFR 54.4(a)(1) function in a corridor. Additionally, sections of the condensate (COND), equipment drains radioactive (EDR), miscellaneous waste radioactive (MWR), floor drain radioactive (FDR), fuel pool cooling (FPC), demineralized water (DW), plant service water (TSW), fire protection (FP), potable hot water (PWH), and potable cold water (PWC) systems that have the potential to spray or splash on the cables with an 10 CFR 54.4(a)(1) function located in corridors were found. Portions of these systems were added to the 10 CFR 54.4(a)(2) scope in Reference 3 [Letter GO2-10-094, dated July 17, 2010].

> The review found cables with a 10 CFR 54.4(a)(1) function in conduits attached to the ceiling of [elevation] 437' [foot] Radwaste Building which is the bottom of the 467' [foot] floor [elevation] of the Control Structure. Therefore, water filled pipes that can directly spray or splash and steam containing piping in the Radwaste Building were added to the LR scope (Reference 3). This additional scope includes piping for HS, HCO, HSV, CO, TSW, DW, PWC, COND, [reactor closed cooling water] (RCC), MWR, condensate processing radioactive (CPR), control air system (CAS), floor drains (FD), EDR, FDR and reactor water clean-up (RWCU) systems.
>
> The extent of condition determination also validated LRA [T]able 2.2-1, which provides a listing of systems that are in-scope or out-of-scope for License Renewal. The out-of-scope systems were reevaluated to ensure that initial scoping was correct. When LRA table 2.2-1 was reviewed no additional systems (beyond those in part B.2 of this response) were added to scope. The Reactor Building Potable Hot Water System had been eliminated by plant modification and was removed from LRA table 2.2-1 (Reference 3).

The staff reviewed the applicant’s response to RAI 2.1-1(B) and determined that the applicant revised its process and performed an additional evaluation of nonsafety-related SSCs located near safety-related SSCs to determine if there is a potential for spatial interaction. The applicant performed walkdowns of additional spaces, including corridors, and identified nonsafety-related SSCs that had the potential to affect safety-related SSCs. As a result of the process revision and the evaluation subsequently performed, the applicant included additional nonsafety-related SSCs within the scope of license renewal in accordance with 10 CFR 54.4(a)(2). The staff determined that the revised process was in accordance with the requirements of 10 CFR 54.4(a)(2) and was, therefore, acceptable. RAI 2.1-1(B) is resolved.

During the scoping and screening methodology audit, performed onsite on May 10–13, 2010, the staff reviewed the LRA and 10 CFR 54.4(a) implementing procedures and had discussions with the applicant. The staff determined that the applicant discussed the bounding conditions (as described in NEI 95-10, Appendix F) that had been used to identify the portion of nonsafety-related pipe, attached to safety-related SSCs, to be included within the scope of license renewal in accordance with 10 CFR 54.4(a)(2). The staff determined that the use of some bounding conditions had not been described in the LRA and additional information would be required to complete its review.

By letter dated June 9, 2010, the staff issued RAI 2.1-1(C), which asked the applicant to discuss all bounding conditions used to identify the portion of nonsafety-related pipe, attached to safety-related SSCs, to be included within the scope of license renewal in accordance with 10 CFR 54.4(a)(2).

The applicant responded to RAI 2.1-1(C) by letter dated July 16, 2010, which states the following:

> Where identified on plant drawings or in piping design analyses, anchors were the preferred method for the establishment of license renewal boundaries for NSR piping attached to safety-related SSCs.
>
> If a license renewal boundary could not be identified at a seismic anchor, a review of plant documentation was conducted to determine if an "equivalent" anchor was defined in plant-specific piping design analyses. Columbia's overlap

criteria are applied in piping design analyses in overlap areas (SR/NSR interfaces). The overlap method is used for analyzing the dynamic response of a piping system by performing separate analyses of two or more overlapped subsystems of the complete piping system. This method is used only when the overlap region has enough rigid restraints in each of the three orthogonal directions to prevent the transmission of motion due to modal excitation from one end to the other and to reduce to a negligible level the sensitivity of the piping system to the direction of excitation. If the overlap method is used, the series of supports which define the overlap region (consisting of at least three rigid restraints or snubbers in each of three orthogonal directions) serves as an equivalent anchor.

If an anchor could not be identified as a license renewal boundary, and the overlap method could not be used to define an equivalent anchor, as described above, an equivalent anchor was established at a boundary point defined to include at least 2 supports in each of the 3 orthogonal directions.

Consistent with NEI 95-10 Appendix F Section 4, the following alternatives to identifying a seismic anchor or an equivalent anchor were also used in determining end points for the portions of NSR piping attached to safety related piping to be included in the scope of license renewal:

- a base-mounted component (e.g., heat exchanger, pump)
- a flexible connection
- a free end of NSR piping (e.g., piping drains and vents, instrument loops)
- NSR piping runs that are connected at both ends to safety related piping
- buried piping, which is considered to be an acceptable anchor for piping systems not subject to significant thermal loads.
- a smaller branch line can be decoupled where the moment of inertia ratio of the larger piping to the smaller piping is equal to or greater than 25 to 1 ratio

The review included all branch lines from the main piping runs, regardless of size, to ensure that forces and moments could not be transmitted back through the SR/NSR interface.

The staff reviewed the applicant's response to RAI 2.1-1(C) and determined that the applicant provided a detailed description of the methods used to identify the portion of nonsafety-related piping systems, attached to safety-related SSCs, to be included within the scope of license renewal. The staff determined that the methods used to identify the portion of nonsafety-related piping systems to be included within the scope of license renewal were consistent with those discussed in NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," and met the requirements of 10 CFR 54.4(a)(2) and were, therefore, acceptable. RAI 2.1-1(C) is resolved.

2.1.4.2.3 Conclusion

On the basis of the review of the LRA, the review of implementing procedures, the sample reviews of scoping results, the discussions with the applicant, and the information provided in the response to RAIs 2.1-1(B) and 2.1-1(C), the staff concluded that the applicant's methodology for identifying systems and structures meeting the scoping criteria pursuant to 10 CFR 54.4(a)(2) is acceptable.

2.1.4.3 Application of the Scoping Criteria in Title 10, Part 54.4(a)(3) of the Code of Federal Regulations

2.1.4.3.1 Summary of Technical Information in the Application

LRA Section 2.1.1.3, "Regulated Events Scoping Criteria," states the following:

> Plant engineering documents provide the technical basis for the SSCs that are required for compliance with one or more of the above NRC regulated events. SSCs required for compliance with one or more of these NRC regulated events are identified through a combined review of the pertinent CLB documents and engineering documents. The augmented quality (AQ) classification in the MEL database for components that require quality augmentation either as a result of NRC requirements or as committed by Columbia, but otherwise have no safety-related function, include components required for fire protection, anticipated transients without scram, and station blackout. The MRSM also identifies certain system functions as "AQ" if they are performed by components that meet the criteria for quality augmentation.

<u>Fire Protection</u>. LRA Section 2.1.1.3.1, "Fire Protection (10 CFR 50.48)," described scoping of systems and structures relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the fire protection criterion. LRA Section 2.1.1.3.1 states the following:

> The CLB for the Columbia fire protection program is described in Appendix F of the UFSAR, "Fire Protection Evaluation." Systems and structures required for compliance with 10 CFR 50.48, as well as the corresponding intended functions, are determined through a review of the Columbia CLB for fire protection. This determination includes both the features required for fire protection of safety-related equipment, and the SSCs included in, or which provide necessary support for, one or more of the safe shutdown paths credited for conformance with Appendix R.
>
> Systems that contain equipment that performs functions required for fire protection of safety-related equipment meet the Fire Protection license renewal scoping criteria (10 CFR 54.4(a)(3)), as do the systems that contain equipment credited as part of, or that support credited systems in, one or more of the safe shutdown paths.

<u>Environmental Qualification.</u> LRA Section 2.1.1.3.2, "Environmental Qualification (10 CFR 50.49)," described scoping of systems and structures relied on in safety analyses or plant evaluations to perform a function in compliance with the EQ criterion. LRA Section 2.1.1.3.2 states the following:

> Electrical and mechanical systems, and thereby the components in those systems, relied upon in safety analyses or in plant evaluations to remain functional when exposed to conditions existing during and following design basis accidents, in accordance with 10 CFR 50.49, "Environmental qualification of

> electrical equipment important to safety for nuclear power plants," are within the scope of license renewal in accordance with 10 CFR 54.4(a)(3).
>
> The electrical components at Columbia that are required to be environmentally qualified for a harsh environment, in accordance with 10 CFR 50.49, are identified in the MEL database as "EQ-Related." Systems that include environmentally qualified components satisfy the scoping criterion of 10 CFR 54.4(a)(3) and are in the scope of license renewal.

Pressurized Thermal Shock. LRA Section 2.1.1.3.3, "Pressurized Thermal Shock (10 CFR 50.61)," states the following:

> Columbia is a boiling water reactor (BWR) design and the regulations for pressurized thermal shock are not applicable to a BWR. Therefore, 10 CFR 50.61 is not applicable and consideration of pressurized thermal shock as a scoping criteria is not required for Columbia license renewal.

Anticipated Transient Without Scram. LRA Section 2.1.1.3.4, "Anticipated Transients Without Scram (10 CFR 50.62)," described scoping of systems and structures relied on in safety analyses or plant evaluations to perform a function in compliance with the ATWS criterion. LRA Section 2.1.1.3.4, states the following:

> Systems and structures required for compliance with 10 CFR 50.62, as well as the corresponding intended functions, are determined through a review of the Columbia CLB. This determination includes the necessary support functions and other plant system functions that are credited in the ATWS analysis.

Station Blackout. LRA Section 2.1.1.3.5, "Station Blackout (10 CFR 50.63)," described the scoping of systems and structures relied on in safety analyses or plant evaluations to perform a function in compliance with the SBO criterion. LRA Section 2.1.1.3.5, states the following:

> The evaluation for Columbia against the regulatory requirements in 10 CFR 50.63 is documented in Appendix 8A of the UFSAR. The identified equipment is relied upon for compliance with 10 CFR 50.63. An additional consideration for license renewal, based on NRC guidance, is that the systems and structures relied upon to restore the offsite AC power (including the plant system portion of the offsite power system) and onsite AC power for an SBO event be included within the scope of license renewal.
>
> Systems and structures required for compliance with 10 CFR 50.63, as well as the corresponding intended functions, are determined through a review of the Columbia CLB, considering the requirements of the License Renewal Rule, and the guidance provided in NUREG-1800 and LR-ISG-02. The Columbia evaluation boundary for SBO is addressed in Section 2.5.6.

2.1.4.3.2 Staff Evaluation

The staff reviewed the applicant's approach to identifying SSCs in accordance with 10 CFR 50.54.4(a)(3), which is relied upon to perform functions meeting the requirements of the NRC's regulations on fire protection, EQ, ATWS, and SBO. The criteria for pressurized thermal shock are not applicable to the Columbia BWR design. As part of this review, the staff discussed the applicant's methodology and reviewed the boundary scoping drawings, the position papers, and the LRA for the development and approach taken to complete the scoping process for these regulated safety systems. The staff also evaluated SSCs (on a sampling basis) included within the scope of license renewal, pursuant to 10 CFR 54.4(a)(3).

The staff confirmed that the applicant's plant engineering documents, as described in LRA Section 2.1.1.3, were used for identifying Columbia SSCs within the scope of license renewal, pursuant to 10 CFR 54.4(a)(3). The applicant evaluated the Columbia CLB to identify all SSCs that perform functions addressed in 10 CFR 54.4(a)(3), "Regulated Events," and then included these SSCs within the scope of license renewal as documented in the specific Columbia regulated event(s) position papers. The staff determined that these position paper results reference the information sources used for determining the SSCs credited for compliance with the events listed in the specified regulations for the applicable license renewal regulated events.

Fire Protection. The staff determined that the applicant's fire protection scoping document identified SSCs in the scope of license renewal required for fire protection. Columbia used CLB documents to identify the SSCs within the scope of license renewal for fire protection. The primary CLB document for Columbia is the UFSAR, Appendix F, "Fire Protection Evaluation." The staff reviewed the source documents used by the applicant to identify SSCs within the scope of license renewal in accordance with 10 CFR 54.4(a)(3) for fire protection. The documents included the UFSAR and the Columbia PFSS analysis. The staff reviewed, on a sampling basis, the scoping results in conjunction with the LRA and the CLB information to validate the methodology for including the appropriate SSCs within the scope of license renewal. The staff determined that the applicant's scoping included SSCs that perform intended functions to meet the requirements of 10 CFR 50.48. Based on its review of the CLB documents and the sample review, the staff determined that the applicant's scoping methodology was adequate for including SSCs credited in performing fire protection functions within the scope of license renewal.

Environmental Qualification. The staff confirmed that the applicant's EQ scoping document required the inclusion of safety-related electrical equipment; nonsafety-related electrical equipment whose failure under postulated environmental conditions could prevent satisfactory accomplishments of safety functions of the safety-related equipment; and certain post-accident monitoring equipment, as defined in 10 CFR 50.49(b)(1), 10 CFR 50.49(b)(2), and 10 CFR 50.49(b)(3). The staff determined that the applicant used the MEL, which identifies environmentally qualified equipment as "EQ-Related." The staff reviewed the LRA, implementing procedures, scoping results reports, and MEL database to verify that the applicant identified SSCs within the scope of license renewal that meet EQ requirements. Based on its review, the staff determined that the applicant's scoping methodology is adequate for identifying EQ SSCs within the scope of license renewal.

Pressurized Thermal Shock. The pressurized thermal shock criteria are not applicable to BWRs.

Anticipated Transient Without Scram. The staff determined that the applicant's ATWS scoping document included the plant systems credited for ATWS mitigation in the Columbia CLB. The staff reviewed this scoping document and the LRA, in conjunction with the scoping results, to validate the methodology for identifying ATWS systems and structures that are within the scope of license renewal. The staff determined that the scoping results included systems and structures that perform intended functions meeting 10 CFR 50.62 requirements. The staff determined that the applicant's scoping methodology was adequate for identifying SSCs with functions credited for complying with the ATWS regulation.

Station Blackout. The staff determined that the applicant's SBO scoping documents included SSCs, from the Columbia CLB, that the applicant identified to be associated with coping and safe shutdown of the plant following an SBO event. The staff confirmed this by reviewing the UFSAR Appendix 8A. The staff reviewed the SBO documents (on a sampling basis) and the LRA, in conjunction with the scoping results, to validate the applicant's methodology. The staff finds that the scoping results included systems and structures that perform intended functions meeting 10 CFR 50.63 requirements. The staff determined that the applicant's scoping methodology was adequate for identifying SSCs credited in complying with the SBO regulation within the scope of license renewal.

2.1.4.3.3 Conclusion

On the basis of the review of the LRA, implementing procedures, sample reviews of scoping results, and discussion with the applicant, the staff concluded that the applicant's methodology for identifying systems and structures meeting the scoping criteria pursuant to 10 CFR 54.4(a)(1) is acceptable.

2.1.4.4 Plant-Level Scoping of Systems and Structures

2.1.4.4.1 Summary of Technical Information in the Application

LRA Section 2.1.1, "Scoping Methodology," states the following:

> NEI 95-10 (Reference 2.1-1) provides industry guidance for determining what plant SSCs are in the scope of license renewal. The process to determine the SSCs in the scope of license renewal for Columbia follows the recommendations of NEI 95-10.
>
> The staff's endorsement of NEI 95-10, as stated in Section C.2 of RG 1.188, "Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses" (Reference 2.1-2), is [as follows]: "Revision 6 of NEI 95-10…provides methods that the staff considers acceptable for complying with the requirements of 10 CFR Part 54 for preparing a license renewal application."
>
> Consistent with NEI 95-10, the Columbia license renewal project scoping process establishes a listing of plant systems and structures, determines the functions they perform, and then determines which functions meet any one or more of the three criteria of 10 CFR 54.4(a). Functions that meet any one or more of the criteria are intended functions for license renewal. The systems or structures that perform those functions are included in the scope of license renewal.
>
> Each Columbia system was evaluated against the criteria in 10 CFR 54.4(a) as described in the following sections. Additionally, since structural scoping was done independent of mechanical and electrical scoping, a review of mechanical and electrical scoping was performed to provide added assurance that structures that support or shelter in-scope mechanical and electrical components are included within the scope of license renewal.

2.1.4.4.2 Staff Evaluation

The staff reviewed the applicant's methodology for performing the scoping of plant systems and components to ensure it was consistent with 10 CFR 54.4. The methodology used to determine the systems and components within the scope of license renewal was documented in implementing procedures and scoping results reports for systems. The scoping process defined the plant in terms of systems and structures. Specifically, the implementing procedures identified the systems and structures that are subject to 10 CFR 54.4 review, described the processes for capturing the results of the review, and were used to determine if the system or structure performed intended functions consistent with the criteria of 10 CFR 54.4(a). The process was completed for all systems and structures to ensure that the entire plant was addressed.

The applicant documented the results of the plant-level scoping process in accordance with the implementing procedures. The results were provided in the systems and structures documents and reports, which contained the following information:

- description of the structure or system
- listing of functions performed by the system or structure
- identification of intended function
- 10 CFR 54.4(a) scoping criteria met by the system or structure
- references
- basis for the classification of the system or structure intended functions

During the scoping and screening methodology audit, the staff reviewed a sampling of the documents and reports and concluded that the applicant's scoping results contained an appropriate level of detail to document the scoping process.

2.1.4.4.3 Conclusion

Based on its review of the LRA, site guidance documents, and a sampling of system scoping results reviewed during the scoping and screening methodology audit, the staff concluded that the applicant’s methodology for identifying SSCs within the scope of license renewal, and their intended functions, is consistent with the requirements of 10 CFR 54.4 and, therefore, is acceptable.

2.1.4.5 Mechanical Component Scoping

2.1.4.5.1 Summary of Technical Information in the Application

LRA Section 2.1.1.4, “Scoping Boundary Determination,” and its subsection state the following:

> Each of the plant systems and structures are evaluated, as described above, to determine those that meet one or more of the scoping criteria listed in 10 CFR 54.4(a), and to determine their system- or structure-level intended functions, as described in 10 CFR 54.4(b). The license renewal evaluation boundaries (scoping boundaries) identify those portions of the in-scope system that are necessary to ensure that the intended functions of the system will be performed. Components needed to support each of the system-level intended functions identified in the scoping process must be included within the evaluation boundaries.

LRA Section 2.1.1.4.1, “Mechanical Systems,” states the following:

> For mechanical systems, the evaluation boundaries are illustrated on system flow diagrams by highlighting the flow paths that are required for the system to perform the intended functions identified in LRA Sections 2.1.1.1, 2.1.1.2, and 2.1.1.3. The evaluation boundaries associated with Class 1 components are highlighted in blue. The evaluation boundaries for non-Class 1 components that perform a function other than spatial interaction are highlighted in green. The evaluation boundaries for NSR components that are in scope for spatial considerations are highlighted in magenta (pink).

2.1.4.5.2 Staff Evaluation

The staff evaluated LRA Sections 2.1.1, 2.1.1.4, and 2.1.1.4.1 and the guidance in the implementing procedures and reports to perform the review of the mechanical scoping process. The project documents and reports provided instructions for identifying the evaluation boundaries. The staff reviewed the implementing procedures and the CLB documents associated with mechanical system scoping and found that the guidance and CLB source information noted above were acceptable in identifying mechanical components and support structures in mechanical systems that are within the scope of license renewal. The staff conducted detailed discussions with the applicant's license renewal project personnel and reviewed documentation pertinent to the scoping process. The staff assessed whether or not the applicant had appropriately applied the scoping methodology outlined in the LRA and implementing procedures and whether or not the scoping results were consistent with CLB requirements. The staff determined that the applicant's procedures were consistent with the description provided in the LRA Sections 2.1.1 and 2.1.1.4 and the guidance contained in the SRP-LR, Section 2.1 and that the applicant's procedure was adequately implemented.

To sample the applicant's process, the staff reviewed the applicant's scoping reports for the service water and the emergency DGs and support systems—mechanical component types that met the scoping criteria of 10 CFR 54.4. The staff also reviewed the implementing procedures and discussed the methodology and results with the applicant. The staff confirmed that the applicant had identified and used pertinent engineering and licensing information to determine that, for the service water and emergency diesel generator (DG) and support systems, these systems' mechanical component types are required to be within the scope of license renewal. As part of the review process, the staff evaluated each system’s intended function identified for service water and the emergency DGs and support systems, evaluated the basis for inclusion of the intended function, and evaluated the process used to identify each of the system component types. The staff confirmed that the applicant identified and highlighted system piping and instrumentation drawings (P&IDs) to develop the license renewal boundaries, in accordance with the procedural guidance. Additionally, the staff determined that the applicant independently verified the results in accordance with the governing procedures. The staff confirmed that the applicant employed license renewal personnel that were knowledgeable about the system, that these personnel had performed independent reviews of the marked-up drawings to ensure accurate identification of system intended functions, and that the applicant had performed additional cross-discipline verification and independent reviews of the resultant highlighted drawings before final approval of the scoping effort.

2.1.4.5.3 Conclusion

On the basis of its review of the LRA and scoping implementing procedures, and the sampling system review of mechanical scoping results, the staff concluded that the applicant’s methodology for identifying mechanical SSCs within the scope of license renewal is in accordance with the requirements of 10 CFR 54.4 and, therefore, is acceptable.

2.1.4.6 Structural Scoping

2.1.4.6.1 Summary of Technical Information in the Application

LRA Section 2.1.1.4.2, "Structures," states that "the evaluation boundary of an in-scope structure is the structure itself and the structural commodities within that structure unless noted otherwise."

2.1.4.6.2 Staff Evaluation

The staff evaluated LRA Sections 2.1.1, 2.1.1.4 and 2.1.1.4.2 and the guidance in the implementing procedures and reports to perform the review of the structural scoping process. The project documents and reports provided instructions for identifying the evaluation boundaries. The staff reviewed the applicant's approach to identifying structures relied upon to perform the functions described in 10 CFR 54.4(a). As part of this review, the staff discussed the methodology with the applicant, reviewed the documentation developed to support the review, and evaluated—on a sampling basis—the scoping results for the turbine building that were identified within the scope of license renewal. The staff determined that the applicant identified and developed a list of plant structures and the structure's intended functions through a review of MEL, UFSAR, drawings, and walkdowns. Each structure the applicant identified was evaluated by the staff using the criteria of 10 CFR 54.4(a)(1), 10 CFR 54.4(a)(2), and 10 CFR 54.4(a)(3).

The staff reviewed selected portions of the MEL, CLB information, drawings, and implementing procedures to verify the adequacy of the applicant's methodology. The staff reviewed the applicant's methodology for identifying structures meeting the scoping criteria as defined by the Rule. The staff also reviewed the scoping methodology implementing procedures and discussed the methodology and results with the applicant. In addition, the staff reviewed, on a sampling basis, the applicant's scoping reports, including information contained in the source documentation, to verify that the application of the methodology would provide the results documented in the LRA.

The staff confirmed that the applicant identified and used pertinent engineering and licensing information to determine that the turbine building should be included within the scope of license renewal.

2.1.4.6.3 Conclusion

On the basis of its review of information in the LRA and scoping implementation procedures, and a sampling review of structural scoping results for the turbine building, the staff concluded that the applicant's methodology for identifying the structural SSCs within the scope of license renewal is in accordance with the requirements of 10 CFR 54.4 and, therefore, is acceptable.

2.1.4.7 Electrical Component Scoping

2.1.4.7.1 Summary of Technical Information in the Application

LRA Section 2.1.1.4.3, "Electrical and Instrumentation and Control Systems" states the following:

> The philosophy of electrical systems license renewal scoping is that all plant electrical commodity groups are included within the scope of license renewal. This approach does not prevent commodity groups or specific plant components from being eliminated from the license renewal scope during further review as the intended functions of commodity groups or specific components are examined.
>
> To aid in this process, each of the plant electrical and instrumentation and control (I&C) systems is evaluated to determine those that do not meet one or more of the criteria listed in 10 CFR 54.4 - that is, those systems that will be scoped out if the criteria are not met. This process requires a general knowledge of the plant's operation, its CLB, and plant-specific engineering evaluations.
>
> The scoping of electrical systems includes the Columbia plant electrical systems (e.g., electrical distribution), along with the I&C systems (e.g., Radiation Monitoring, Neutron Monitoring), and an evaluation of electrical components within mechanical systems required for a complete evaluation of the mechanical system.

2.1.4.7.2 Staff Evaluation

The staff evaluated LRA Sections 2.1.1, 2.1.1.4 and 2.1.1.4.3, and the guidance contained in the implementing procedures and reports, to review the electrical scoping process. The staff reviewed the applicant's approach to identifying electrical and I&C SSCs that are relied upon to perform the functions described in 10 CFR 54.4(a). The staff reviewed portions of the documentation used by the applicant to perform the electrical scoping process including the UFSAR, plant equipment list, CLB documentation, drawings, and specifications. As part of this review, the staff discussed the methodology with the applicant, reviewed the implementing procedures developed to support the review, and evaluated the scoping results for a sample of SSCs that were identified within the scope of license renewal. The staff determined that the applicant included electrical and instrument control components, including components contained in mechanical or structural systems, within the scope of license renewal on a commodity basis.

2.1.4.7.3 Conclusion

On the basis of its review of information contained in the LRA, scoping implementing procedures, scoping bases documents, and a sampling review of electrical scoping results, the staff concluded that the applicant's methodology for the scoping of electrical components within the scope of license renewal is in accordance with the requirements of 10 CFR 54.4, and therefore, is acceptable.

2.1.4.8 Scoping Methodology Conclusion

On the basis of its review of the LRA, implementing procedures, and a sampling review of scoping results, the staff concluded that the applicant's scoping methodology is consistent with the guidance contained in the SRP-LR. The staff also determined that the applicant identified those SSCs that are safety-related, whose failure could affect safety-related functions, and that are necessary to demonstrate compliance with the NRC's regulations for fire protection, EQ, ATWS, and SBO. The staff concluded that the applicant's methodology is consistent with the requirements of 10 CFR 54.4(a), and, therefore, is acceptable.

2.1.5 Screening Methodology

2.1.5.1 General Screening Methodology

2.1.5.1.1 Summary of Technical Information in the Application

LRA Section 2.1.2, "Screening Methodology," and its subsections describe the screening process that identifies the SCs within the scope of license renewal that are subject to an AMR. Section 2.1.2 states the following:

> Screening is the process for determining the structures and components that are subject to AMR. The requirement for screening is found in 10 CFR 54.21(a), which states:
>
> (1) For those systems, structures, and components within the scope of this part, as delineated in § 54.4, identify and list those structures and components subject to an aging management review. Structures and components subject to an aging management review shall encompass those structures and components—
>
> (i) That perform an intended function, as described in § 54.4, without moving parts or without a change in configuration or properties. These structures and components include, but are not limited to, the reactor vessel, the reactor coolant system pressure boundary, steam generators, the pressurizer, piping, pump casings, valve bodies, the core shroud, component supports, pressure retaining boundaries, heat exchangers, ventilation ducts, the containment, the containment liner, electrical and mechanical penetrations, equipment hatches, Seismic Category I structures, electrical cables and connections, cable trays, and electrical cabinets, excluding, but not limited to, pumps (except casing), valves (except body), motors, diesel generators, air compressors, snubbers, the control rod drive, ventilation dampers, pressure transmitters, pressure indicators, water level indicators, switchgears, cooling fans, transistors, batteries, breakers, relays, switches, power inverters, circuit boards, battery chargers, and power supplies; and
>
> (ii) That are not subject to replacement based on a qualified life or specified time period.
>
> (2) Describe and justify the methods used in paragraph (a)(1) of this section.
>
> (3) For each structure and component identified in paragraph (a)(1) of this section, demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation.
>
> NUREG-1800 and NEI 95-10, Appendix B are used as the basis for the identification of passive SCs. Most passive SCs are long-lived. Although the requirements for the IPA are the same for all systems and structures, in practice, the screening process differed for each of the mechanical, structural, and electrical disciplines. The screening process for each discipline meets the requirements of 10 CFR 54.21(a).

2.1.5.1.2 Staff Evaluation

Pursuant to 10 CFR 54.21, each LRA must contain an IPA that identifies SCs within the scope of license renewal that are subject to an AMR. The IPA must identify components that perform an intended function without moving parts or a change in configuration or properties (passive) as well as components that are not subject to periodic replacement based on a qualified life or specified time period (long-lived). In addition, the IPA must include a description and justification of the methodology used to determine the passive and long-lived SCs and a demonstration that the effects of aging on those SCs will be adequately managed so that the intended function(s) will be maintained under all design conditions imposed by the plant-specific CLB for the period of extended operation.

The staff reviewed the methodology used by the applicant to identify the mechanical and SCs and electrical commodity groups within the scope of license renewal that should be subject to an AMR. The applicant implemented a process for determining which SCs were subject to an AMR in accordance with the requirements of 10 CFR 54.21(a)(1). In LRA Section 2.1.2, the applicant discusses these screening activities as it relates to the component types and commodity groups within the scope of license renewal.

The staff determined that the screening process evaluated the component types and commodity groups, included within the scope of license renewal, to determine which ones were long-lived and passive and, therefore, subject to an AMR. The staff reviewed LRA Section 2.3, “Scoping and Screening Results: Mechanical Systems,” LRA Section 2.4, “Scoping and Screening Results: Structures,” and LRA Section 2.5, “Scoping and Screening Results: Electrical and Instrumentation and Control Systems.” These sections of the LRA provided the results of the process used to identify component types and commodity groups subject to an AMR. The staff also reviewed, on a sampling basis, the screening results reports, the service water and emergency DGs and support systems, and the turbine building.

The applicant provided the staff with a detailed discussion of the processes used for each discipline and provided administrative documentation that described the screening methodology. Specific methodology for mechanical, electrical, and structural are discussed in SER Sections 2.1.5.2, 2.1.5.3, and 2.1.5.4, respectively.

2.1.5.1.3 Conclusion

On the basis of a review of the LRA, the implementing procedures, and a sampling of screening results, the staff concluded that the applicant's screening methodology is consistent with the guidance contained in the SRP-LR and is capable of identifying passive, long-lived components in-scope of license renewal that are subject to an AMR. The staff concluded that the applicant’s process for determining which component types and commodity groups are subject to an AMR is consistent with the requirements of 10 CFR 54.21 and is, therefore, acceptable.

2.1.5.2 Mechanical Component Screening

2.1.5.2.1 Summary of Technical Information in the Application

LRA Section 2.1.2.1 and subsections state that “for each mechanical system within the scope of license renewal, the screening process identifies those components that are subject to AMR.”

LRA Section 2.1.2.1.1, “Identifying Mechanical Components Subject to Aging Management Review,” states the following:

Within the evaluation boundaries, all passive, long-lived mechanical components that perform or support a system-intended function are subject to AMR.

In making the determination that a component is passive (i.e., the component intended function is performed without moving parts or a change in configuration or properties), it is not necessary to consider the piece parts of the component. For example, in the case of pumps, valves, fans and dampers, the pump casings, valve bodies, and fan and damper housings may perform the component intended function of maintaining system pressure boundary integrity, and therefore, would be subject to AMR, whereas the pump impeller, valve discs and stems, fan blades, and damper blades are moving parts and not subject to AMR. A list of typical passive components is contained in NEI 95-10, Appendix B.

A determination is made as to whether a component is long-lived or short-lived (i.e., subject to replacement based on a qualified life or specified time period). Long-lived components are subject to AMR. Components that are short-lived and subject to replacement programs are excluded from AMR. Replacement programs may be based on vendor recommendations, plant experience, or any means that establishes a specific service life, qualified life or replacement frequency under a controlled program. The specific replacement program for a component must be identified in order to exclude it from AMR. Components subject to refurbishment or replacement solely on the basis of condition (e.g., the component is replaced only if significant degradation is observed during a periodic inspection) are long-lived and require an AMR. Consumables are addressed in the process for determining components subject to AMR. Consumables are, by definition, not long-lived components and include such items as packing, gaskets, component seals, o-rings, oil, grease, component filters, system filters, fire extinguishers, fire hoses, and air packs. The guidance provided in Table 4.1-2 of NEI 95-10 is used to disposition consumables for Columbia (refer to [LRA] Section 2.1.2.4).

<u>Grouping of Mechanical Components into Component Types</u>

In order to streamline the AMR process, most of the mechanical components that are subject to AMR are grouped into component types with similar characteristics. For example, it is not necessary to perform the AMR on each and every valve within the system evaluation boundaries. Rather, the valves are grouped together according to their materials of fabrication or construction and the environment to which they are exposed. In this way, the AMR is conducted once for carbon steel exposed to raw water, for example, and the results are applied to all carbon steel valves within the system evaluation boundaries that are exposed to raw water.

Components and component types within the system evaluation boundaries are reviewed against the list contained in NEI 95-10, Appendix B, and those that are both passive and long-lived are identified as subject to AMR. Typically, major plant components such as pumps, tanks, and heat exchangers that may have unique design features or functions are identified separately, and may include a component identification number; whereas others (piping, valves, instrumentation, etc.) are grouped by component type.

LRA Section 2.1.2.1.2, “Mechanical Component Intended Functions,” states the following:

> Mechanical components are evaluated to determine their intended functions. The component intended function is the component-level function, such as “maintain pressure boundary integrity,” that supports the system-level function, such as “provide core cooling flow.” The primary component intended function performed by mechanical components is to maintain pressure boundary integrity. For systems with heat exchangers, the function of heat transfer may also be performed. A limited number of components may have secondary functions such as filtration, flow control, spray, or throttling.

2.1.5.2.2 Staff Evaluation

The staff reviewed the mechanical screening methodology discussed and documented in LRA Sections 2.1.2 and its subsections, the implementing procedures, the scoping and screening reports, and the license renewal drawings. The staff determined that the mechanical system screening process began with the results from the scoping process, and the applicant reviewed each system evaluation boundary as depicted on the P&IDs to identify passive and long-lived components. Additionally, the staff determined that the applicant identified all passive and long-lived components that perform or support an intended function within the system evaluation boundaries and determined those components to be subject to an AMR. The results of the review were documented in the scoping and screening reports, which contain information such as the information sources reviewed and the component intended functions.

The staff verified that mechanical system evaluation boundaries were established for each system within the scope of license renewal and that the boundaries were determined by mapping the system intended function boundary onto P&IDs. The staff confirmed that the applicant reviewed the components within the system intended function boundary to determine if the component supported the system intended function, and those components that supported the system intended function were reviewed to determine if the component was passive and long-lived and, therefore, subject to an AMR.

The staff reviewed selected portions of the UFSAR, plant equipment list, CLB documentation, Columbia databases and documents, procedures, drawings, specifications, and selected scoping and screening reports. The staff conducted detailed discussions with the applicant’s license renewal team and reviewed documentation pertinent to the screening process. The staff also performed a walkdown of portions of the selected systems with plant engineers to verify documentation. The staff assessed whether or not the mechanical screening methodology outlined in the LRA and procedures was appropriately implemented and if the scoping results were consistent with CLB requirements. During the scoping and screening methodology audit, the staff discussed the screening methodology with the applicant and, on a sampling basis, reviewed the applicant’s screening reports for the service water and the emergency DGs and support system to verify proper implementation of the screening process. Based on these audit activities, the staff did not identify any discrepancies between the methodology documented and the implementation results.

2.1.5.2.3 Conclusion

On the basis of its review of the LRA, screening implementation procedures, selected portions of the UFSAR, MEL, CLB documentation, procedures, drawings, specifications and selected scoping and screening reports, and a sample of the service water and the emergency DGs and support systems, the staff concluded that the applicant’s methodology for identification of mechanical components within the scope of license renewal and subject to an AMR is in accordance with the requirements of 10 CFR 54.21(a)(1), and therefore, is acceptable.

2.1.5.3 Structural Component Screening

2.1.5.3.1 Summary of Technical Information in the Application

LRA Section 2.1.2.2, "Screening of Structures," states that "for each structure or building within the scope of license renewal, the screening process identifies those structural components and commodities that are subject to AMR. [LRA] Section 2.4 presents the results for structures."

LRA Section 2.1.2.2.1, "Identifying Structural Components Subject to Aging Management Review," states the following:

> In accordance with the License Renewal Rule, an in-scope structure (i.e., Auxiliary Building) contains inherently passive long-lived structural components and commodities. Those structural components and commodities that perform an intended function are identified as subject to AMR.
>
> The screening process for structural components and commodities involves review of design and licensing basis documents (design basis documents, drawings, UFSAR, etc.) to identify specific structural components and commodities that make up the structure. Structural components and commodities typically have no unique identifiers like those given to mechanical components and are therefore categorized into groups.
>
> Structural components and commodities are categorized by commodity groups based on materials of construction. Once the structural commodity groups are identified within an in-scope structure or building (e.g., steel, concrete, fire barriers, elastomers), subdividing the commodity groups into discrete structural component types based on design (e.g., walls, floors and ceiling, fire doors, flood curbs, equipment supports, penetrations, foundations, personnel airlocks) is useful because the same component types may have different intended functions based on their application.
>
> <u>Grouping of Structural Components into Commodity Groups</u>
>
> Structural components and commodities that are attached to a structure or reside within a structure are categorized as: (1) component supports, or (2) other structural members.
>
> The evaluation boundaries for mechanical component supports are established in accordance with rules governing inspection of component supports (i.e., ASME Section XI, Subsection IWF). Component support examination boundaries for integral and non-integral (i.e., mechanically attached) supports are defined in article IWF-1300, Figure IWF-1300-1. In general, the support boundary extends to the surface of the building structure, but does not include the building structure. Furthermore, the support boundary extends to include non-integral attachments to piping and equipment, but excludes integral attachments to the same. Component support evaluation boundaries for non ASME in-scope components include the structural component and the associated attachment to the building structure (e.g., structural component supports for HVAC ducts include HVAC duct support members, baseplate and anchorage).

> Supports for electrical components include cable trays and conduit supports, electrical panels, racks, cabinets and other enclosures. The evaluation boundary for these items includes all supporting elements including mechanical or integral attachments to the building structure.
>
> Evaluation boundaries for other structural members that function to carry dynamic loads caused by postulated design basis events are consistent with the method for establishing boundaries for supports specified above. That is, the boundary includes the structural component and the associated attachment to the building structure. The portion of the attachment embedded in the building structure is part of the structure.

LRA Section 2.1.2.2.2, "Structural Commodity Intended Functions," states that "structural components and commodities are evaluated to determine their intended functions. The intended functions for structural commodities are based on guidance provided in NEI 95-10 and related industry documents for license renewal. Table 2.0-1 provides definitions of intended functions identified in this application, including those used for structural commodities."

2.1.5.3.2 Staff Evaluation

The staff reviewed the structural screening methodology discussed and documented in LRA Sections 2.1.2.2 and its subsections, the implementing procedures, the scoping and screening reports, and the license renewal structures drawing. The staff reviewed the applicant's methodology for identifying SCs that are subject to an AMR as required in 10CFR 54.21(a)(1). The staff confirmed that the applicant reviewed the structures included within the scope of license renewal and identified the passive, long-lived components with component-level intended functions and determined those components to be subject to an AMR.

The staff reviewed selected portions of the UFSAR, design and licensing basis, which the applicant used to perform the structural scoping and screening. The staff also reviewed screening activities, on a sampling basis, that documented the SCs within the scope of license renewal. The staff conducted discussions with the applicant's license renewal team and reviewed documentation pertinent to the screening process to assess whether the screening methodology outlined in the LRA and implementing procedures were appropriately implemented and if the scoping results were consistent with CLB requirements.

During the scoping and screening methodology audit, the staff reviewed, on a sampling basis, the applicant's screening reports related to the turbine building to verify proper implementation of the screening process. Based on these onsite review activities, the staff did not identify any discrepancies between the methodology documented and the implementation results.

2.1.5.3.3 Conclusion

On the basis of its review of information contained in the LRA, implementing procedures, the plant equipment database, and a sampling of screening results, the staff concluded that the applicant's methodology for identification of SCs within the scope of license renewal and subject to an AMR is in accordance with the requirements of 10 CFR 54.21(a)(1) and, therefore, is acceptable.

2.1.5.4 Electrical Component Screening

2.1.5.4.1 Summary of Technical Information in the Application

LRA Section 2.1.2.3, "Screening of Electrical and Instrumentation and Control Systems," states that "for each electrical system within the scope of license renewal, the screening process identifies those electrical components and commodities that are subject to AMR. Electrical components in mechanical systems that are within the scope of license renewal are addressed under the electrical screening process. Section 2.5 presents the results for electrical systems."

LRA Section 2.1.2.3.1, "Identifying Electrical Commodities Subject to Aging Management Review," states the following:

> The electrical components and commodity types identified at Columbia are evaluated to determine if they are subject to AMR and to determine the materials of construction and the service conditions (the operating environments) of the equipment. The basic philosophy of the electrical component IPA process is that all electrical components are subject to an AMR unless they are scoped out at the system level or are screened out at the component level (by commodity group or by specific component). Based on the guidance of NEI 95-10, Appendix B, the electrical components are grouped by component type and are evaluated in their respective commodity groups. The commodity groups are segregated into those which are active (by function) and those which are passive (by function). Per the criteria of 10 CFR 54.21(a)(1)(i), only passive components are subject to AMR; therefore, active components are excluded from AMR. The electrical screening process also sets aside the components that are subject to replacement based on a qualified life or specified time period (such as those within the Columbia environmental qualification program) as allowed by 10 CFR 54.21(a)(1)(ii). The remaining electrical components (i.e., commodity groups) are subject to AMR.

LRA Section 2.1.2.3.2, "Electrical Commodity Intended Functions," states that "electrical commodities are evaluated to determine their intended functions. The intended functions for electrical commodities are based on guidance provided in NEI 95-10."

2.1.5.4.2 Staff Evaluation

The staff reviewed the applicant's methodology used for electrical component screening in LRA Sections 2.1.2.3 and 2.5, "Scoping and Screening Results: Electrical and Instrumentation and Control Systems," the applicant's implementing procedures, bases documents, and electrical AMR reports. The staff confirmed that the applicant used the screening process described in these documents, along with the information contained in NEI 95-10 Appendix B and the SRP-LR, to identify the electrical and I&C components subject to an AMR.

The staff determined that the applicant identified commodity groups that met the passive criteria outlined in NEI 95-10. In addition, the staff determined that the applicant evaluated and identified the passive commodities to determine whether they were subject to replacement based on a qualified life or specified time period (short-lived) or not subject to replacement based on a qualified life or specified time period (long-lived); the remaining passive, long-lived components were determined to be subject to an AMR.

The staff performed a review to determine if the screening methodology outlined in the LRA and implementing procedures were appropriately implemented and if the scoping results were consistent with CLB requirements. During the scoping and screening methodology audit, the staff reviewed selected screening reports and discussed the reports with the applicant to verify proper implementation of the screening process. Based on these onsite review activities, the staff did not identify any discrepancies between the methodology documented and the implementation results.

2.1.5.4.3 Conclusion

On the basis of its review of the LRA, screening implementation procedures, selected portions of the UFSAR, MEL, CLB documentation, procedures, drawings, specifications, selected scoping and screening reports, discussion with the applicant, and a sample of the results of the screening methodology, the staff concluded that the applicant’s methodology for identification of electrical components within the scope of license renewal and subject to an AMR is in accordance with the requirements of 10 CFR 54.21(a)(1) and, therefore, is acceptable.

2.1.5.5 Screening Methodology Conclusion

On the basis of its review of the LRA, screening implementing procedures, discussions with the applicant’s staff, and a sample review of screening results, the staff concluded that the applicant's screening methodology is consistent with the guidance contained in the SRP-LR and identified those passive, long-lived components within the scope of license renewal that are subject to an AMR. The staff concluded that the applicant's methodology is consistent with the requirements of 10 CFR 54.21(a)(1) and, therefore, is acceptable.

2.1.6 Summary of Evaluation Findings

On the basis of its review of the information presented in LRA Section 2.1, the supporting information in the scoping and screening implementing procedures and reports, the information presented during the scoping and screening methodology audit, discussions with the applicant, sample system reviews, and the applicant's responses to the staff's RAIs, dated July 16, 2010, the staff confirms that the applicant’s scoping and screening methodology is consistent with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1). The staff also concluded that the applicant’s description and justification of its scoping and screening methodology are adequate to meet the requirements of 10 CFR 54.21(a)(1). From this review, the staff concluded that the applicant’s methodology for identifying systems and structures within the scope of license renewal and SCs requiring an AMR is acceptable.

2.2 Plant-Level Scoping Results

2.2.1 Introduction

LRA Section 2.1 describes the methodology for identifying systems and structures within the scope of license renewal. In LRA Section 2.2, the applicant used the scoping methodology to determine which systems and structures must be included within the scope of license renewal.

2.2.2 Summary of Technical Information in the Application

The staff reviewed the plant-level scoping results to determine if the applicant has properly identified the following groups:

- safety-related SSCs that are those relied upon to remain functional during and following DBEs, as required by 10 CFR 54.4(a)(1)
- all nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of any safety-related functions, as required by 10 CFR 54.4(a)(2)
- all SSCs relied on in safety analyses of plant evaluations to perform a function that demonstrates compliance with the NRC regulations for fire protection, pressurized thermal shock, ATWS, and SBO, as required by 10 CFR 54.4(a)(3)

LRA Table 2.2-1 lists those mechanical systems, electrical and I&C systems, and structures that are within the scope of license renewal. Also in LRA Table 2.2-1, the applicant listed the systems and structures that do not meet the criteria specified in 10 CFR 54.4(a) and are excluded from the scope of license renewal. Based on the DBEs considered in the CLB, other CLB information relating to nonsafety-related systems and structures, and certain regulated events, the applicant identified plant-level systems and structures within the scope of license renewal, as defined by 10 CFR 54.4.

2.2.3 Staff Evaluation

In LRA Section 2.1, the applicant described its methodology for identifying systems and structures within the scope of license renewal and subject to an AMR. The staff reviewed the scoping and screening methodology and provided its evaluation in SER Section 2.1. To verify that the applicant properly implemented its methodology, the staff's review focused on the implementation results shown in LRA Tables 2.2-1, 2.2-2, and 2.2-3 to confirm that there were no omissions of plant-level systems and structures within the scope of license renewal.

The staff determined whether the applicant properly identified the systems and structures within the scope of license renewal in accordance with 10 CFR 54.4. The staff reviewed selected systems and structures that the applicant did not identify as within the scope of license renewal to verify if the systems and structures have any intended functions requiring their inclusion within the scope of license renewal. The staff's review of the applicant's implementation was conducted in accordance with the guidance in SRP-LR Section 2.2, "Plant-Level Scoping Results."

The staff's review of LRA Section 2.2 identified an area where additional information was necessary to complete the review of the applicant's scoping and screening results. The applicant responded to the staff's RAI as discussed below.

In RAI 2.2-01, dated July 15, 2010, the staff noted the UFSAR systems shown in SER Table 2.2-1 could not be located in LRA Tables 2.2-1 or 2.2-2.

Table 2.2-1 UFSAR Systems

UFSAR Section	System
8.3.1.1.4, 120/208-Volt Non-Class 1E Instrumentation Power System	120/208-Volt Non-Class 1E Instrumentation Power System
9.1.4 Fuel Handling System	Fuel Handling System
9.5.3 Plant Lighting System	Plant Lighting System
11.2–11.4 Radwaste (Liquid, Gaseous & Solid Radwaste)	Radwaste (Liquid, Gaseous & Solid Radwaste)

11.6 Post-Accident Sampling System	Post-Accident Sampling System

The applicant was asked to provide additional information to describe how the above systems were scoped for license renewal. In its response, by letter dated September 15, 2010, the applicant explained the following:

- The 120/208 volt non-class 1E system is part of the 120 VAC electrical distribution.
- The fuel handling system is addressed in LRA Section 2.4.2, “Reactor Building Structure.”
- The plant lighting system consists of normal lighting and emergency lighting. Emergency lighting is addressed in LRA Table 2.2-2. LRA Table 2.2-2 was amended to add normal lighting.
- The radwaste systems (liquid, gaseous, and solid) are shown in LRA Table 2.2-1 but are identified by their specific system names rather than being generically identified.
- The post-accident sampling system is addressed in LRA Section 2.3.34 and LRA Table 2.2-1, as part of the process sampling radioactive (PSR) system.

Based on its review, the staff finds the applicant’s response to RAI 2.2-01 acceptable because the applicant described where to locate the systems in question and revised Table 2.2-2 to include the normal lighting system. Therefore, the staff’s concern described in RAI 2.2-01 is resolved.

2.2.4 Conclusion

The staff reviewed LRA Section 2.2, the RAI response, and the UFSAR supporting information to determine if the applicant failed to identify any systems and structures within the scope of license renewal. On the basis of its review, the staff concluded that the applicant appropriately identified the systems and structures within the scope of license renewal, in accordance with 10 CFR 54.4.

2.3 Scoping and Screening Results: Mechanical Systems

This section documents the staff’s review of the applicant’s scoping and screening results for mechanical systems. Specifically, this section discusses the following:

- reactor vessel, internals, and the reactor coolant system
- ESFs
- auxiliary systems
- steam and power conversion systems

In accordance with the requirements of 10 CFR 54.21(a)(1), the applicant must list passive, long-lived SCs within the scope of license renewal and subject to an AMR. To verify that the applicant properly implemented its methodology, the staff’s review focused on the implementation results. This focus allowed the staff to verify that the applicant identified the mechanical system SCs that met the scoping criteria and were subject to an AMR, confirming that there were no omissions.

The staff's evaluation of mechanical systems was performed using the evaluation methodology described in SRP-LR Section 2.3 and took into account (where applicable) the system function(s) described in the UFSAR. The objective was to determine if the applicant identified, in accordance with 10 CFR 54.4, components and supporting structures for mechanical systems that meet the license renewal scoping criteria. Similarly, the staff evaluated the applicant's screening results to verify that all passive, long-lived components are subject to an AMR, as required by 10 CFR 54.21(a)(1).

In its scoping evaluation, the staff reviewed the LRA, applicable sections of the UFSAR, license renewal boundary drawings, and other licensing basis documents, as appropriate, for each mechanical system within the scope of license renewal. The staff reviewed relevant licensing basis documents for each mechanical system to confirm that the LRA specified all intended functions defined by 10 CFR 54.4(a). The review then focused on identifying any components, with intended functions defined by 10 CFR 54.4(a), that the applicant may have omitted from the scope of license renewal.

After reviewing the scoping results, the staff evaluated the applicant's screening results. For those SCs with intended functions delineated under 10 CFR 54.4(a), the staff verified the applicant properly screened out only SCs that have functions performed with moving parts or a change in configuration or properties or SCs that are subject to replacement after a qualified life or specified time period, as described in 10 CFR 54.21(a)(1). For SCs not meeting either of these criteria, the staff confirmed the remaining SCs received an AMR, as required by 10 CFR 54.21(a)(1).

The staff evaluation of the mechanical system scoping and screening results applies to all mechanical systems reviewed. Those systems that required RAIs to be generated include an additional staff evaluation which specifically addresses the applicant's responses to the RAI(s).

2.3.1 Reactor Vessel, Internals, and Reactor Coolant Pressure Boundary

LRA Section 2.3.1 describes the reactor vessel, internals, and reactor coolant pressure boundary SCs subject to an AMR for license renewal. The applicant described the supporting SCs of the reactor vessel, internals, and reactor coolant pressure boundary in the following LRA sections:

- LRA Section 2.3.1.1, "Reactor Pressure Vessel"
- LRA Section 2.3.1.2, "Reactor Vessel Internals"
- LRA Section 2.3.1.3, "Reactor Coolant Pressure Boundary"

2.3.1.1 Reactor Pressure Vessel

2.3.1.1.1 Summary of Technical Information in the Application

The reactor pressure vessel (RPV) is a vertical, cylindrical pressure vessel of welded construction designed by GE. The RPV has a cylindrical shell, bottom head, and upper head. Both the upper head and upper shell have a forged flange welded to them for vessel closure. The upper head is secured to the RPV by studs, nuts, and washers. The RPV vessel flanges are sealed by two concentric rings designed to prevent leakage through the inner or outer seal at any operating condition.

The intended functions of the RPV, within the scope of license renewal, include the following:

- maintain reactor coolant pressure boundary
- provide a barrier to radiation release
- contain and support the reactor core, internals, and coolant moderator
- provide a floodable volume in which the core can be adequately cooled in the event of a breach in the reactor coolant pressure boundary

The RPV evaluation boundary consists of the following components:

- vessel shell
- heads
- closure flanges
- vessel closure bolting
- nozzles
- safe ends
- safe end extensions
- nozzle caps
- nozzle flanges (including blank flanges)
- thermal sleeves
- incore penetrations (housings)
- internal attachments (including shroud support, jet pump riser support pads, core spray brackets, steam dryer holddown brackets, guide rod brackets, surveillance specimen brackets, steam dryer support brackets, and feedwater sparger brackets)
- stabilizer brackets
- support skirt and bearing plate
- control rod drive (CRD) stub tubes and housings
- associated pressure boundary bolting

LRA Table 2.3.1-1 lists the component types that require AMR and their intended functions.

2.3.1.1.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA and UFSAR, the staff concluded that the applicant appropriately identified the RPV components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the RPV components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.1.2 Reactor Vessel Internals

2.3.1.2.1 Summary of Technical Information in the Application

The reactor vessel internal components include the following:

- core (including fuel assemblies, and control rod assemblies, control rod guide thermal sleeves, guide rods, incore dry tubes, incore guide tubes)
- core support structure (control rode guide tubes, core plate and holddown bolts, fuel supports, shroud, shroud support, and top guide)
- core spray lines and spargers
- differential pressure line
- feedwater spargers
- jet pump assemblies and instrumentation
- low-pressure coolant injection (LPCI) couplings
- steam dryer
- shroud head and steam separator assembly
- surveillance sample holders
- vessel head spray line

The intended functions of the reactor vessel internals, within the scope of license renewal, include the following:

- maintain reactor coolant pressure boundary
- contain and support the reactor core, internals, and coolant moderator
- provide a floodable volume in which the core can be adequately cooled in the event of a breach in the reactor coolant pressure boundary
- maintain core geometry to ensure control rods and emergency core cooling systems (ECCSs) can perform their safety functions
- provide active nuclear fuel and cladding
- provide emergency reactor shutdown capability

The reactor vessel internals evaluation boundary includes the core support subcomponents and other reactor vessel internal components.

LRA Table 2.3.1-2 lists the component types that require AMR and their intended functions.

2.3.1.2.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA and UFSAR, the staff concluded that the applicant appropriately identified the reactor vessel internal components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the reactor vessel internal components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.1.3 Reactor Coolant Pressure Boundary

2.3.1.3.1 Summary of Technical Information in the Application

The reactor coolant pressure boundary consists of those systems and components that contain or transport fluids coming from, or going to, the reactor core. The reactor recirculation system provides coolant flow through the core. The reactor recirculation system consists of the two recirculation pump loops external to the reactor vessel. Each external loop contains one motor-driven recirculation pump and provides the piping path to the reactor vessel jet pumps. The reactor recirculation system is mainly within the primary containment; however, the system has instrumentation lines that penetrate containment, with tubing, valves, and transmitters in the reactor building outside the primary containment.

The intended functions of the reactor coolant pressure boundary, within the scope of license renewal, include the following:

- maintain integrity of reactor coolant pressure boundary
- provide isolation and integrity of primary containment
- provide capability to trip recirculation pumps

LRA Table 2.3.1-3 lists the component types that require AMR and their intended functions.

2.3.1.3.2 Conclusion

The staff reviewed the LRA and UFSAR to determine if the applicant failed to identify any SSCs within the scope of license renewal. The staff finds no such omissions. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. The staff finds no such omissions. On the basis of its review, the staff concluded that the applicant appropriately identified the reactor coolant pressure boundary components within the scope of license renewal as required by 10 CFR 54.4(a) and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.2 Engineered Safety Features

LRA Section 2.3.2 describes the ESFs system SCs subject to an AMR for license renewal. The applicant described the supporting SCs of the ESFs system in the following LRA sections:

- LRA Section 2.3.2.1, "Residual Heat Removal System"
- LRA Section 2.3.2.2, "Reactor Core Isolation Cooling System"
- LRA Section 2.3.2.3, "High-Pressure Core Spray System"
- LRA Section 2.3.2.4, "Low-Pressure Core Spray System"
- LRA Section 2.3.2.5, "Standby Gas Treatment System"

2.3.2.1 Residual Heat Removal System

2.3.2.1.1 Summary of Technical Information in the Application

The residual heat removal (RHR) system is a three-loop system. Each loop has its own motor-driven pump, piping, valves, instrumentation, controls, and a suction source from the suppression pool, and each loop is capable of discharging water to the RPV or back to the suppression pool. In addition, loops A and B have heat exchangers, the ability to take suction from the reactor recirculation system suction, and connections to the RCIC system steam line. The standby service water (SW) systems cool the heat exchangers. Loops A and B can also discharge to reactor recirculation discharge or to the suppression pool and drywell spray spargers.

A spool piece is permanently installed on the shutdown cooling piping to connect to the fuel pool cooling system so that RHR can provide assistance to cooling the fuel pool.

The RHR system has seven modes of operation:

(1) low pressure coolant injection (LPCI)
(2) suppression pool cooling
(3) containment spray (CS)
(4) shutdown cooling
(5) alternate shutdown cooling
(6) fuel pool cooling
(7) reactor steam condensing mode (has been deactivated)

The intended functions of the RHR system, within the scope of license renewal, include the following:

- restore and maintain coolant inventory in the reactor vessel so that the core is adequately cooled following a design basis loss-of-coolant accident (LOCA) (LPCI Mode)
- provide primary containment isolation and integrity
- maintain reactor coolant pressure boundary integrity
- maintain suppression pool temperature below that required to condense steam after a LOCA (suppression pool cooling mode)
- maintain the RHR pump discharge piping filled with water

LRA Table 2.3.2-1 lists the component types that require AMR and their intended functions.

2.3.2.1.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA and UFSAR, the staff concluded that the applicant appropriately identified the RHR system boundary components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the RHR system boundary components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.2.2 Reactor Core Isolation Cooling System

2.3.2.2.1 Summary of Technical Information in the Application

The reactor core isolation cooling (RCIC) system consists of a turbine, pump, piping, valves, accessories, and instrumentation capable of delivering makeup water to the RPV to maintain sufficient reactor water inventory and adequate core cooling. The RCIC is automatically initiated at a predetermined low reactor water level. The RCIC turbine is driven with a portion of the decay heat steam from the reactor and exhausts to the suppression pool.

During normal modes of operation, the turbine-driven pump takes suction from the condensate storage tank (CST) and injects makeup water into the RPV. There is an automatic suction source switchover to the suppression pool when the CST is exhausted.

The RCIC system is not credited in the UFSAR, Section 6 or Section 15 accident analysis, and it is not an ECCS or ESF system. It is designed to mitigate low reactor water level events and, therefore, included with the ECCS and ESF systems because of the similar purpose.

The intended functions of the RCIC system, within the scope of license renewal, include the following:

- supply water to the RPV when the vessel is isolated
- provide primary containment isolation and integrity
- maintain reactor coolant pressure boundary integrity

LRA Table 2.3.2-2 lists the component types that require AMR and their intended functions.

2.3.2.2.2 Conclusion

The staff reviewed the LRA and UFSAR to determine if the applicant failed to identify any SSCs within the scope of license renewal. The staff finds no such omissions. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. The staff finds no such omissions. On the basis of its review, the staff concluded that the applicant appropriately identified the RCIC system boundary components within the scope of license renewal as required by 10 CFR 54.4(a) and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.2.3 High-Pressure Core Spray System

2.3.2.3.1 Summary of Technical Information in the Application

The high-pressure core spray (HPCS) system is designed to pump water into the RPV over a wide range of pressures. The HPCS system consists of a motor-driven centrifugal pump, a spray sparger in the reactor vessel located above the core (separate from the LPCS sparger), and associated system piping, valves, controls, and instrumentation. The HPCS system normally takes suction from the CST, but it can also take suction from the suppression pool. The HPCS pump is located sufficiently below both suction sources to provide flooded pump suction and to meet net positive suction head (NPSH) requirements.

The intended functions of the HPCS system, within the scope of license renewal, include the following:

- provide core cooling by restoring and maintaining reactor coolant level following DBEs
- provide primary containment isolation and integrity
- maintain reactor coolant pressure boundary integrity

LRA Table 2.3.2-3 lists the component types that require AMR and their intended functions.

2.3.2.3.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA and UFSAR, the staff concluded that the applicant appropriately identified the HPCS system boundary components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the HPCS system boundary components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.2.4 Low-Pressure Core Spray System

2.3.2.4.1 Summary of Technical Information in the Application

The low-pressure core spray (LPCS) system is designed to provide cooling to the reactor core only when the reactor vessel pressure is low, as is the case for large LOCA break sizes. The LPCS system consists of a motor-driven centrifugal pump, a spray sparger in the reactor vessel above the core (separate from the HPCS sparger), piping and valves to convey water from the suppression pool to the sparger, and associated controls and instrumentation. However, when LPCS operates in conjunction with the automatic depressurization system (ADS), the effective core cooling capability of the LPCS system is extended to all break sizes because the ADS can rapidly reduce the reactor vessel pressure to the LPCS operating range.

The LPCS system takes suction from the suppression pool. The LPCS pump is located sufficiently below the water level in the suppression pool to ensure flooded pump suction and to meet the NPSH requirements.

The intended functions of the LPCS system within the scope of license renewal include the following:

- provide emergency core cooling
- provide primary containment isolation and integrity
- maintain reactor coolant pressure boundary integrity

LRA Table 2.3.2-4 lists the component types that require AMR and their intended functions.

2.3.2.4.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA and UFSAR, the staff concluded that the applicant appropriately identified the LPCS system boundary components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the LPCS system boundary components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.2.5 Standby Gas Treatment System

2.3.2.5.1 Summary of Technical Information in the Application

The standby gas treatment (SGT) system is designed to maintain airborne radioactive release from the secondary containment to the atmosphere within the limits required by 10 CFR 50.67. The system is designed to enable purging of the primary containment through the SGT system filters when airborne radiation levels inside the primary containment are too high to permit direct purging to atmosphere by means of the reactor building exhaust system.

2.3.2.5.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR and drawings, the staff concluded that the applicant appropriately identified the SGT system components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the SGT system components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3 Auxiliary Systems

LRA Section 2.3.3 identifies the auxiliary system SCs subject to an AMR for license renewal. The applicant described the supporting SCs of the auxiliary systems in the following LRA sections:

- LRA Section 2.3.3.1, “Circulating Water System”
- LRA Section 2.3.3.2, “Condensate Processing Radioactive (Demineralizer) System”
- LRA Section 2.3.3.3, “Containment Atmosphere Control System”
- LRA Section 2.3.3.4, “Containment Exhaust Purge and Containment Supply Purge Systems”
- LRA Section 2.3.3.5, “Containment Instrument Air System”
- LRA Section 2.3.3.6, “Containment Monitoring System”
- LRA Section 2.3.3.7, “Containment Nitrogen System”
- LRA Section 2.3.3.8, “Containment Return Air System”
- LRA Section 2.3.3.9, “Containment Vacuum Breaker System”
- LRA Section 2.3.3.10, “Control Air System”
- LRA Section 2.3.3.11, “Control Rod Drive System”
- LRA Section 2.3.3.12, “Control Room Chilled Water System”
- LRA Section 2.3.3.13, “Demineralized Water System”
- LRA Section 2.3.3.14, “Diesel Building HVAC System”
- LRA Section 2.3.3.15, “Diesel Cooling Water System”
- LRA Section 2.3.3.16, “Diesel (Engine) Exhaust System”
- LRA Section 2.3.3.17, “Diesel Engine Starting Air System”

- LRA Section 2.3.3.18, "Diesel Fuel Oil System"
- LRA Section 2.3.3.19, "Diesel Generator System"
- LRA Section 2.3.3.20, "Diesel Lubricating Oil System"
- LRA Section 2.3.3.21, "Equipment Drains Radioactive System"
- LRA Section 2.3.3.22, "Fire Protection System"
- LRA Section 2.3.3.23, "Floor Drains System"
- LRA Section 2.3.3.24, "Floor Drain Radioactive System"
- LRA Section 2.3.3.25, "Fuel Pool Cooling System"
- LRA Section 2.3.3.26, "Leak Detection System"
- LRA Section 2.3.3.27, "Miscellaneous Waste Radioactive System"
- LRA Section 2.3.3.28, "Plant Sanitary Drains Systems"
- LRA Section 2.3.3.29, "Plant Service Water Systems"
- LRA Section 2.3.3.30, "Potable Cold Water System"
- LRA Section 2.3.3.31, "Potable Hot Water System"
- LRA Section 2.3.3.32, "Primary Containment System"
- LRA Section 2.3.3.33, "Process Sampling System"
- LRA Section 2.3.3.34, "Process Sampling Radioactive System"
- LRA Section 2.3.3.35, "Pump House HVAC System"
- LRA Section 2.3.3.36, "Radwaste Building Chilled Water System"
- LRA Section 2.3.3.37, "Radwaste Building HVAC System"
- LRA Section 2.3.3.38, "Reactor Building HVAC System"
- LRA Section 2.3.3.39, "Reactor Closed Cooling Water System"
- LRA Section 2.3.3.40, "Reactor Protection System"
- LRA Section 2.3.3.41, "Reactor Water Cleanup System"
- LRA Section 2.3.3.42, "Service Air System"
- LRA Section 2.3.3.43, "Standby Liquid Control System"
- LRA Section 2.3.3.44, "Standby Service Water System"
- LRA Section 2.3.3.45, "Suppression Pool Temperature Monitoring System"
- LRA Section 2.3.3.46, "Tower Makeup Water System"
- LRA Section 2.3.3.47, "Traversing Incore Probe System"
- LRA Section 2.3.3.48, "Heating Steam System"
- LRA Section 2.3.3.49, "Heating Steam Condensate System"

- LRA Section 2.3.3.50, "Heating Steam Vent System"

Auxiliary Systems Generic RAIs. In RAI 2.3.3-01, dated July 15, 2010, the staff noted drawings where the staff was unable to identify the license renewal boundary because continuations were not provided, were incorrect, or the continuation drawing was not provided. The applicant was asked to provide additional information to locate the continuations shown in SER Table 2.3-1.

Table 2.3-1 Continuation Issue for License Renewal Drawings

License Renewal System Drawing Number & Location	Continuation Issue
2.3.3.5 Containment Instrument Air (CIA) System	
LR-M556-1, zone K/9	1″CIA (54)-1 line after the relief valve CIA-RV-6A ends without a continuation note provided.
LR-M556-1, zone J/7	½″CIA (3)-2-3 and ½″CIA (3)-2-30 lines downstream of valves CIA-V-93A and CIA-V-93B, respectively, end without continuation notes provided.
2.3.3.10 Control Air System (CAS)	
LR-M510-2 at H-11	¾″ a (2) line after the valve CAS-V-174 to test vent ends without a continuation provided.
2.3.3.24 Floor Drain Radioactive (FDR) System	
LR-M539, zone D/15	• Section of (a)(2) piping continues to the floor drain collector tank on drawing LR-M531. Drawing LR-M531 was not submitted as part of the application. • Section of (a)(2) piping continues to the chemical waste tanks on drawing LR-M533-1. Drawing LR-M533-1 was not submitted as part of the application. • Section of (a)(2) piping continues to the detergent drain tanks on drawing LR-M533-1. Drawing LR-M533-1 was not submitted as part of the application.
2.3.3.27 Miscellaneous Waste Radioactive (MWR) System	
LR-M539, zone D/15	3″FDR (52)-1 continued to drawing LR-M538 (E/3). Drawing LR-M538 was not submitted as part of the application.
2.3.4.3 Condensate (Nuclear) (COND) System	
LR-527-1, zone D/6	¾″ piping downstream of valve COND-V-675 is in-scope and ends without a continuation note provided.

In its response, dated September 15, 2010, the applicant provided information to clarify the extent of the license renewal boundary for each of the continuations listed above. In each case, the applicant detailed the routing and location of the piping in question and provided revised drawings where needed.

Based on its review, the staff finds the applicant's response to RAI 2.3.3-01 acceptable. No new systems or components were added to the scope of license renewal as a result of the response to RAI 2.3.3-01, and there were no systems or components identified that had not been previously evaluated. Therefore, the staff's concern described in RAI 2.3.3-01 is resolved.

2.3.3.1 Circulating Water System

2.3.3.1.1 Summary of Technical Information in the Application

The circulating water (CW) system is a closed cycle cooling system using six mechanical induced draft cross-flow cooling towers. Three CW pumps take suction from a common intake plenum and discharge through a common pipe to the three waterboxes of the condenser. The water from the condenser is returned to the cooling towers, cooled, and collected in the cooling tower basins that supply the CW pumps intake plenum.

During a tornado or high wind condition, if there is damage to the service water spray header, the standby service water system system is aligned for feed and bleed. Feed is provided from the tower makeup water system and the system is aligned to bleed to the CW system.

2.3.3.1.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.1, UFSAR Section 10.4.5.2, the license renewal boundary drawings using the evaluation methodology described in SER Section 2.3, and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.1-01 and noted drawing LR-507-1, zones E/8 and F/7, shows lines 144" I.D.CW(2)-1 and 36" TMU(1)-1 as not within scope per license renewal, note D, "Flowpath not required to fulfill LR function." This note appears to conflict with license renewal, note F, "Components highlighted on this drawing are in-scope for [10 CFR 54.4](a)(2)-functional. Therefore, only components in the main flow paths and branch lines to the first isolation valve are highlighted." The applicant was asked to provide additional information to locate the license renewal boundaries for these two branch lines to the first isolation valve.

In its response, dated September 15, 2010, the applicant stated that it revised the system boundaries to include additional piping up to the first isolation valve on the branch lines. This revision brings the license renewal scope into agreement with the description of note F on drawing LR-507-1. This change resulted in the inclusion of additional piping and valves into scope for license renewal, but it did not result in the identification of any new component types or material and environment combinations.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.1-01 acceptable. The applicant revised the drawing to include the piping in question and identified the full scope of 10 CFR 54.4(a)(2)-functional components. Therefore, the staff's concern described in RAI 2.3.3.1-01 is resolved.

2.3.3.1.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant has appropriately identified the CW system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.2 Condensate Processing Radioactive (Demineralizer) System

2.3.3.2.1 Summary of Technical Information in the Application

The purpose of the condensate processing radioactive (CPR) system is to maintain feedwater quality such that the reactor water limits are not exceeded. The system removes corrosion products, condenser inleakage impurities, and impurities present in the condensed steam. The system controls the condensate impurity concentration during plant operation. The system functions as a chemical mixing and supply system to clean the filter demineralizer units and direct the waste to the chemical waste system. It functions as a backwash system to remove the spent resin from the filter demineralizers and direct the waste to the backwash-receiving tank. Additionally, it functions as a precoat system to circulate fresh precoat material through the filter demineralizers.

2.3.3.2.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the CPR (demineralizer) system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the CPR (demineralizer) system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.3 Containment Atmosphere Control System

2.3.3.3.1 Summary of Technical Information in the Application

The containment atmosphere control (CAC) system consists solely of the hydrogen-oxygen recombiner system, has been deactivated. The CAC system and its components no longer provide a process function but are required to maintain piping system structural integrity. The CAC system does not perform any safety-related system-intended functions; however, the failure of nonsafety-related SSCs in the CAC system potentially could prevent the satisfactory accomplishment of a safety-related function; therefore, the CAC system was determined to meet the scoping criteria of 10 CFR 54.4(a)(2). LRA Table 2.3.3-3 identifies CAC system component types within the scope of license renewal and subject to an AMR.

2.3.3.3.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the CAC system components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the CAC system components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.4 Containment Exhaust Purge and Containment Supply Purge Systems

2.3.3.4.1 Summary of Technical Information in the Application

The containment exhaust purge (CEP) and containment supply purge (CSP) systems are designed to purge either the drywell or the suppression chamber or both chambers, in series or in parallel. The CEP and CSP systems provide primary containment isolation and integrity.

Also, the primary containment is provided with CEP and CSP systems to reduce residual contamination and to de-inert the containment before personnel access is permitted. The CEP and CSP systems contain safety-related components relied upon to remain functional during and following DBEs. The failure of nonsafety-related SSCs in the CEP and CSP systems potentially could prevent the satisfactory accomplishment of a safety-related function; therefore, the CEP and CSP system was determined to meet the scoping criteria of 10 CFR 54.4(a)(2). In addition, the CEP and CSP systems perform functions that support EQ. LRA Table 2.3.3-4 identifies CEP and CSP system component types within the scope of license renewal and subject to an AMR.

2.3.3.4.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the CEP and CSP system components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the CEP and CSP system components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.5 Containment Instrument Air System

2.3.3.5.1 Summary of Technical Information in the Application

The purpose of the containment instrument air (CIA) system is to provide primary containment isolation and integrity and supply nitrogen to automatic depressurization system (ADS) main steam relief valves (MSRVs) accumulators in support of short-term and long-term core cooling.

The CIA system delivers clean, dry, compressed gas (nitrogen or air) to the MSRV and MSIV accumulators inside primary containment. The safety-related function of the CIA system is to provide compressed gas to the accumulators to cycle the ADS MSRVs should the normal supply of compressed gas become unavailable. The nonsafety-related function of the CIA system is to provide compressed gas from the CN system to station instrumentation, controls, and accumulators for valve actuators (inboard MSIVs) inside of containment, non-ADS MSRVs, set pressure verification device, and reactor recirculation cooling pump seal drain valves.

2.3.3.5.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.5, UFSAR Sections 9.3.1.1.2 and 9.3.1.3.2, the license renewal boundary drawings using the evaluation methodology described in SER Section 2.3, and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results. The applicant responded to the staff's RAI 2.3.3-01, which is discussed in Section 2.3.3 of the SER.

2.3.3.5.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the CIA system mechanical components within the scope of license renewal, as required by

10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.6 Containment Monitoring System

2.3.3.6.1 Summary of Technical Information in the Application

The containment monitoring system (CMS) consists of instrumentation, categorized as Regulatory Guide (RG) 1.97 (Category 1 and 2), that provides post-accident monitoring information to the operator to enable assessment of the status of safety-related systems. The Category 1 parameters monitored by the CMS are primary containment hydrogen and oxygen concentration, radiation level, pressure, suppression pool chamber pressure, and suppression pool water level. The Category 2 parameters monitored by the CMS are drywell temperature, suppression pool atmosphere temperature, and suppression pool water temperature.

2.3.3.6.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.6, UFSAR Sections 7.5 and Appendix F.4.3, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.6-01 and noted the system description of the CMS states that this system monitors Category 2 parameters like drywell temperature, suppression pool atmosphere temperature, and suppression pool water temperature. Drawing LR-M543-1 shows thermal elements CMS-TE-3 and CMS-TE-4, zone E/7, and CMS-TE-1, zone E/13,

CMS-TE-2, zone E/11, and other thermal elements in the drywell are shown to be not within the scope of license renewal, while similar thermal elements CMS-TE-25, zone K/9 and CMS-TE-32, zone K/11 are included within the scope of license renewal. The applicant was asked to provide additional information explaining why some of the thermal elements are not included within scope of license renewal while similar components in the drywell are included within scope.

In its response, dated September 15, 2010, the applicant stated that recorders CMS-TR-5 and CMS-TR-6, and the temperature elements connected to these recorders, are within the scope of LRA as they provide input for the Columbia SBO event. Temperature elements CMS-TE-32 and CMS-TE-33 are installed in ductwork and, therefore, perform a pressure boundary or structural integrity function. All other TEs connected to the recorders have only an electrical function and were screened out as active components during the scoping and screening evaluation. The highlighting of CMS components not in-scope for mechanical functions was removed in a revised drawing.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.6-01 acceptable. The applicant clarified the discrepancy in the highlighting of CMS components and revised the drawing in question. No new systems or components were included in the scope of license renewal as a result of this RAI response. Therefore, the staff's concern described in RAI 2.3.3.6-01 is resolved.

2.3.3.6.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the CMS mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.7 Containment Nitrogen System

2.3.3.7.1 Summary of Technical Information in the Application

The containment nitrogen (CN) system provides nitrogen to the CIA system for normal plant operation. A CN system cryogenic storage vessel supplies the nitrogen, which is also the source of nitrogen for inerting the primary containment atmosphere.

2.3.3.7.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the CN system components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the CN system components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.8 Containment Return Air System

2.3.3.8.1 Summary of Technical Information in the Application

The containment return air (CRA) system is designed to maintain temperatures throughout the containment at suitable levels for equipment and personnel protection during reactor operations and shutdown. The CRA system recirculates air inside the primary containment to minimize stagnant areas and circulates air post-LOCA to ensure hydrogen mixing by means of the reactor head area return fans. The CRA system contains safety-related components relied upon to remain functional following DBEs. In addition, the CRA system performs functions that support EQ. LRA Table 2.3.3-8 identifies CRA system component types within the scope of license renewal and subject to an AMR.

2.3.3.8.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the CRA system components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the CRA system components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.9 Containment Vacuum Breaker System

2.3.3.9.1 Summary of Technical Information in the Application

The containment vacuum breaker (CVB) system is designed to provide vacuum relief to the drywell. The CVB system contains safety-related components relied upon to remain functional during and following DBEs. The failure of nonsafety-related SSCs in the CVB system potentially could prevent the satisfactory accomplishment of a safety-related function; therefore, the CVB system was determined to meet the scoping criteria of 10 CFR 54.4(a)(2). In addition, the CVB system performs functions that support EQ and ATWS. LRA Table 2.3.3-9 identifies CVB system component types within the scope of license renewal and subject to an AMR.

2.3.3.9.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the CVB system components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the CVB system components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.10 Control Air System

2.3.3.10.1 Summary of Technical Information in the Application

The control air system (CAS) provides oil-free, filtered, and dried instrument-quality air throughout the plant for pneumatic instrumentation, controls, and actuators. The CAS also provides air to the outboard MSIV accumulators and to the wetwell vacuum breaker solenoid pilot valves. The purpose of the CAS is to provide uninterrupted service during normal plant operation and provide primary containment isolation and integrity.

2.3.3.10.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.10, UFSAR Sections 9.3.1.1.1 and 9.3.1.3.1, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results. The applicant responded to the staff's RAI 2.3.3-01, which is discussed in Section 2.3.3 of the SER.

2.3.3.10.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the CAS mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also determined that the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.11 Control Rod Drive System

2.3.3.11.1 Summary of Technical Information in the Application

The control rod drive (CRD) system consists of locking piston CRD mechanisms and the hydraulic system. The CRD hydraulic system consists of hydraulic control units, a hydraulic power supply (pumps), interconnecting piping, and instrumentation. The CRD hydraulic system delivers clean, demineralized water for driving, rapid insertion, and cooling functions related to the operation of the 185 control rod drives. The hydraulic control units manage water flow to and from the control rod.

One supply pump pressurizes the system with water from a condensate supply header, which takes suction from the condensate treatment system or CSTs. A portion of the pump discharge flow is diverted through a minimum flow bypass line to the CST.

The scram accumulators store sufficient energy to fully insert a control rod at lower vessel pressures. At higher vessel pressures, the accumulator pressure is assisted or supplanted by reactor vessel pressure. The accumulator is a hydraulic cylinder with a free-floating piston. The piston separates the water on top from the nitrogen below. During a scram, the scram inlet (and outlet) valves open and permit the stored energy in the accumulators to discharge into the drives.

The scram discharge volume (SDV) header system is designed as a continually expanding path from the 185 individual scram discharge (withdrawal) lines to one of two integrated SDV and instrument volume (IV) systems (one system per approximately half the drives). During normal plant operation, each SDV is empty and vented to the atmosphere through its open vent and drain valves. When a scram occurs, these vent and drain valves are closed to conserve reactor water.

The intended functions of the CRD system within the scope of license renewal include the following:

- provide emergency reactor shutdown (SCRAM)
- provide primary containment isolation and integrity
- provide secondary containment bypass leakage isolation valves
- maintain reactor coolant pressure boundary integrity

LRA Table 2.3.3-11 lists the component types that require AMR and their intended functions.

2.3.3.11.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA and UFSAR, the staff concluded that the applicant appropriately identified the CRD system boundary components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the CRD system boundary components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.12 Control Room Chilled Water System

2.3.3.12.1 Summary of Technical Information in the Application

The control room chilled water (CCH) system is normally used only during emergency conditions. The CCH system or the standby service water system can maintain control room temperature within the design limit of 104 degrees Fahrenheit in the event both radwaste chillers are inoperative (emergency condition).

2.3.3.12.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA and UFSAR, the staff concluded that the applicant appropriately identified the CCH system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the CCH system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.13 Demineralized Water System

2.3.3.13.1 Summary of Technical Information in the Application

The demineralized water (DW) system is designed to use the demineralized effluent from the plant makeup water treatment system to provide DW to the CSTs and to distribute DW throughout the plant.

2.3.3.13.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.13, UFSAR Section 9.2.3, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.13-01 and noted that anchors could not be found on nine nonsafety-related lines that are connected to safety-related lines. The applicant was asked to provide additional information to locate the seismic anchors or anchored components between the safety and nonsafety interface and at the end of the 10 CFR 54.4(a)(2) scoping boundaries.

In its response, dated September 15, 2010, the applicant described and provided the anchor or seismic endpoint locations for the nine safety and nonsafety interfaces. No modifications to the scoping boundary of the DW system were made as a result of this response.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.13-01 acceptable because the applicant provided the location of the anchors or seismic endpoints for the nine safety and nonsafety interfaces and the staff confirmed that no modifications to the scoping boundary of the DW system were needed as a result of this response. Therefore, the staff's concern described in RAI 2.3.3.13-01 is resolved.

2.3.3.13.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the DW system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an ARM, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.14 Diesel Building Heating, Ventilation, and Air Conditioning Systems

2.3.3.14.1 Summary of Technical Information in the Application

Each of the three diesel generator (DG) rooms is serviced by a separate, but essentially identical, diesel building heating, ventilation, and air conditioning (HVAC) system. Also included within the diesel building HVAC systems is the emergency cable cooling ventilation system.

With the exception of the fuel oil day tank room and the fuel oil pump room exhaust fans, the function of the diesel building HVAC systems is to maintain suitable temperatures within the rooms for equipment operation. The exhaust fans provided in each of the three fuel oil day tank rooms and each of the three fuel oil pump rooms prevent the buildup of oil fumes.

The diesel building HVAC systems operate automatically to maintain ambient temperature below equipment operability limits during all emergency modes of operation for the various locations in the DG building.

2.3.3.14.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the diesel building HVAC system components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the diesel building HVAC system components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.15 Diesel Cooling Water System

2.3.3.15.1 Summary of Technical Information in the Application

Each DG set is serviced by an independent cooling system. These systems are located in separate rooms associated with their respective DG. Each engine cooling water system is a closed water circuit that recirculates treated water for engine cooling. The treated water is circulated through the water-jacketed components of the engine to remove heat from the engine parts and the intake air. The jacket water heat is then rejected through a shell and tube heat exchanger to the standby service water system.

The diesel cooling water (DCW) system provides cooling water to enable the emergency DG to start, run, and load.

2.3.3.15.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the DCW system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the DCW system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.16 Diesel (Engine) Exhaust System

2.3.3.16.1 Summary of Technical Information in the Application

The diesel (engine) exhaust (DE) system includes both the intake and exhaust for the DG sets. The DE system provides combustion air intake and exhaust for diesel engine operation. The air intake trains associated with each DG are housed in separate rooms, and each is supplied air from the exterior of the DG building through a screened air intake louver.

The diesel exhaust trains associated with each DG are housed in separate rooms. Exhaust gases are discharged through a turbocharger from the exhaust manifold and are expelled to the exterior of the DG building.

2.3.3.16.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.16, UFSAR Section 9.5.8, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.16-01 and noted that LRA Table 2.3.3-16 lists the turbocharger pump casing and heat exchanger components (tube, cover and shell); however, license renewal drawings LR-512-1, LR-512-2, and LR-512-3 do not show the turbochargers or aftercooler. LRA Section 2.3.3.16 and UFSAR Section 9.5.8 state that the turbocharger and aftercooler are components in the diesel engine intake and exhaust systems, which would be expected to be shown on drawings. The applicant was asked to provide additional information to confirm that all components in the line leading to the turbocharger are in-scope and to identify any additional in-scope components of the DE system that are not shown on the boundary drawings.

In its response, dated September 15, 2010, the applicant explained that the turbochargers and aftercoolers are considered part of the diesel engine and are not shown explicitly on the drawings. The applicant stated that "components leading to the turbocharger, including the aftercooler, as described in UFSAR Section 9.8.5.2, were included in the scope of LR. There are no additional components, other than the turbocharger and the aftercooler, in the diesel (Engine) exhaust system that are in-scope of LR, but are not shown on the LR boundary drawings."

Based on its review, the staff finds the applicant's response to RAI 2.3.3.16-01 acceptable because the applicant confirmed that the turbocharger and aftercooler are in-scope for license renewal, and there are no additional in-scope components that do not appear on the boundary drawings. Therefore, the staff's concern described in RAI 2.3.3.16-01 is resolved.

2.3.3.16.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the DE system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also determined that the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.17 Diesel Engine Starting Air System

2.3.3.17.1 Summary of Technical Information in the Application

The diesel engine starting air (DSA) system is designed to provide a reliable method for automatically starting each DG unit. The starting air system on each engine consists of four air start motors. The DSA system provides air to the air start motors to enable the emergency DGs to start, run, and load.

2.3.3.17.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.17, UFSAR Section 9.5.6, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.17-01 and noted that license renewal drawing LR-M512-1, zone J/3 and J/4, shows ¾ in. lines (¾ in. DSA (6)-2) as within scope for license renewal for 10 CFR 54.4(a)(2). However, portions of an interconnecting line and a drain line connecting to components DSA-HX-2 and DSA-DY-2 are shown as not within scope. The applicant was asked to provide additional information to clarify why the connection between DSA-HX-2 and DSA-DY-2 and the drain line are not in-scope for spatial interaction (leakage or spray).

In its response, dated September 15, 2010, the applicant clarified that the pipe between DSA-HX-2 (aftercooler) and DSA-DY-2 (air dryer) does not contain liquid or steam and is not within scope for spatial interaction. However, the drain line from the air dryer is in-scope for spatial interaction, and the applicant provided updates to LRA Tables 3.3.1 and 3.3.2-17 and revised boundary drawings LR-M512-1, LR-M512-2, and LR-M512-3 to include the drain lines within scope.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.17-01 acceptable because the applicant explained why the pipe between DSA-HX-2 and DSA-DY-2 is not within scope, and the applicant updated the LRA tables and license renewal boundary drawings to show that the subject pipeline from the drier to the drain is in-scope for spatial interaction. Therefore, the staff's concern described in RAI 2.3.3.17-01 is resolved.

2.3.3.17.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the DSA system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.18 Diesel Fuel Oil System

2.3.3.18.1 Summary of Technical Information in the Application

The diesel fuel oil system provides fuel oil to enable the emergency DGs to start, run, and load.

The diesel fuel oil system consists of separate, independent diesel oil supply systems serving each of the DGs. Each of these systems consists of a fuel oil storage tank, a transfer pump, a day tank, interconnecting piping and valves, and associated instruments and controls.

The fuel oil supply from the day tanks to each diesel engine consists of two mutually redundant systems. Either system is capable of supplying fuel oil to the engine.

2.3.3.18.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the diesel fuel oil system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the diesel fuel oil system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.19 Diesel Generator System

2.3.3.19.1 Summary of Technical Information in the Application

The diesel generator (DG) system provides emergency power to safety-related equipment. The DG system, which is the standby AC power source for the plant, consists of three DG sets, each one serving ESF loads in it associated division (1,2,3), their attendant air starting and fuel supply systems, and automatic control circuitry. The DG sets supply power to those electrical loads that are required to achieve safe cold shutdown of the plant or to mitigate the consequences of a DBE coincident with a loss of all offsite AC power.

The dual drive DGs, comprising the Division 1 and 2 standby AC power supplies, start immediately upon receipt of 4.16-kV Class 1E bus undervoltage or plant LOCA signals and are designed to quickly restore onsite power to their respective Class 1E distribution system divisions.

The HPCS standby power source is designed to supply the power required for Division 3 emergency core cooling (water spray) in the event of a LOCA. The HPCS DG starts automatically on receipt of 4.16-kV HPCS bus undervoltage or plant LOCA signals.

2.3.3.19.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the DG system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the DG system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.20 Diesel Lubricating Oil System

2.3.3.20.1 Summary of Technical Information in the Application

The diesel lubricating oil (DLO) system provides cooling and lubrication of diesel engine parts to enable the emergency DGs to start, run, and load. The DLO system, one for each DG, is designed to provide sufficient lubrication for proper operation of its associated DG under all loading conditions. The system is required to circulate the lube oil to the diesel engine working surfaces and to remove excess heat generated by friction during operation.

The lubrication system for each DG is a combination of three separate systems—the main lubricating oil system, the piston cooling system, and the scavenging oil system. Each lubrication system has its own pump.

2.3.3.20.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.20, UFSAR Section 9.5.7, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.20-01 and noted that license renewal drawings LR-M512-1, zone E/11, LR-M512-2, zones E/5 and E/11, and LR-M512-3, zones E/I5 and E/11, show an overspeed trip housing component in-scope for 10 CFR 54.4(a)(1) that was not included in LRA Table 2.3.3-20 as a component type subject to AMR. The applicant was asked to provide additional information to explain why the overspeed trip housing component type is not included in LRA Table 2.3.3-20.

In its response, dated September 15, 2010, the applicant clarified that the in-scope overspeed trip housing component type should be included in LRA Table 2.3.3-20. LRA Tables 2.3.3-20 and 3.3.2-20 were updated to include the overspeed trip housings.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.20-01 acceptable because the applicant updated LRA Tables 2.3.3-20 and 3.3.2-20 to include the overspeed trip housing component type as in-scope for license renewal. Therefore, the staff's concern described in RAI 2.3.3.20-01 is resolved.

2.3.3.20.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the DLO system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also determined that the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.21 Equipment Drains Radioactive System

2.3.3.21.1 Summary of Technical Information in the Application

The equipment drains radioactive (EDR) system provides primary containment isolation and integrity (including valve position indication) and secondary containment isolation and integrity (including valve position indication). The EDR system consists of equipment drain subsystems in the reactor, turbine, and radwaste buildings.

2.3.3.21.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.21, UFSAR Section 9.3.3.2.1, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.21-01 and noted that license renewal drawing LR-M521-2, zone G/4, shows a 10 CFR 54(a)(1) line 4 in. RHR(9)-2-6 connected to a 10 CFR 54 (a)(2) line 4 in. EDR(20)-1. Line 4 in. FDR (43)-1 is a branch from the 4 in. EDR (20)-1, and the anchor on this line could not be located. The applicant was asked to provide additional information to locate the seismic anchor or anchored components between the safety and nonsafety interface and the end of the 10 CFR 54.4(a)(2) scoping boundary.

In its response, dated September 15, 2010, the applicant described and provided the location of the pipe line anchor and no new systems or components were included as a result of the response.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.21-01 acceptable because the applicant identified the location of the anchor in question, and no new systems or components needed to be included as a result of this response. Therefore, the staff's concern described in RAI 2.3.3.21-01 is resolved.

2.3.3.21.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the EDR system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also determined that the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.22 Fire Protection System

2.3.3.22.1 Summary of Technical Information in the Application

LRA Section 2.3.3.22 describes the fire protection systems. The purpose of the fire protection system is to control or extinguish a fire. The fire protection system consists of the fire protection water supply system, wet pipe sprinkler systems, preaction sprinkler systems, deluge water spray systems, carbon dioxide (CO_2) fire suppression systems, Halon 1301 suppression systems, and dry chemical fire suppression system.

The fire protection system provides isolation of the fire water supply to the SGT system filter units and to the radwaste building mixed air system emergency filter units. These system-intended functions are safety-related components and are included in the fire protection systems based on the criterion of 10 CFR 54.4(a)(1). Most portions of the fire protection system are in scope of license renewal as nonsafety-related SSCs based on the criterion of 10 CFR 54.4(a)(2), i.e., nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of safety-related functions. In addition, other portions of the fire protection system are in scope of license renewal based on 10 CFR 54.4(a)(3)–Regulated Events. LRA Table 2.3.3-22 lists the components subject to an AMR for the fire protection system by component type and intended function.

2.3.3.22.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.22, the UFSAR, and license renewal drawings, using the evaluation methodology described in SER Section 2.3 and guidance in SRP-LR, Section 2.3. During its review, the staff evaluated the system functions described in the LRA and UFSAR to verify that the applicant had not omitted from the scope of license renewal any components with intended functions pursuant to 10 CFR 54.4(a). The staff then reviewed those components that the applicant identified as within the scope of license renewal to verify that the applicant had not omitted any passive or long-lived components subject to an AMR, in accordance with 10 CFR 54.21(a)(1).

The staff also reviewed the following fire protection documents cited in the CLB, listed in the Columbia Operating License Condition 2 C(14):

- NUREG-0892, "Safety Evaluation Report related to the operation of [Washington Public Power Supply System] WPPSS Nuclear Project No. 2," dated March 1982
- NUREG-0892, supplement 3 "Safety Evaluation Report related to the operation of WPPSS Nuclear Project No. 2," dated May 1983
- NUREG-0892, supplement 4 "Safety Evaluation Report related to the operation of WPPSS Nuclear Project No. 2," dated December 1983
- NRC SERs issued with letters dated November 11, 1987, and May 22, 1989

Based on the documents above, the staff reviewed the Columbia commitment to 10 CFR 50.48, "Fire Protection" (i.e., approved Fire Protection Program). The review consisted of a point-by-point comparison with Appendix A to the Branch Technical Position (BTP) Auxiliary and Power Conversion Systems Branch (APCSB) 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," May 1, 1976, documented in the UFSAR, Appendix F.

During its review of LRA Section 2.3.3.22, the staff identified areas in which additional information was necessary to complete its review of the applicant's scoping and screening results.

In a letter dated June 24, 2010, the staff issued RAI 2.3.3.22-1 and stated that LRA drawing LR-M515-1 shows that several yard fire hydrants and post-indicator valves are not in-scope (i.e., not colored in green). The staff believes that yard fire hydrants and post-indicator valves have the fire protection-intended functions required to be compliant with 10 CFR 50.48, as stated in 10 CFR 54.4. The fire hydrants also serve as the pressure boundary for the fire protection water supply system. Further, NUREG-0892, "Safety Evaluation Report related to the operation of WPPSS Nuclear Project No. 2," dated March 1982, Section 9.5.1.6, "Fire Detection and Suppression," on page 9-33, states that "fire hydrants are provided on the yard main at 300-foot intervals. A hydrant hose house is provided at each hydrant with 200 feet of 2 ½ in. hose and other equipment. A valve is provided in each hydrant lateral to facilitate hydrant maintenance and repair without interrupting flow in the underground pipe loop."

The staff asked the applicant to verify if the yard hydrants and valves are in the scope of license renewal, in accordance with 10 CFR 54.4(a), and if they are subject to an AMR, in accordance with 10 CFR 54.21(a)(1). If the SCs are excluded from the scope of license renewal and are not subject to an AMR, the staff asked that the applicant justify its exclusion.

In a letter dated April 19, 2010, the applicant responded to RAI 2.3.3.22-1 and stated that the initial scoping for the yard hydrants did not include all yard fire hydrants and post-indicating valves that have fire protection functions compliant with 10 CFR 50.48, as stated in 10 CFR 54.4. However, additional yard hydrants and post-indicating valves have been added to the scope of license renewal based on the UFSAR Appendix F, and have been revised in the license renewal boundary drawings. These hydrants and post-indicating valves are credited in the Fire Hazards Analysis section of UFSAR Appendix F for the diesel building, reactor building, radwaste building, service water pump houses, turbine building, and adjustable speed drive (ASD) building. The additional hydrants and valve bodies are subject to an AMR, as listed in LRA Tables 2.3.3-22 and 3.3.2-22.

Based on its review, the staff finds the applicant's response acceptable because the applicant revised its license renewal drawing LR-M515-1 to reflect the addition of yard fire hydrants and post-indicating valves that have license renewal-intended function. The staff's concern described in RAI 2.3.3.22-1 is resolved.

In a letter dated June 24, 2010, the staff issued RAI 2.3.3.22-2 and stated that the fire protection components—including jockey pump (FP-P-3), valves, piping, and fittings—are not highlighted in the LRA drawing LR-M515-1 as components within the scope of license renewal and subject to an AMR. Further, NUREG-0892, "Safety Evaluation Report related to the operation of WPPSS Nuclear Project No. 2," dated March 1982, Section 9.5.1.6, "Fire Detection and Suppression," on page 9-33, states that "a separate jockey pump, rated at 50 gpm at 100 psig, maintain[s] the yard fire main pressure at 100 to 125 psig." The staff believes that these fire protection components perform a pressure boundary-intended function consistent with rest of the in-scope fire protection system.

The staff asked that the applicant verify if the fire protection components listed above are in the scope of license renewal, in accordance with 10 CFR 54.4(a), and if they are subject to an AMR, in accordance with 10 CFR 54.21(a)(1). If the SCs are excluded from the scope of license renewal and are not subject to an AMR, the staff asked that the applicant justify its exclusion.

In a letter dated April 19, 2010, the applicant responded to RAI 2.3.3.22-2 and stated that the primary water supply jockey pump (FP-P-3) is provided to maintain system pressure and to prevent cycling of the main fire pumps (FP-P-1, 2A, 2B), as described in LRA Section 2.3.3.22 and UFSAR Section F.2.4.1. The jockey pump (FP-P-3) and associated components, shown on LR-M515-1, do not have a fire protection-intended function required for compliance with 10 CFR 50.48. That is, the main (electric and diesel) fire pumps have fire protection-intended functions for compliance with 10 CFR 50.48, whereas the jockey pump is a support feature to reduce unnecessary cycling of the main fire pumps. However, Energy Northwest has included the primary water supply jockey pump (FP-P-3) and associated components, as well as the secondary water supply jockey pump (FP-P-111) and associated components that support diesel fire pump (FP-P-110), within the scope of license renewal and subject to AMR. The revised license renewal boundary drawings and a revision to LRA Table 3.3.2-22, “Aging Management Review—Fire Protection,” to include the jockey pumps and associated components was provided.

Based on its review, the staff finds the applicant’s response acceptable because it clarifies that the jockey pump and its associated components in question are required for compliance with 10 CFR 50.48. The applicant has highlighted jockey pumps (FP-P-3 and FP-P-110), and their associated components, on the license renewal drawing LR-M515-1. The staff’s concern described in RAI 2.3.3.22-2 is resolved.

In a letter dated June 24, 2010, the staff issued RAI 2.3.3.22-3 and stated that the LRA drawing LR-M515-1 shows that several fire suppression systems (Building 5, Building 6, and Building 8) are not in-scope (i.e., not colored in green).

The staff asked that the applicant verify if these fire water suppression systems installed in various buildings of the plant are in the scope of license renewal, in accordance with 10 CFR 54.4(a), and subject to an AMR, in accordance with 10 CFR 54.21(a)(1). If the SCs are excluded from the scope of license renewal and not subject to an AMR, the staff asked that the applicant justify its exclusion.

In a letter dated April 19, 2010, the applicant responded to RAI 2.3.3.22-3 and stated that the fire suppression systems in the cited buildings are not in the scope of license renewal. They are not required for protection of safety-related equipment and are not required for post-fire safe shutdown, since there are no safety-related components in the buildings and other systems (not located in these buildings) are credited for protecting safety-related equipment and for post-fire safe shutdown of the plant, as described in the Fire Hazards Analysis Report, UFSAR Section F.4. As such, the suppression systems in Building 5 (Alternate Health Physics Access Point), Building 6 (Technical Support Center), and Building 8 (ASD) do not perform intended functions compliant with 10 CFR 50.48.

Based on its review, the staff finds the applicant’s response acceptable because it clarified that the fire suppression systems in question are not required to protect safety-related equipment and are not required for post-fire safe shutdown. The staff found that, since the fire suppression systems in question are not required for protection of safety-related equipment and are not required for post-fire safe shutdown, they are not in the scope of license renewal and are not subject to an AMR. In addition, there are no safety-related components in the buildings and there are other systems (not located in these buildings) credited for protecting safety-related equipment and for post-fire safe shutdown of the plant. The staff’s concern described in RAI 2.3.3.22-3 is resolved.

In a letter dated June 24, 2010, the staff issued RAI 2.3.3.22-4 and stated that the LRA drawing LR-M515-4 shows that the fire suppression systems installed in the turbine building are not in-scope (i.e., not colored in green).

The staff asked that the applicant verify if the turbine building fire water suppression systems are in the scope of license renewal, in accordance with 10 CFR 54.4(a), and subject to an AMR, in accordance with 10 CFR 54.21(a)(1). If the SCs are excluded from the scope of license renewal and not subject to an AMR, the staff asked that the applicant justify its exclusion.

In a letter dated April 19, 2010, the applicant responded to RAI 2.3.3.22-4 and stated that the fire suppression systems identified on LRA drawing LR-M515-4 for the turbine building are required for compliance with 10 CFR 50.48. The SCs were incorrectly omitted in the LRA. Therefore, the piping and components in the turbine building, as identified on drawings LR-M515-1 and LR-M515-4, have been included in-scope of license renewal.

Based on its review, the staff finds the applicant's response acceptable because it clarifies that the turbine building fire suppression systems in question are required for compliance with 10 CFR 50.48. The applicant has highlighted the turbine building fire suppression systems on the license renewal drawings LR-M515-1 and LR-M515-4. The staff's concern described in RAI 2.3.3.22-4 is resolved.

In a letter dated June 24, 2010, the staff issued RAI 2.3.3.22-5 and stated that the LRA drawing LR-M573-2 shows that several fire protection components—pumps, tank, piping, valves, drains, and test connections are not in-scope (i.e., not colored in green).

The staff asked that the applicant verify if these fire protection components are in the scope of license renewal, in accordance with 10 CFR 54.4(a), and subject to an AMR, in accordance with 10 CFR 54.21(a)(1). If the SCs are excluded from the scope of license renewal and not subject to an AMR, the staff asked that the applicant justify its exclusion.

In a letter dated April 19, 2010, the applicant responded to RAI 2.3.3.22-5 and stated that the 400,000-gallon fire protection water storage tank (FP-TK-110) is filled from the potable water tank (PWC-TK-100), as shown on boundary drawing LR-M573-2 (Coordinates C-G/8-11). The primary water supply (CW basin) and the secondary water supply (FP-TK-110) can provide the necessary water demand for compliance with 10 CFR 50.48, as described in LRA Section 2.3.3.22 and in UFSAR Section F.2.4.1. The FP-TK-110 fill pump (FP-P-113) and its associated components are not required for compliance with 10 CFR 50.48. Therefore, PWC-TK-100, FP-P-113, and associated piping, valves, drains, and test connections do not perform a function that satisfies the license renewal scoping criteria of 10 CFR 54.4(a)(3) and are not included within the scope of license renewal.

The secondary water supply jockey pump (FP-P-111) is provided to maintain system pressure and to prevent cycling of the main fire pump, as described in LRA Section 2.3.3.22. The jockey pump (FP-P-111) and associated components, shown on LR-M573-2, do not have a fire protection-intended function required for compliance with 10 CFR 50.48. It is the diesel fire pump (FP-P-110), which the secondary water supply jockey pump supports, that has a fire protection function that complies with 10 CFR 50.48. While not required to comply with 10 CFR 50.48, Energy Northwest has added the secondary water supply jockey pump (FP-P-111) and associated components in the scope of license renewal subject to AMR (as noted in the response to RAI 2.3.3.22-2). In addition, fire protection pump FP-P-112 (recirculation pump) keeps the bladder tank (FP-TK-110) from freezing in the winter and, therefore, performs a 10 CFR 50.48 function. The revised boundary drawing LR-M573-2 including FP-P-111 (jockey pump), FP-P-112, and associated components within the scope of license renewal was provided.

Based on its review, the staff finds the applicant's response acceptable because it clarifies that pumps, tank, piping, valves, drains, and test connections in question on LRA drawing LR-M573-2 do not have a license renewal-intended function and are not subject to an AMR. The staff notes that the applicant identified primary fire and secondary fire water supply systems and components for compliance with the 10 CFR 50.48. Furthermore, the applicant identified additional fire water supply components (fire protection pump FP-P-112 and bladder tank FP-TK-110) that are required for compliance with 10 CFR 50.48. The applicant has highlighted these components on the license renewal drawing LR-M573-2. The staff's concern described in RAI 2.3.3.22-5 is resolved.

In a letter dated June 24, 2010, the staff issued RAI 2.3.3.22-6 and stated that the LRA Section 2.3.3.22, on page 2.3-93, states that "the low pressure CO_2 system automatically provides fire protection for turbine generator exciter housing. A manual CO_2 hose station, with reel and hose, is also provided for exciter housing protection on the turbine generator floor." The automatic CO_2 fire suppression system and manual CO_2 hose station, with reel and hose, do not appear in LRA drawings as being in the scope of the license renewal and subject to an AMR.

The staff asked the applicant if the CO_2 fire suppression features are in the scope of license renewal, in accordance with 10 CFR 54.4(a), and subject to an AMR, in accordance with 10 CFR 54.21(a)(1). If the SCs are excluded from the scope of license renewal and not subject to an AMR, the staff asked that the applicant justify its exclusion.

In a letter dated April 19, 2010, the applicant responded to RAI 2.3.3.22-6 and stated that the automatic CO_2 system was not originally within the scope of license renewal because Energy Northwest had determined that it did not perform a license renewal-intended function. After further review, Energy Northwest established that the CO_2 system is relied upon to demonstrate compliance with and meet the 10 CFR 54.4(a)(3) scoping criteria for the fire protection (10 CFR 50.48) regulated event. Therefore, the automatic CO_2 system and a manual CO_2 hose station were included in the LRA and a revised boundary drawing LR-M515-3 was provided.

Based on its review, the staff finds the applicant's response acceptable because it clarifies that the automatic CO_2 fire suppression system in question is required to meet the scoping criteria of 10 CFR 54.4(a)(3) and is required for compliance with 10 CFR 50.48. The applicant has updated its license renewal document to add the automatic CO_2 fire suppression system and a manual CO_2 hose station with reel and highlighted these components on the license renewal drawing LR-M515-3. The staff's concern described in RAI 2.3.3.22-6 is resolved.

In a letter dated June 24, 2010, the staff issued RAI 2.3.3.22-7 and stated that the LRA Section 2.3.3.22, on page 2.3-93, states that "Halon 1301 suppression systems are installed in normally occupied areas where the application of water would be inappropriate. Halon 1301 provides automatic fire protection for the main control room Power Generation Control Cabinet (PGCC) under the floor. Eighteen Halon 1301 system[s] are installed in various main control room PGCC subfloor duct sections to discharge on activation of their associated thermal detector units." The 18 main control room PGCC Halon 1301 fire suppression systems do not appear in LRA drawings as being in the scope of the license renewal and subject to an AMR.

The staff asked that the applicant verify if these Halon 1301 fire suppression systems are in the scope of license renewal, in accordance with 10 CFR 54.4(a), and subject to an AMR, in accordance with 10 CFR 54.21(a)(1). If the SCs are excluded from the scope of license renewal and not subject to an AMR, the staff asked that the applicant justify its exclusion.

In a letter dated April 19, 2010, the applicant responded to RAI 2.3.3.22-7 and stated that the Halon 1301 suppression systems and associated components are included within the scope of license renewal; however, this distinction is not clear within the LRA. The revised boundary drawings was provided and clarified that the Halon 1301 systems are within the scope of license renewal.

In addition, LRA Section 2.3.3.22 states that “Halon cylinders are within the scope of license renewal. The principal design criterion for these bottles is Department of Transportation Standards (DOT). The Halon cylinders comply with the requirements of the DOT standards. The Halon cylinders are consumables, replaced periodically in accordance with DOT standards, and are not subject to AMR.” However, the licensee stated that the Halon cylinders are not replaced periodically and, therefore, are subject to an AMR. The applicant updated LRA Table 3.3.2-22, items 226 and 227, to specify that the Halon cylinders are subject to AMR.

Based on its review, the staff finds the applicant’s response acceptable because it clarifies that the automatic Halon 1301 fire suppression systems in question are in the scope of license renewal and subject to an AMR. Furthermore, the applicant stated that the Halon 1301 cylinders are not replaced periodically (the applicant considered Halon 1301 cylinders long-lived, passive components) and are, therefore, in the scope of license renewal and subject to an AMR. The applicant has updated its license renewal document and highlighted the Halon 1301 fire suppression systems and components on license renewal drawings LR-02H13-05,221,2, LR02H13-05,221,2A, and LR-02H13-05,250,1. The staff’s concern described in RAI 2.3.3.22-7 is resolved.

In a letter dated June 24, 2010, the staff issued RAI 2.3.3.22-8 and stated that the LRA Section 2.3.3.22, on page 2.3-94, states that “a dry chemical system is installed in approved portable hazardous material storage buildings within the plant. The system automatically actuates by melting of the fusible links or manually by a local pull station….” The dry chemical fire suppression system does not appear in LRA drawings as being in the scope of the license renewal and subject to an AMR.

The staff asked that the applicant verify if the above dry chemical fire suppression system is in the scope of license renewal, in accordance with 10 CFR 54.4(a), and subject to an AMR, in accordance with 10 CFR 54.21(a)(1). If the SC is excluded from the scope of license renewal and not subject to an AMR, the staff asked that the applicant justify its exclusion.

In a letter dated April 19, 2010, the applicant responded to RAI 2.3.3.22-8 and stated that there is one dry chemical fire protection system in the plant. A portable hazardous material storage building is located in the turbine building on the 441-foot elevation. The dry chemical fire suppression system is associated with the portable storage building. The automatic dry chemical system was not originally within the scope of license renewal because it was believed that it did not perform a license renewal-intended function. After further review, Energy Northwest established that the dry chemical system is relied upon to demonstrate compliance with and meet the 10 CFR 54.4(a)(3) scoping criteria for the fire protection (10 CFR 50.48) regulated event. Therefore, the dry chemical system is included within the scope of license renewal.

Based on its review, the staff finds the applicant’s response acceptable because it clarifies that the automatic dry chemical fire suppression system in question is required to meet the scoping criteria of 10 CFR 54.4(a)(3) and is required for compliance with 10 CFR 50.48. The applicant has included the dry chemical fire suppression system within the scope of license renewal and updated its license renewal document. The staff's concern described in RAI 2.3.3.22-8 is resolved.

In a letter dated June 24, 2010, the staff issued RAI 2.3.3.22-9 and asked that the applicant determine if Tables 2.3.3-22 and 3.3.2-33 of the LRA should include the following fire protection components:

- fire hose stations, fire hose connections, and hose racks
- pipe fittings, pipe supports, hangers, and couplings
- flow elements
- flow indicators
- strainers
- filter housings
- test connections
- sprinklers
- floor drains for fire water
- dikes and curbs for oil spill confinement

If the applicant determined that LRA Tables 2.3.3-22 and 3.3.2-22 should not include these components, the staff asked that the applicant justify the exclusion of these components from the scope of license renewal.

In its response, dated April 19, 2010, the applicant provided the results of scoping and screening for the listed fire protection components types as follows:

- Fire hose stations, fire hose connections, and hose racks: Fire hose stations consist of an angle hose valve, a wye gate valve, a hose cabinet, and fire hose. Fire hoses connect directly to the wye gate, and there is no separate connection fitting. All hose stations in the plant have a wye gate to convert the 2 1/2" outlet of the angle hose valve to two 1 1/2" hoses. The angle hose and wye gate valves are in the scope of license renewal and subject to AMR for those hose stations that are in-scope. There is no separate equipment part number for the wye gate valve, as it is included as part of the angle hose valve on the boundary drawings. See boundary drawing LR-M515-5, detail C. The wye gate is considered a valve for the purposes of LRA Tables 2.3.3-22 and 3.3.2-22. The hose cabinet is considered an equipment component support, which is in the scope of license renewal and subject to AMR under bulk commodities in LRA Table 2.4-13. Therefore, the listed components are included in LRA Tables 2.3.3-22 and 3.3.2-22, rows 159-167, and in LRA Table 2.4-13. The fire hoses are in-scope, but they are not subject to AMR because they are not long-lived.
- Pipe fittings, pipe supports, hangers, and couplings: Pipe fittings—such as elbows, reducers, couplings, flanges—are included as piping in LRA Tables 2.3.3-22 and 3.3.2-22. Pipe supports and hangers are included in bulk commodities in LRA Table 2.4-13. Therefore, the listed components are included in LRA Tables 2.3.3-22, 3.3.2-22, and 2.4-13.
- Flow elements: There are no flow elements within the scope of license renewal because the piping sections that contain flow elements do not meet the 10 CFR 54.4(a)(3) criteria.

- Flow indicators: There are no flow indicators within the scope of license renewal because the piping sections that contain flow indicators do not meet the 10 CFR 54.4(a)(3) criteria.
- Strainers: There are strainers (body and screen) within the scope of license renewal and subject to AMR. The component type "Strainer (body and screen)" is listed in Table 2.3.3-22 and Table 3.3.2-22 of the LRA.
- Filter housings: There are no filter housings within the scope of license renewal because the piping sections that contain filter housings do not meet the 10 CFR 54.4(a)(3) criteria.
- Test connections: Scoping of mechanical systems that have a 10 CFR 54.4(a)(3) fire protection function was performed as follows:

  > For components that are in-scope only for 10 CFR 54.4(a)(2) functional and for 10 CFR 54.4(a)(3), highlight the main flow paths required to perform the functions, and branch lines up to, and including, the first valve capable of isolating the branch line. Also, highlight (outline) major components, such as tanks, that support these [10 CFR 54.4](a)(2) and (a)(3) functions. However, do not highlight attached piping (e.g., vents, drains, fill and overflow lines) that is not part of the main flow path, and does not support the functions, unless its failure could result in a loss of inventory; then, highlight up to, and including, the first valve.
  >
  > Test connections do not perform a 10 CFR 54.4(a)(3) function and would be downstream of an isolation valve. Therefore, no test connections are within the scope of license renewal.

- Sprinklers: Sprinklers are called "Spray Nozzles," which are in-scope and listed in Table 2.3.3-22 and Table 3.3.2-22 of the LRA.
- Floor drains for fire water: Columbia does not have floor drains specifically for fire water. Columbia does have floor drain systems that are in the scope of license renewal and are the method of removing fire protection water from building areas. The floor drain (FD) system is discussed in LRA Section 2.3.3.23, and the floor drain radioactive (FDR) system is discussed in LRA Section 2.3.3.24.
- Dikes and curbs for oil spill confinement: Curbs for oil spill confinement are considered structural commodities and are listed as "Flood Curbs" on LRA Table 3.5.2-13.

In reviewing its response to RAI, the staff found that the applicant had addressed and resolved each item in the RAI, as discussed below.

Fire hose stations connect directly to the wye gate, and there is no separate connection. Fire hose stations are in the scope of license renewal and subject to an AMR. In addition, fire hose cabinets are also in the scope of license renewal and subject to an AMR, and they are listed under bulk commodities in LRA Table 2.4-13. LRA Tables 2.3.3-22, 3.3.2-22, and 2.4-13 provide the AMR results for these components.

Although the description of the "Piping" item, provided in LRA Tables 2.3.3-22 and 3.3.2-22, does not list components specifically, the applicant stated that it considers this item to include pipe fittings, couplings, elbows, reducers, and flanges. In addition, the applicant stated that strainers (body and screen), that are within the scope of license renewal and subject to an AMR, are listed in LRA Tables 2.3.3-22 and 3.3.2-22. Furthermore, in its response, the applicant confirmed that sprinklers are included under item “Spray Nozzles,” which are in the scope of license renewal and listed in LRA Tables 2.3.3-22 and 3.3.2-22. The applicant considered curbs for oil spill confinement under structural commodities as “Flood Curbs,” listed in LRA Table 3.5.2-13. In its response, the applicant confirmed that there are no floor drain systems specifically for fire water. The floor drain system is used to remove fire-fighting water at Columbia. The floor drain system and floor drain radioactive system are discussed in LRA Sections 2.3.3.23 and 2.3.3.24, respectively.

The applicant determined that flow elements, flow indicators, filter housing, and test connections do not meet the scoping criteria of 10 CFR 54.4(a)(3) because their failure will not result in a failure of the fire protection function of the associated system.

Based on its review, the staff found the applicant’s response to RAI 2.3.3.22-9 acceptable because it resolved the staff’s concerns about the scoping and screening of fire protection system components listed in the RAI. The staff’s concern described in RAI 2.3.3.22-9 is resolved.

2.3.3.22.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI responses, and drawings to determine if the applicant failed to identify any fire protection systems and components within the scope of license renewal. The staff finds no such omissions. In addition, the staff sought to determine if the applicant failed to identify any component subject to an AMR. On the basis of its review, the staff concluded that the applicant adequately identified the fire protection system components that are within the scope of license renewal, as required by 10 CFR 54.4(a), and those that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.23 Floor Drain System

2.3.3.23.1 Summary of Technical Information in the Application

The floor drain (FD) system consists of non-radioactive floor drain subsystems in the service building and turbine building. FDs from normally uncontaminated areas of the turbine building are collected in three sumps. All three sumps are routed to the radwaste system for processing.

FDs in the service building are collected in a single sump containing two sump pumps. Water collected in the service building floor drain sump is pumped to the storm water drainage system. Water collected by the storm drainage system is conveyed by a concrete pipe to a point approximately 1,500 feet northeast of the plant. The pipe discharges to an earthen channel that carries the water to a small, unlined evaporation and percolation pond. Roof drains, which are evaluated as part of the FD system, are drained by gravity or pumped to the storm drain system.

2.3.3.23.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.23, UFSAR Section 9.3.3.2.3, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff’s review identified an area in which additional information was necessary to complete the review of the applicant’s scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.23-01 and noted license renewal drawing LR-540, zone H/12 shows 6"FD (10)-1 within scope for 10 CFR 54.4(a)(2). This line appears to be located in the radwaste building, but the description of the floor drain system in LRA Section 2.3.3.23 only referenced the service building and turbine building. The applicant was asked to clarify that the system description of LRA Section 2.3.3.23 is correct, and the FD system is not also located in the radwaste building.

In its response, dated September 15, 2010, the applicant stated the FD system is located in the radwaste building as well as the DG and reactor buildings. The system description in the LRA, taken from UFSAR Section 9.3.3.2.3 was incorrect. The description of the FD system in LRA Section 2.3.3.23 was revised to include all building locations containing FD system components. The applicant stated a condition report has been issued to investigate the adequacy of the UFSAR non-radioactive water drainage system description.

Based on its review, the staff finds the applicant’s response to RAI 2.3.3.23-01 acceptable because the applicant stated the FD system is located in the radwaste building as well as the DG and reactor buildings. A condition report was issued to investigate the adequacy of the UFSAR non-radioactive water drainage system description. Therefore, the staff’s concern described in RAI 2.3.3.23-01 is resolved.

2.3.3.23.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff’s review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the FD system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.24 Floor Drain Radioactive System

2.3.3.24.1 Summary of Technical Information in the Application

The floor drain radioactive (FDR) system provides primary containment isolation and integrity, secondary containment isolation and integrity, RG 1.97 Category 1 indication, and primary containment isolation valve position indication.

The FDR system consists of floor drain subsystems in the reactor, turbine, and radwaste buildings.

2.3.3.24.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.24, UFSAR Section 9.3.3.2.2, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff’s review identified an area in which additional information was necessary to complete the review of the applicant’s scoping and screening results. The applicant responded to the staff’s RAI 2.3.3-01, which is discussed in Section 2.3.3 of the SER.

2.3.3.24.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the FD radioactive system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.25 Fuel Pool Cooling System

2.3.3.25.1 Summary of Technical Information in the Application

The fuel pool cooling (FPC) system provides spent fuel cooling and level control, primary containment isolation and integrity, and secondary containment isolation and integrity. The FPC system consists of two separate trains, each containing a circulating pump and a heat exchanger. The FPC pumps normally circulate the fuel pool water in a closed loop, taking suction from the surge tanks, circulating the water through a heat exchanger and a filter demineralizer and discharging it through the diffusers at the bottom of the fuel pool. Makeup water for the system is normally transferred from the condenser storage tank to a skimmer surge tank to makeup fuel pool water losses.

The FPC system must operate in a variety of conditions. During normal reactor operations, the FPC provides for cooling and cleaning of the spent fuel containing discharged fuel assemblies. During refueling outages, the FPC system may be required to provide additional decay heat removal.

2.3.3.25.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.25, UFSAR Section 9.1.3, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.25-01 and noted license renewal drawing LR-M526-1, zone H/10 shows the diffuser assembly component as within scope for criterion 10 CFR 54.4(a)(1). The diffuser assembly is not listed as a component type in LRA Table 2.3.3-25. The applicant was asked to provide additional information to explain why the diffuser is not listed as a component type in LRA Table 2.3.3-25.

In its response, dated September 15, 2010, the applicant stated the diffuser is considered a pipe fitting and is evaluated as piping in LRA Table 2.3.3-25.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.25-01 acceptable because the applicant explained that the diffuser is evaluated as piping and is included as a component type in LRA Table 2.3.3-25. Therefore, the staff's concern described in RAI 2.3.3.25-01 is resolved.

2.3.3.25.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the FPC system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.26 Leak Detection System

2.3.3.26.1 Summary of Technical Information in the Application

The leak detection (LD) system monitors leakage from the reactor coolant pressure boundary, and initiates alarms or isolation signals when predetermined limits are exceeded. The LD system consists of temperature, pressure, and flow sensors with associated instrumentation and alarms. This system detects, annunciates, and isolates (in certain cases) leakages in the MS lines, the reactor water cleanup system, the RHR system, the RCIC system, the reactor feedwater (RFW) system, the HPCS system, the LPCS system, and coolant systems within the primary containment.

Small leaks generally are detected by temperature and pressure changes and drain sump pump activities. Large leaks are detected by changes in reactor water level and changes in flow rates in process lines.

2.3.3.26.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the LD system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the LD system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.27 Miscellaneous Waste Radioactive System

2.3.3.27.1 Summary of Technical Information in the Application

The miscellaneous waste radioactive (MWR) system provides primary containment isolation and integrity and secondary containment isolation and integrity. The MWR system is designed to collect water in the reactor, turbine, and radwaste buildings that can contain potentially radioactive detergent and transfer the fluid directly by gravity to the radwaste building sump or the detergent drain tanks. It is also used to drain the decontamination solution in the reactor building from the decontamination pit and reactor closed cooling water chemical addition tank to the chemical waste tanks. Additionally, the system also consists of SLC system drains. These equipment and floor drains collect borated water from the SLC system and direct it to 55-gallon drums located in the reactor building.

2.3.3.27.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.27, UFSAR Section 11.2, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results. The applicant responded to the staff's RAI 2.3.3-01, which is discussed in Section 2.3.3 of the SER.

2.3.3.27.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the MWR system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.28 Plant Sanitary Drains Systems

2.3.3.28.1 Summary of Technical Information in the Application

All non-contaminated sanitary waste from the site building is directed into the plant sanitary drains (PSD) system. All sanitary drains in the plant are collected into a main sewage header that leaves the plant building complex, below grade, from the service building. All waste lines are vented to the atmosphere via roof vents, in accordance with applicable codes, except those in the reactor building, which are vented to the main reactor building exhaust system, and those in the main control room, which are vented to the main control room exhaust system.

2.3.3.28.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the PSD system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the PSD system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.29 Plant Service Water Systems

2.3.3.29.1 Summary of Technical Information in the Application

The plant service water (TSW) system consists of two 100 percent capacity pumps taking suction from the circulating water intake structure and supplying cooling water to equipment located throughout the plant. TSW is returned to the circulating water tunnel for heat removal by the circulating water system cooling towers.

2.3.3.29.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.29, UFSAR Section 9.2.1.2, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.29-01 and noted on license renewal drawing LR-M548-2, zones G/5, G/8, G/10, and G/14, four anchors that could not be found on nonsafety-related lines connected to the safety-related TSW supply to WMA-CC-53B2, WMA-CC-52B2, WMA-CC-52A2, and WMA-CC-53A2. The applicant was asked to provide additional information to locate the seismic anchors or anchored components between the safety and nonsafety interface and the end of the 10 CFR 54.4(a)(2) scoping boundary.

In its response, dated September 15, 2010, the applicant identified the anchor or seismic endpoint location for the four requested locations. The licensee revised note C on the license renewal drawing LR-M550-2. No new systems or components were included in the scope of license renewal as a result of this response.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.29-01 acceptable because the applicant provided the location of the four anchors or seismic endpoints and no new systems or components needed to be included in the scope of license renewal as a result of the response. Therefore, the staff's concern described in RAI 2.3.3.29-01 is resolved.

2.3.3.29.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the TSW system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.30 Potable Cold Water System

2.3.3.30.1 Summary of Technical Information in the Application

The potable cold water (PWC) system supplies potable water throughout the plant and provides supply water to the plant makeup water treatment system; the system can also be used to supply makeup water to the spray ponds. The PWC system is designed to provide cold water to the points of potable water usage such as toilets, showers, sinks, shower and eyewash stations, and electric drinking water coolers located in the various plant buildings as well as for site grounds irrigation.

2.3.3.30.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the PWC system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the PWC system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.31 Potable Hot Water System

2.3.3.31.1 Summary of Technical Information in the Application

The potable hot water (PWH) system supplies potable water throughout the plant and provides supply water to the plant makeup water treatment system; the system can also be used to supply makeup water to the spray ponds. The PWH system is designed to provide hot water to the points of potable water usage, such as sinks and showers located in the various plant buildings. Potable hot water is provided by individual electric hot water heaters.

2.3.3.31.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the PWH system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the PWH system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.32 Primary Containment System

2.3.3.32.1 Summary of Technical Information in the Application

LRA Section 2.3.3.32 describes the primary containment system, which includes the mechanical components associated with the personnel access lock. The primary containment system contains safety-related components relied upon to remain functional during and following DBEs. The primary containment system does not contain nonsafety-related components that are attached to or located near safety-related SSCs, whose failure creates a potential for spatial interaction that could prevent the satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1). LRA Table 2.3.3-32 identifies primary containment component types within the scope of license renewal and subject to an AMR.

2.3.3.32.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the primary containment components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the primary containment components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.33 Process Sampling System

2.3.3.33.1 Summary of Technical Information in the Application

The process sampling (PS) system is designed to provide representative samples, under controlled conditions, of plant process streams. Provisions for continuous monitoring of selected systems provide a means of analytical surveillance of system trends and performance during plant operation.

2.3.3.33.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the PS system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the PS system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.34 Process Sampling Radioactive System

2.3.3.34.1 Summary of Technical Information in the Application

The process sampling radioactive (PSR) system is designed to provide representative samples, under controlled conditions, of plant process streams. Provisions for continuous monitoring of selected systems provide a means of analytical surveillance of system trends and performance during plant operations. Laboratory samples are taken to provide comprehensive analytical information on plant operations, a check on continuous monitoring instrumentation, and regular reports on critical plant systems to ensure safe and proper operation.

2.3.3.34.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.34, UFSAR Section 9.3.2.1, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified areas in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.34-01 and noted that anchors could not be found on five nonsafety-related lines connected to safety-related lines. The applicant was asked to provide additional information to locate the seismic anchors or anchored components between the safety and nonsafety interface and the end of the 10 CFR 54.4(a)(2) scoping boundaries.

In its response, dated September 15, 2010, the applicant identified the five seismic anchors or anchored components beyond the safety and nonsafety interfaces. No new systems or components were included in the scope of license renewal as a result of this response. No revisions were made to the license renewal boundary shown on the drawings.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.34-01 acceptable because the applicant provided the location of the five seismic anchors and the staff verified that no new systems or components needed to be included in the scope of license renewal as a result of the response. Therefore, the staff's concern described in RAI 2.3.3.34-01 is resolved.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.34-02 and noted license renewal drawing LR-MS96, zone G/7 shows lines ½ in. PSR(1)-4S and ¾ in. PSR(1)-4S, downstream of pumps PSR-P-702 and PSR-P-701 in the reactor building, as not in-scope for license renewal. The staff noted that the lines have the potential for spatial interaction as non-safety affecting safety-related components in the reactor building. The applicant was asked to clarify the scoping classification for these pipe sections.

In its response, dated September 15, 2010, the applicant stated that the lines ½ in. PSR(1)-4S and ¾ in. PSR(1)-4S, downstream of pumps PSR-P-702 and PSR-P-701, are atmospheric sample lines that normally contain ambient air and are not a concern for spatial interaction.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.34-02 acceptable because the applicant clarified the scoping classification of the pipe lines and the staff notes that atmospheric sampling line containing ambient air is not a concern for spatial interation. Therefore, the staff's concern described in RAI 2.3.3.34-02 is resolved.

2.3.3.34.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI responses, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the PSR system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.35 Pump House Heating, Ventilation, and Air Conditioning Systems

2.3.3.35.1 Summary of Technical Information in the Application

The pump house HVAC systems provide service water pump house cooling. The standby service water (SW) pump house HVAC and the makeup water pump house HVAC system form the pump house HVAC systems.

The SW pump house HVAC system is designed to remove the heat generated by operation of the SW pumps and the HPCS service water pump and to limit the temperature in the two pump houses.

The makeup water pump house HVAC system maintains suitable conditions for operation of the makeup water pumps, which may be operated to refill the SW spray ponds following the hypothesized dewatering of the ponds due to a tornado.

2.3.3.35.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the pump house HVAC system components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the pump house HVAC system components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.36 Radwaste Building Chilled Water System

2.3.3.36.1 Summary of Technical Information in the Application

The radwaste building chilled water (WCH) system is designed to provide a reliable source of chilled water to the main control room air handling units, the cable spreading room air handling units, the switchgear area air handling units, and the air handling units serving the conditioned areas of the radwaste building.

2.3.3.36.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the WCH system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the WCH system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.37 Radwaste Building Heating, Ventilation, and Air Conditioning Systems

2.3.3.37.1 Summary of Technical Information in the Application

The radwaste building HVAC systems provide the following:

- ESF exhaust systems in the main control room, battery rooms, critical switchgear rooms, and cable spreading rooms
- cooling and emergency filtration to the main control room
- cooling and filtration to the critical switchgear rooms and cable spreading room
- isolation valves to maintain the control room remote air source integrity
- outside air intakes to the radwaste building ESF HVAC system

Three separate HVAC systems make up the radwaste building HVAC system, each individually serving the main control room, the cable spreading room, and the critical switchgear area.

2.3.3.37.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the radwaste building HVAC system components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the radwaste building HVAC system components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.38 Reactor Building Heating, Ventilation, and Air Conditioning Systems

2.3.3.38.1 Summary of Technical Information in the Application

The reactor building HVAC systems provide secondary containment isolation and integrity and cooling to critical switchgear, ECCS pump rooms, and other vital rooms in the reactor building during emergency conditions. The reactor building HVAC systems operate as “push-pull” heating and ventilation systems, providing once-through air flow with no recirculation, and consist of supply air, exhaust air, and emergency cooling systems.

2.3.3.38.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the reactor building HVAC system components within the scope of license renewal, as required by

10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the reactor building HVAC system components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.39 Reactor Closed Cooling Water System

2.3.3.39.1 Summary of Technical Information in the Application

The reactor closed cooling water (RCC) system is a closed loop system that provides parallel-flow cooling to auxiliary equipment in the primary containment, reactor building, and radwaste building. Each of the three pumps and three heat exchangers are rated at 50 percent capacity, based on maximum normal cooling requirements. Heat is removed from the RCC system by the plant service water system. Plant service water is passed through the tube side of the RCC heat exchanger, and the closed-loop water is passed through the shell side. A 550-gallon surge tank accommodates volume changes from thermal expansion and contraction.

2.3.3.39.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.39, UFSAR Section 9.2.2, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.39-01 and noted that anchors could not be found on two nonsafety-related lines connected to safety-related lines. The applicant was asked to locate the seismic anchors or anchored components between the safety and nonsafety interface and the end of the 10 CFR 54.4(a)(2) scoping boundaries.

In its response, dated September 15, 2010, the applicant identified the two seismic anchors or anchored components between the safety and nonsafety interfaces. No new systems or components were included in the scope of license renewal as a result of this response. No revisions were made to the license renewal boundary shown on the drawings.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.39-01 acceptable because the applicant provided the location of the two seismic anchors and the staff verified that no new systems or components needed to be included in the scope of license renewal as a result of the response. Therefore, the staff's concern described in RAI 2.3.3.39-01 is resolved.

2.3.3.39.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the RCC system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.40 Reactor Protection System

2.3.3.40.1 Summary of Technical Information in the Application

The reactor protection system (RPS) is designed to cause rapid insertion of control rods (SCRAM) to shut down the reactor when specific variables exceed predetermined limits. RPS instrument lines associated with the digital electro-hydraulic control (DEH) system, some of which are assigned to the instrument rack system, are noted as safety-related on the RPS flow diagram. The attached DEH lines are nonsafety-related but provide structural integrity to support the safety-related RPS instruments. However, a loss of pressure boundary function for the RPS components initiates an emergency reactor shutdown, which is the license renewal-intended function of the RPS system. Therefore, the applicant concluded, the structural integrity function of the DEH components is not required, and the DEH system is not in-scope. Components (i.e., valves) assigned by EPN to the instrument rack system are included within the evaluation boundaries of the RPS.

The intended functions of the RPS system within the scope of license renewal include providing emergency reactor shutdown (SCRAM).

2.3.3.40.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA and UFSAR, the staff concluded that the applicant appropriately identified the RPS system boundary components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the RPS system boundary components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.41 Reactor Water Cleanup System

2.3.3.41.1 Summary of Technical Information in the Application

The reactor water cleanup (RWCU) system consists of two pumps, regenerative and nonregenerative heat exchangers, and two filter-demineralizers with supporting equipment. Reactor coolant is removed from the reactor coolant recirculation system, cooled in the regenerative and non-regenerative heat exchangers, filtered and demineralized, and returned to the feedwater system through the shell side of the regenerative heat exchanger.

The intended functions of the RWCU system within the scope of license renewal include the following:

- provide primary containment isolation and integrity
- provide RWCU flow mismatch isolation
- maintain reactor coolant pressure boundary integrity

LRA Table 2.3.3-39 lists the component types that require AMR and their intended functions.

2.3.3.41.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.41, UFSAR Section 5.4.8, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified areas in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.41-01 and noted that anchors could not be found on two nonsafety-related lines connected to safety-related lines. The applicant was asked to locate the seismic anchors or anchored components between the safety and nonsafety interface and the end of the 10 CFR 54.4(a)(2) scoping boundaries.

In its response, dated September 15, 2010, the applicant identified the seismic anchors or anchored components between the two safety and nonsafety interfaces. No new systems or components were included in the scope of license renewal as a result of this response. No revisions were made to the license renewal boundary shown on the drawings.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.41-01 acceptable because the applicant provided the location of the two seismic anchors and the staff verified that no new systems or components needed to be included in the scope of license renewal as a result of the response. Therefore, the staff's concern described in RAI 2.3.3.41-01 is resolved.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.41-02 and noted license renewal drawing LR-M-523-1, zones G/4 and J/4, show 4 in. lines (4 in. RCWU(2)-3-1 and 4 in. RCWU(1)-3-1) as in-scope for license renewal for 10 CFR 54.4 (a)(2), which are connected to 10 CFR 54.4(a)(1) lines. Note F on license renewal drawing LR-M-523-1 states that the "evaluation boundary for [nonsafety-related] NSR connected to [safety related] SR ends at a seismic anchor located just inside the radwaste building." The extent of the piping beyond this point is not shown on the drawings or described in the application. The applicant was asked to confirm there are no additional component types between the continuation piping and the seismic anchor.

In its response, dated September 15, 2010, the applicant stated that the seismic anchor is located just inside the radwaste building wall. The applicant also clarified that there are no additional component types installed between the continuation piping and the seismic anchor.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.41-02 acceptable because the applicant clarified the location of the seismic anchor and the staff verified that no new systems or components needed to be included in the scope of license renewal as a result of the response. Therefore, the staff's concern described in RAI 2.3.3.41-02 is resolved.

2.3.3.41.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI responses, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant has appropriately identified the RWCU system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also determined that the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.42 Service Air System

2.3.3.42.1 Summary of Technical Information in the Application

The service air (SA) system provides compressed air for general services (such as demineralizer resin mixing and filter and demineralizer backwashing) and hose connections for maintenance and the breathing air system. The SA system, with its own compressors and dryers, is cross-connected with, but designed to be isolated from, the CAS supply piping to conserve air for CAS use.

2.3.3.42.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the SA system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the SA system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.43 Standby Liquid Control System

2.3.3.43.1 Summary of Technical Information in the Application

The standby liquid control (SLC) system consists of a boron solution tank, a test water tank, two positive-displacement pumps, two explosive valves, two motor operated pump suction valves, and associated local valves and controls mounted in the reactor building outside primary containment. The SLC system is manually initiated through two key lock switches from the main control room to pump a boron neutron absorber solution into the reactor if the operator determines that the reactor cannot be shut down with the control rods or if suppression pool pH control is required to mitigate the dose consequences of a LOCA. The liquid is piped into the reactor vessel and discharged into the core via the HPCS spray header so that it mixes with the cooling water rising through the core.

The intended functions of the SLC system within the scope of license renewal include the following:

- provide borated water to the RCS to bring the reactor to a shutdown condition at any time in the reactor core life.
- provide primary containment isolation and integrity
- maintain reactor coolant pressure boundary integrity
- provide post-LOCA pH control in the suppression pool that will minimize the potential for re-evolution of elemental iodine dissolved in the suppression pool

LRA Table 2.3.3-41 lists the component types that require AMR and their intended functions.

2.3.3.43.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA and UFSAR, the staff concluded that the applicant appropriately identified the SLC system boundary components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the SLC system boundary components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.44 Standby Service Water System

2.3.3.44.1 Summary of Technical Information in the Application

The standby service water (SW) system provides cooling for plant equipment essential to a safe reactor shutdown following a design basis LOCA, long-term cooling, and a makeup water source to the fuel pool cooling system following a loss of the reactor closed cooling water system.

The SW pumps discharge to three independent piping systems, which serve ECCS equipment, auxiliary plant equipment, and reactor shutdown cooling equipment. During normal and emergency shutdown modes of operation, water is circulated from the spray ponds to the equipment requiring cooling and returned to the ponds.

2.3.3.44.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.44, UFSAR Section 9.2.7, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.44-01 and noted license renewal drawing LR-M524-1, zone B/10, shows 1 in. lines (1 in. SW (7)-2-1 and 1 in. SW (27)-2-1) in and out of the LPCS pump as in-scope for license renewal for 10 CFR 54.4(a)(1). However, the LPCS pump itself is shown as not within scope for license renewal. The applicant was asked to explain why the pump is not within the scope of license renewal.

In its response dated September 15, 2010, the applicant clarified that the LPCS pump was included in the LRA, is within the scope of license renewal, and is subject to aging management review.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.44-01 acceptable because the applicant clarified that the LPCS pump is within the scope of license renewal and the staff verified that no new systems or components needed to be included in the scope of license renewal as a result of the response. Therefore, the staff's concern described in RAI 2.3.3.44-01 is resolved.

2.3.3.44.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the SW system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.45 Suppression Pool Temperature Monitoring System

2.3.3.45.1 Summary of Technical Information in the Application

The suppression pool temperature monitoring (SPTM) system provides suppression pool bulk temperature monitoring via sensors distributed around the pool. The system provides the main control room operator with the necessary information to avoid conditions that might lead to high-temperature, steam-quenching, vibration phenomena.

2.3.3.45.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA and UFSAR, the staff concluded that the applicant appropriately identified the SPTM system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the SPTM system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.46 Tower Makeup Water System

2.3.3.46.1 Summary of Technical Information in the Application

The tower makeup water (TMU) system supplies Columbia River water to the spray ponds and replaces water lost during normal operation due to evaporation and drift. Additionally, the TMU system replaces pond water during a tornado event. To ensure system availability for this mode of operation, the TMU system is designed to withstand a design basis tornado coincident with a loss of offsite power.

During a tornado or high wind condition, if there is damage to the service water spray header, the SW system is aligned for feed and bleed. Feed is provided from the TMU system, and the system is aligned to bleed to the CW system.

2.3.3.46.2 Staff Evaluation

The staff reviewed LRA Section 2.3.3.46, UFSAR Section 9.2.7.2 and 10.4.5.2, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.3.46-01 and noted license renewal drawing LR-507-1, zones B/2 and C/2, show sluice gate valves TMU-V-7A and TMU-V-7B as not in-scope. However, license renewal drawings LR-225-02, 21 and LR-225-02, 22 show these valves as in-scope for license renewal. The applicant was asked to clarify the scoping classification for these two valves.

In its response, dated September 15, 2010, the applicant referenced license renewal note E on drawing LR-507-1, which points to drawings LR-225-02, 21 and LR-225-02, 22 for continuation of the license renewal scoping boundary. The applicant stated that the sluice gate valves TMU-V-7A and TMU-V-7B are in-scope, as shown on drawings LR-225-02, 21 and LR-225-02, 22, respectively.

Based on its review, the staff finds the applicant's response to RAI 2.3.3.46-01 acceptable because the applicant clarified the sluice gate valves are in-scope for license renewal. Therefore, the staff's concern described in RAI 2.3.3.46-01 is resolved.

2.3.3.46.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the TMU system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.3.47 Traversing Incore Probe System

2.3.3.47.1 Summary of Technical Information in the Application

The traversing incore probe (TIP) machines are comprised of a TIP detector, a drive mechanism, an indexing mechanism, and guide tubes. One traversing ion chamber, and its associated drive mechanism, is provided for each group of seven to nine fixed incore assemblies.

A valve system is provided with a valve on each guide tube entering the drywell. A ball valve and a cable shearing valve are mounted in the guide tubing just outside the drywell. A valve is also provided for a nitrogen gas purge line to the indexing mechanisms. The shear valves are actuated by explosive squibs and can cut the cable and close off the guide tube.

The intended functions of the TIP system within the scope of license renewal include providing primary containment isolation and integrity.

LRA Table 2.3.3-44 lists the component types that require AMR and their intended functions.

2.3.3.47.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA and UFSAR, the staff concluded that the applicant appropriately identified the TIP system boundary components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the TIP system boundary components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.48 Heating Steam System

2.3.3.48.1 Summary of Technical Information in the Application

The applicant addressed this system as meeting the scoping criteria of 10 CFR 54.4(a)(2) in its LRA supplement dated July 16, 2010. The applicant states that the heating steam system contain nonsafety-related components that are attached to or located near safety-related SSCs, whose failure creates a potential for spatial interaction that could prevent the satisfactory accomplishment of one or more of the functions identified in 10 CFR 54.4(a)(1).

The heating steam (HS) system originates from four pressure-reducing stations (two in the turbine generator building and one each in the reactor and radwaste buildings). Steam at 200 psig pressure is supplied to these pressure-reducing stations from either the auxiliary boiler or the gland steam evaporator. At the pressure-reducing stations, the steam pressure is reduced to 50 psig and this steam is fed to the heating coils, humidifiers, steam unit heaters, and hot water heat exchanger.

2.3.3.48.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA and UFSAR, the staff concluded that the applicant appropriately identified the HS system components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the HS system components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.49 Heating Steam Condensate System

2.3.3.49.1 Summary of Technical Information in the Application

The applicant addressed this system as meeting the scoping criteria of 10 CFR 54.4(a)(2) in its LRA supplement dated July 16, 2010. The applicant states that the heating steam system contain nonsafety-related components that are attached to or located near safety-related SSCs, whose failure creates a potential for spatial interaction that could prevent the satisfactory accomplishment of one or more of the functions identified in 10 CFR 54.4(a)(1).

The condensate of the heating steam condensate (HCO) system originates from the HS system and is returned to the auxiliary boiler condensate return tank located in the auxiliary boiler room of the turbine generator building. Condensate from the reactor building, turbine generator building, and upper level of the service building is returned to the auxiliary condensate return tank by gravity.

In the radwaste building, the condensate returns are below the level of the auxiliary condensate return tank; therefore, a condensate pump set pump the condensate to the return tank.

2.3.3.49.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA and UFSAR, the staff concluded that the applicant appropriately identified the HCO system components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the HCO system components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.3.50 Heating Steam Vent System

2.3.3.50.1 Summary of Technical Information in the Application

The applicant addressed this system as meeting the scoping criteria of 10 CFR 54.4(a)(2) in its LRA supplement dated July 16, 2010. The applicant states that the heating steam system contain nonsafety-related components that are attached to or located near safety-related SSCs, whose failure creates a potential for spatial interaction that could prevent the satisfactory accomplishment of one or more of the functions identified in 10 CFR 54.4(a)(1).

The heating steam vent (HSV) system provides a vent through the roof of the respective buildings of the relief valves and tanks of the HS and HCO systems.

2.3.3.50.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA and UFSAR, the staff concluded that the applicant appropriately identified the HSV system components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the HSV system components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4 Steam and Power Conversion Systems

LRA Section 2.3.4 identifies the steam and power conversion systems SCs subject to an AMR for license renewal. The applicant described the supporting SCs of the steam and power conversion systems in the following LRA sections:

- LRA Section 2.3.4.1, “Auxiliary Steam System”
- LRA Section 2.3.4.2, “Condensate (Auxiliary) System”
- LRA Section 2.3.4.3, “Condensate (Nuclear) System”
- LRA Section 2.3.4.4, “Main Steam System”
- LRA Section 2.3.4.5, “Main Steam Leakage Control System”
- LRA Section 2.3.4.6, “Miscellaneous Drain System”
- LRA Section 2.3.4.7, “Reactor Feedwater System”
- LRA Section 2.3.4.8, “Sealing Steam System”

2.3.4.1 Auxiliary Steam System

2.3.4.1.1 Summary of Technical Information in the Application

The auxiliary steam (AS) system normally operates only when the heating steam evaporators are inoperative during plant shutdown.

The AS system supplies steam to HVAC systems for air and water space heating and for humidification. The AS system supplies steam to the nitrogen inerting steam vaporizer in the containment nitrogen system. The AS system can also supply sealing steam to the gland seal steam evaporator loads, including the turbine shaft seal glands.

2.3.4.1.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the AS system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the AS system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.2 Condensate (Auxiliary) System

2.3.4.2.1 Summary of Technical Information in the Application

The condensate (auxiliary) (CO) system returns condensate from the AS system, which operates only when the heating steam evaporators are inoperative during plant shutdown, to the condensate return tank—by means of either the radwaste building heating condensate pump set or the condensate pump set.

2.3.4.2.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the CO system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the CO system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.3 Condensate (Nuclear) System

2.3.4.3.1 Summary of Technical Information in the Application

The condensate (nuclear) (COND) system provides a source of water for testing and makeup during operation. Two condensate storage tanks are interconnected to simultaneously supply condensate to the main condenser via one header, to the CRD pumps via a second header, and to the RHR, RCIC, and HPCS systems and condensate supply and condensate filter and demineralizer backwash pumps via a third header. The storage tanks are normally cross-connected but can be individually isolated from the system. The condensate supply pumps deliver condensate to miscellaneous services in the reactor and radwaste buildings. The condensate and feedwater systems also provide a reliable source of high purity feedwater, during both normal operation and anticipated transient conditions.

A minimum inventory of 135,000 gallons in the condensate storage is reserved for the RCIC and HPCS pumps. This ensures the immediate availability of a sufficient quantity of condensate for emergency core cooling, reactor shutdown, and SBO, although the supply of water in the suppression pool is the emergency source of water.

2.3.4.3.2 Staff Evaluation

The staff reviewed LRA Section 2.3.4.3, UFSAR Section 9.2.6 and 10.4.7, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified areas in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.4.3-01 and noted license renewal drawing LR-527-1, zones E/11 and E/14, show condensate storage tanks COND-TK-1A and COND-TK-1B as within scope for 10 CFR 50.54(a)(1). However, the attached piping of penetrations E, F, and H, for both tanks, are shown not within scope. The applicant was asked to clarify why the piping attached to a 10 CFR 50.54 (a)(1) component are not in-scope.

In its response, dated September 15, 2010, the applicant stated that each of these piping penetrations are located above the air-water interface and do not support the function of maintaining a pressure boundary for coping with an SBO.

Based on its review, the staff finds the applicant's response to RAI 2.3.4.3-01 acceptable because the applicant clarified why the attached piping of the penetrations is not in-scope and the staff verified that each of the piping penetrations that are located above the air-water interface, do not support the function of maintaining a pressure boundary for coping with an SBO. Therefore, the staff's concern described in RAI 2.3.4.3-01 is resolved.

2.3.4.3.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI responses, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the COND system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.4.4 Main Steam System

2.3.4.4.1 Summary of Technical Information in the Application

The main steam (MS) system delivers steam from the RPV to the main turbine. The MS system also provides steam to the moisture separator re-heaters and steam-jet air ejectors, the gland seal steam evaporator, RFW pumps, offgas pre-heaters, the RCIC turbine, and balance-of-plant systems. The MS system provides a path for steam to the main condenser during startup and in the event that the steam produced by the reactor is less than the steam requirements of the turbine generator (bypass steam).

The MS line piping consists of four lines extending from the RPV to the MS header, located upstream of the turbine stop and control valves. This header placement ensures a positive means of bypassing steam via the turbine bypass system during transient conditions and startup. Branch lines from the MS line provide the steam requirements for the RFW pumps, second stage re-heaters, gland seal steam evaporator, offgas pre-heaters, and steam jet air ejectors.

2.3.4.4.2 Staff Evaluation

The staff reviewed LRA Section 2.3.4.4, UFSAR Section 10.3, and the license renewal boundary drawings, using the evaluation methodology described in SER Section 2.3 and the guidance in SRP-LR Section 2.3. The staff's review identified an area in which additional information was necessary to complete the review of the applicant's scoping and screening results.

In a letter dated July 15, 2010, the staff issued RAI 2.3.4.4-01 and noted the "Trap Station Component Numbers" table on license renewal drawing LR-M502-2 shows portions of various steam traps as within scope. Portions of steam traps 6, 7, 8, 9A, 9B, 13, 14, 15, and 24 are shown in-scope for 10 CFR 54.4(a)(2) functional, while the entirety of traps 1, 2, 3, and 4 are shown in-scope for 10 CFR 54.4 (a)(2) spatial interaction. The highlighting of detail "A," corresponding to these steam traps, does not appear to accurately portray either set. It is also unclear why only traps 1–4 are in-scope for spatial interaction. The applicant was asked to explain the scoping of the steam traps.

In its response, dated September 15, 2010, the applicant explained how these steam traps were evaluated and classified. Steam trap stations 1–4 are attached to safety-related piping and are, therefore, in-scope as nonsafety piping attached to safety-related piping under 10 CFR 54.4(a)(2). Steam trap stations 6, 7, 8, 9A, 9B, 13, 14, 15, 24, and 34 are attached to the 10 CFR 54.4(a)(2) functional portion of the MS system, but the actual traps are downstream of isolation valves and, therefore, not within the scope of license renewal. The piping for these steam traps up to the isolation valves are in-scope for 10 CFR 54.4(a)(2) functional, as shown in the table on license renewal drawing LR-M502-2.

Based on its review, the staff finds the applicant's response to RAI 2.3.4.4-01 acceptable because the applicant clarified the license renewal boundaries for these steam traps, and the applicant appropriately identified the MS system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). Therefore, the staff's concern described in RAI 2.3.4.4-01 is resolved.

2.3.4.4.3 Conclusion

The staff reviewed the LRA, UFSAR, RAI response, and boundary drawings to determine if the applicant failed to identify any components within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded the applicant appropriately identified the MS system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a), and the applicant adequately identified the mechanical components subject to an AMR, in accordance with the requirements stated in 10 CFR 54.21(a)(1).

2.3.4.5 Main Steam Leakage Control System

2.3.4.5.1 Summary of Technical Information in the Application

The main steam leakage control (MSLC) system, associated with the MSIVs, is isolated and deactivated. The structural integrity of piping systems and components left in place is maintained. The MSLC system provides primary containment isolation and integrity and maintains the integrity of the reactor coolant pressure boundary.

2.3.4.5.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the MSLC system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the MSLC system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.6 Miscellaneous Drain System

2.3.4.6.1 Summary of Technical Information in the Application

The miscellaneous drain (MD) system receives seal steam condensate drain flow (high-pressure and low-pressure stop valves and governor valve), reactor feedpump turbine stage steam condensate flow, and RFW pump seal leak-by flow.

2.3.4.6.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the MD system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the MD system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.7 Reactor Feedwater System

2.3.4.7.1 Summary of Technical Information in the Application

The reactor feedwater (RFW) system provides a reliable source of high purity feedwater during normal operation and anticipated transient conditions.

Two one-half nominal capacity turbine-driven RFW pumps are provided. Each RFW pump is capable of providing two-thirds of the rated feedwater flow during one pump operation. Minimum flow through the RFW pumps is controlled by using recirculation control valves, located in the pump discharge lines, to permit recirculation of feedwater to the condenser. The feedwater control system automatically controls the flow of feedwater into the RPV to maintain the water level in the vessel within the predetermined levels during all modes of plant operation.

2.3.4.7.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the RF system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the RF system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.3.4.8 Sealing Steam System

2.3.4.8.1 Summary of Technical Information in the Application

The applicant addressed this system as meeting the scoping criteria of 10 CFR 54.4(a)(2) in its LRA supplement dated July 16, 2010. The applicant states that the sealing steam system contain nonsafety-related components that are attached to or located near safety-related SSCs, whose failure creates a potential for spatial interaction that could prevent the satisfactory accomplishment of one or more of the functions identified in 10 CFR 54.4(a)(1).

The sealing steam system provides sealing steam to the turbine shaft seal glands and the valve stem seal glands (stop, control, reheat stop, intercept, and bypass valves). Separate seal steam regulators are provided to regulate the pressure of sealing steam for the high pressure turbine, each low pressure turbine, each reactor feed pump turbine shaft seal, the bypass valve assembly, and the main stop and control valve assembly stems.

2.3.4.8.2 Conclusion

Based on the results of the staff evaluation discussed in Section 2.3 and on a review of the LRA, UFSAR, and drawings, the staff concluded that the applicant appropriately identified the sealing steam system mechanical components within the scope of license renewal, as required by 10 CFR 54.4(a). The staff also concluded that the applicant adequately identified the sealing steam system mechanical components subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4 Scoping and Screening Results: Structures

This section documents the staff's review of the applicant's scoping and screening results for structures. Specifically, this section describes the following structures:

- primary containment (includes drywell, suppression chamber, and internal SCs)
- reactor building (includes secondary containment, reactor cavity, refueling area, new fuel storage vault, and release stack)
- SW pump houses (1A and 1B) and spray ponds (1A and 1B)
- CW pump house
- DG building
- fresh air intake structures
- makeup water pump house
- radwaste control building
- service building
- turbine generator building
- water filtration building
- yard structures

In accordance with the requirements of 10 CFR 54.21(a)(1), the applicant identified and listed passive, long-lived SCs that are within the scope of license renewal and subject to an AMR. To verify that the applicant properly implemented its methodology, the staff focused its review on the implementation results.

This approach allowed the staff to confirm that there were no omissions of SCs that meet the scoping criteria and are subject to an AMR.

The staff's evaluation of the information provided in the LRA was performed in the same manner for all structures. The objective of the review was to determine if the SCs that appeared to meet the scoping criteria specified in the Rule were identified by the applicant as within the scope of license renewal, in accordance with 10 CFR 54.4. Similarly, the staff evaluated the applicant's screening results to verify that all long-lived, passive SCs were subject to an AMR in accordance with 10 CFR 54.21(a)(1). To perform its evaluation, the staff reviewed the applicable LRA sections, focusing its review on components that had not been identified as within the scope of license renewal.

The staff reviewed the UFSAR for each structure to determine if the applicant had omitted components with intended functions delineated under 10 CFR 54.4(a) from the scope of license renewal. The staff also reviewed the UFSAR to determine if all intended functions delineated under 10 CFR 54.4(a) were specified in the LRA. If omissions were identified, the staff asked for additional information to resolve the discrepancies. Once the staff completed its review of the scoping results, the staff evaluated the applicant's screening results. For those components with intended functions, the staff sought to determine if the functions are performed with moving parts or a change in configuration or properties and if they are subject to replacement based on a qualified life or specified time period, as described in 10 CFR 54.21(a)(1). For those that did not meet either of these criteria, the staff sought to confirm that these SCs were subject to an AMR, as required by 10 CFR 54.21(a)(1).

The staff evaluation of the structural scoping and screening results applies to all structures reviewed. Those systems that required RAIs to be generated include an additional staff evaluation which specifically addresses the applicant's responses to the RAI(s).

2.4.1 Primary Containment

2.4.1.1 Summary of Technical Information in the Application

The primary containment pressure vessel is a free standing, Seismic Category I steel structure that includes the drywell, suppression chamber, and internal SCs. The primary containment pressure vessel uses the pressure suppression technique through the Mark II over-under configuration. The drywell is physically located directly above the suppression chamber, and the floor that divides them is a reinforced concrete slab supported by steel beams and concrete columns. The primary containment is part of the reactor building. All equipment and structures within the primary containment are supported on a concrete foundation mat.

In addition, the primary containment vessel is enclosed in a reinforced concrete biological shield wall for shielding purposes and is physically separated from the reinforced concrete by an annulus of compressible isolation material. Additionally, it is also reinforced with vertical and horizontal stiffeners to satisfy design requirements of the various loading combinations and conditions.

The primary containment consists of the following major SCs:

- access hatches (personnel access lock, the (combined) equipment hatch and CRD removal hatch, and the suppression chamber access hatch)
- pipe whip protection support rings
- drywell floor
- drywell floor peripheral seal assembly
- drywell head
- drywell sumps
- sand filled pocket area
- penetrations

- suppression chamber
- radial beam framing systems
- reactor pedestal
- reactor vessel thermal insulation
- refueling bellows seal
- reinforced concrete lining inside the bottom head of the primary containment vessel
- sacrificial shield wall
- stabilizer truss

The primary containment is within the scope of license renewal because it contains SCs that are safety-related and are relied upon to remain functional during and following DBEs and therefore meets the criteria of 10 CFR 54.4(a)(1). The Primary Containment is also relied upon to demonstrate compliance with the Station Blackout (10 CFR 50.63) and Anticipated Transients Without Scram (10 CFR 50.62) regulated events and meets the 10 CFR 54.4(a)(3) scoping criteria.

The purpose of the primary containment, in combination with other accident mitigation systems, is to limit fission product leakage during and following the postulated DBA to values less than leakage rates and to provide support and protection for equipment. The primary containment also supports the ability to maintain required temperatures for operation.

LRA Table 2.4-1 identifies the components subject to an AMR for the primary containment by component type and intended function.

2.4.1.2 Conclusion

The staff followed the evaluation methodology discussed in Section 2.4 and reviewed the LRA and UFSAR to determine if the applicant failed to identify any SSCs within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any SCs subject to an AMR. On the basis of its review, the staff concluded that the applicant adequately identified the primary containment SCs within the scope of license renewal, as required by 10 CFR 54.4(a), and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.2 Reactor Building

2.4.2.1 Summary of Technical Information in the Application

The reactor building, includes the secondary containment, reactor cavity, refueling area, new fuel storage vault, and release stack. It is a cast-in-place, reinforced concrete diaphragm slab and shear wall type structure, up to and including the refueling floor. Above the refueling floor, the building structure is constructed of structural steel members, insulated metal siding, and roof decking. It is founded on a common concrete foundation supporting the steel primary containment vessel and all equipment and structures installed and erected within it. Since the reactor building completely encloses the reactor vessel and the steel primary containment vessel, it provides secondary containment when the primary containment vessel is sealed and in service. However, when the primary containment vessel is open during refueling periods, the reactor building also provides primary containment.

The purpose of the reactor building is to control the release of the radioactivity to the environment, provide support and protection for equipment, and support the ability to maintain required temperatures for operation. The reactor building is relied upon to demonstrate compliance with the fire protection, ATWS, and SBO regulated events. In addition, the reactor building houses the refueling and reactor servicing equipment, fuel storage facilities, RCIC system, RWCU system, SLC system, CRD system, ECCS, SGT system equipment, and electrical equipment components.

LRA Table 2.4-2 identifies the components subject to an AMR for the reactor building by component type and intended function.

2.4.2.2 Staff Evaluation

The staff reviewed LRA Section 2.4.2 using the evaluation methodology described in SER Section 2.4 and the guidance in SRP-LR Section 2.4.

During its review of the LRA Section 2.4.2, the staff identified areas in which additional information was necessary to complete the evaluation of the applicant's scoping and screening results for the reactor building.

In a letter dated August 6, 2010, the staff issued RAI 2.4.2-1 and asked that the applicant clarify whether the coatings are credited with managing the effects of aging of the concrete and steel components or may have an effect on the safety function of the ECCS. If so, the staff asked the applicant to explain if coatings should be included in the scope of license renewal and if there is a subsequent AMR or AMP to evaluate this component.

In its response to the RAI, dated September 24, 2010, the applicant stated that the coatings are not credited with managing the effects of aging of the concrete and steel components and will not have an effect on the safety function of the ECCS. Therefore, no AMR program is required.

However, in a supplemental response, dated December 21, 2010, the applicant stated that it will incorporate the Service Level 1 Protective Coatings Program which is a plant-specific program credited for managing coatings inside the containment. Coatings inside the containment are credited to maintain coating integrity and to ensure the design basis accident analysis limits with regard to coatings will not be exceeded for the suction strainers. The applicant included the new aging management program and AMRs to evaluate this component in the LRA.

Based on its review, the staff finds the response to RAI 2.4.2-1 acceptable because the revised response credited protective coatings, inside the containment, to maintain coating integrity and to ensure the design basis accident analysis limits, with regard to coatings, will not be exceeded for suction strainers. Also, there is a subsequent AMR or AMP to evaluate this component. Therefore, the staff's concern described in RAI 2.4.2-1 is resolved.

2.4.2.3 Conclusion

The staff followed the evaluation methodology discussed in Section 2.4 and reviewed the LRA, UFSAR, and RAI responses to determine if the applicant failed to identify any SSCs in-scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any SCs subject to an AMR. On the basis of its review, the staff concluded that the applicant adequately identified the reactor building SCs within the scope of license renewal, as required by 10 CFR 54.4(a), and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.3 Standby Service Water Pump House 1A and 1B and Spray Pond 1A and 1B

2.4.3.1 Summary of Technical Information in the Application

LRA Section 2.4.3 describes the two SW pump houses (1A and 1B) and two spray ponds (1A and 1B). Each pair of Seismic Category 1 structures consists of a spray pond and a standby service pump house constructed integrally, and they are adjacently located but structurally separated. The SW pump house 1A also houses the HPCS service water pump.

The SW pump houses are described as cast-in-place, reinforced concrete structures that are supported on foundations consisting of spread footings, reinforced concrete retaining walls, and foundation mats. Each structure has four levels: the foundation slabs at the bottom of the pump chambers, the electric vault and valve pit level, the superstructure main operating floor level, and the roof.

The purpose of the SW pump houses is to provide support and protection for equipment, support the ability to maintain required temperatures for operation, and, in conjunction with the spray ponds, to provide a source of cooling water for the RHR, HPCS, LPCS, FPC systems, and the essential HVAC systems.

The spray pond structures are described as reinforced, concrete, rectangular-shaped retention basins consisting of a structural slab on soil and four perimeter exterior walls. Protection against leakage of water stored in the ponds is provided by continuous waterstops that are furnished in all joints, such as construction joints and expansion joints, as well as a membrane vapor barrier under the floor slab. Additionally, a sand trap for sediment retention is built integrally with each pond immediately before the stop logs and screens in the pump barrel intake chambers of each SW pump house.

The purpose of the spray pond (ultimate heat sink) is to impound and supply cooling water to remove heat from all nuclear plant equipment, which is essential for a safe shutdown of the reactor, and maintain it in a safe condition. Additionally, the spray ponds, in conjunction with other systems, remove heat from plant systems that are required for a safe reactor shutdown following a LOCA.

LRA Table 2.4-3 identifies the components subject to an AMR for the SW pump houses 1A and 1B and spray ponds 1A and 1B by component type and intended function.

2.4.3.2 Staff Evaluation

The staff reviewed LRA Section 2.4.3 using the evaluation methodology described in SER Section 2.4 and the guidance in SRP-LR Section 2.4. During its review of the LRA Section 2.4.3, the staff identified areas in which additional information was necessary to complete the evaluation of the applicant's scoping and screening results for the SW pump houses and spray ponds.

In a letter dated August 6, 2010, the staff issued RAI 2.4.3-1 and asked that the applicant confirm the inclusion or justify the exclusion of the reinforced concrete columns in the scope of license renewal and subsequent AMR, since the components were not listed in Table 2.4-3.

In its response to the RAI, dated September 24, 2010, the applicant stated that the reinforced concrete columns that provide support and balance to the pump house are included in the scope of license renewal and have an AMR.

The applicant also stated that the reinforced concrete columns are described as part of the generic component type "Foundations" and are not included under the component type "Reinforced Concrete: walls, floor and ceilings."

Based on its review, the staff finds the response to RAI 2.4.3-1 acceptable because the reinforced concrete columns that provide support and balance to the pump house have been included in the scope of license renewal and are subject to an AMR. Therefore, the staff's concern described in RAI 2.4.3-1 is resolved.

2.4.3.3 Conclusion

The staff followed the evaluation methodology discussed in Section 2.4 and reviewed the LRA, UFSAR, and RAI responses to determine if the applicant failed to identify any SSCs in-scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any SCs subject to an AMR. On the basis of its review, the staff concluded that the applicant adequately identified the SW pump houses 1A and 1B and spray ponds 1A and 1B SCs within the scope of license renewal, as required by 10 CFR 54.4(a), and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.4 Circulating Water Pump House

2.4.4.1 Summary of Technical Information in the Application

The CW pump house is a Seismic Category II structure composed of a reinforced concrete floor, insulated metal wall panels, and a metal roof deck over structural steel framing.

The CW pump house and the chlorination sections of the building are separated by a masonry wall. In addition, the diesel fire storage tank room is isolated by 2-hour, fire-rated masonry walls. Remote buildings credited in the Fire Protection Program—such as the service water pump house 1 and 2, CW pump house, and water filtration building—have non-rated fire barriers. However, the buildings are sufficiently separated from each other and from the plant that a single exposure fire would not spread to more than one building.

The purpose of the CW pump house is to provide physical support and protection to the fire water pumps, which are relied upon to demonstrate compliance with fire protection following a regulated event. Additionally, it houses the electric and diesel driven fire water pumps and three CW pumps.

LRA Table 2.4-4 identifies the components subject to an AMR for the CW pump house by component type and intended function.

2.4.4.2 Conclusion

The staff followed the evaluation methodology discussed in Section 2.4 and reviewed the LRA and UFSAR to determine if the applicant failed to identify any SSCs within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any SCs subject to an AMR. On the basis of its review, the staff concluded that the applicant adequately identified the CW pump house SCs within the scope of license renewal, as required by 10 CFR 54.4(a), and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.5 Diesel Generator Building

2.4.5.1 Summary of Technical Information in the Application

The DG building is a reinforced concrete diaphragm slab and shear wall type structure that is supported on its own foundations consisting of continuous wall footings, isolated spread footings for concrete columns, and isolated equipment foundations. The building is a Seismic Category I structure.

The building houses two DGs and a HPCS DG engine that are located on the ground floor, each in a separate room for fire protection and equipment segregation. The second level houses air handling units ,and the third level houses exhaust silencers. In addition, a diesel oil fuel tank is horizontally buried below each of the three subcompartments in the easterly room, located in the ground level. These tanks are buried in quality Category I backfill, which provides protection for the tanks against fire, Seismic Category I disturbances, the design basis tornado, and tornado-generated missiles. The purpose of the DG building is to provide support and protection for equipment, such as the DGs, and to support the ability to maintain required temperatures for operation.

LRA Table 2.4-5 identifies the components subject to an AMR for the DG building by component type and intended function.

2.4.5.2 Staff Evaluation

The staff reviewed LRA Section 2.4.5 using the evaluation methodology described in SER Section 2.4 and the guidance in SRP-LR Section 2.4. During its review of LRA Section 2.4.5, the staff identified areas in which additional information was necessary to complete the evaluation of the applicant's scoping and screening results for the DG building.

In a letter dated August 6, 2010, staff issued RAI 2.4.5-1 and asked that the applicant confirm the inclusion of the reinforced concrete columns in the scope of license renewal and subsequent AMR and provide the location where it is covered.

In its response to the RAI, dated September 24, 2010, the applicant stated that the reinforced concrete columns that provide support to the DG building are included in the scope of license renewal and have an AMR program.

The applicant also stated that the reinforced concrete columns are described as part of the generic component type "Foundations," and portions of columns above the foundation are included under the component type "Reinforced Concrete: walls, floor and ceilings."

Based on its review, the staff finds the response to RAI 2.4.5-1 acceptable because the reinforced concrete columns that provide support and balance to the DG building have been included in the scope of license renewal and are subject to an AMR. Therefore, the staff's concern described in RAI 2.4.5-1 is resolved.

2.4.5.3 Conclusion

The staff followed the evaluation methodology discussed in Section 2.4 and reviewed the LRA, UFSAR, and RAI responses to determine if the applicant failed to identify any SCs within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any SCs subject to an AMR. On the basis of its review, the staff concluded that the applicant adequately identified the DG building SCs within the scope of license renewal, as required by 10 CFR 54.4(a), and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.6 Fresh Air Intake Structures 1 and 2

2.4.6.1 Summary of Technical Information in the Application

The fresh air intake 1 and 2 structures are predominantly buried structures with above-grade access grating to the air intake plenum. The structures are classified as Seismic Category I structures and are physically remote from all plant structures.

In addition, these structures are designed to withstand the effects of Seismic Category I disturbances, design basis wind velocity, and design basis tornado and tornado-generated missiles.

Fire external to the plant, and any resulting ingress of smoke or combustion vapors, are detected by smoke detectors in the control room fresh air intake ducting, which will alarm in the control room. By letter dated February 16, 2012 that applicant provided an LRA supplement stating that the fire rated dampers will no longer close automatically, but can be manually shut, if necessary, to place the control room in an unfiltered recirculation mode. The resulting supplement does not change the scoping and screening results, since the SSCs did not change.

The purpose of the fresh air intake structure, that is part of the main control room habitability system, is to ensure habitability inside the main control room during all normal and abnormal station operating conditions. The function of the fresh air intake structure is to provide protection from airborne radioactivity by means of pressurizing the control room with filtered air drawn from either of two separate remote fresh air intakes in the event of a LOCA.

LRA Table 2.4-6 identifies the components subject to an AMR for the fresh air intake structure by component type and intended function.

2.4.6.2 Conclusion

The staff followed the evaluation methodology discussed in Section 2.4 and reviewed the LRA and UFSAR to determine if the applicant failed to identify any SSCs within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any SCs subject to an AMR. On the basis of its review, the staff concluded that the applicant adequately identified the fresh air intake structures SCs within the scope of license renewal, as required by 10 CFR 54.4(a), and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.7 Makeup Water Pump House

2.4.7.1 Summary of Technical Information in the Application

The makeup water pump house is a non-Seismic Category I superstructure that has one main level. It is a safety-related installation designed to withstand the design basis tornado and tornado generated missiles. The superstructure is of reinforced concrete, except for miscellaneous platforms and for a portion of the operating floor located over the pump pit and pump floor areas, which are of structural steel framing floored over with steel grating.

The makeup water pump house provides physical support and protection to the makeup water pumps, which are required to supply water to the spray ponds and provide feed-and-bleed mode of operation in the event a design basis tornado empties the ponds of their coolant.

The purpose of the makeup water pump house is to provide structural or functional support to nonsafety-related equipment, whose failure could prevent satisfactory accomplishment of required safety functions. Additionally, the makeup water pump house provides support and protection for equipment and supports the ability to maintain required temperatures for operation. In addition, this building provides physical support and protection to the makeup water pumps, which are required to supply water to the spray ponds and provide feed-and-bleed mode of operation in the event that a design basis tornado empties the ponds of their coolant.

LRA Table 2.4-7 identifies the components subject to an AMR for the makeup water pump house by component type and intended function.

2.4.7.2 Conclusion

The staff followed the evaluation methodology discussed in Section 2.4 and reviewed the LRA and UFSAR to determine if the applicant failed to identify any SSCs within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any SCs subject to an AMR. On the basis of its review, the staff concluded that the applicant adequately identified the makeup water pump house SCs within the scope of license renewal, as required by 10 CFR 54.4(a), and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.8 Radwaste Control Building

2.4.8.1 Summary of Technical Information in the Application

The radwaste control building, houses the control room, cable spreading rooms, critical switchgear room, battery room, HVAC equipment room, off gas treatment room, and the liquid and solids radwaste systems.

The radwaste control building is a Seismic Category I structure. Part of the radwaste control building is a cast-in-place reinforced concrete structure and part is a structural steel framed structure. The radwaste control building houses equipment and components for both safety-related and nonsafety-related systems. Those portions of the radwaste control building that house systems or components necessary for safe shutdown of the reactor are designed to Quality Class I and Seismic Category I requirements. Similarly, those portions of the radwaste control building housing equipment containing radioactive material are designed to Seismic Category I requirements.

The purpose of the radwaste control building is to provide support and protection for equipment, and ensure the ability to maintain required temperatures for operation. The main control room is designed to ensure habitability during all normal and abnormal station operating conditions, including 30 days of habitability following a LOCA.

LRA Table 2.4-8 identifies the components subject to an AMR for the radwaste control building by component type and intended function.

2.4.8.2 Staff Evaluation

The staff reviewed LRA Section 2.4.8 using the evaluation methodology described in SER Section 2.4 and the guidance in SRP-LR Section 2.4. During its review of the LRA Section 2.4.8, the staff identified areas in which additional information was necessary to complete the evaluation of the applicant's scoping and screening results for the DG building.

In a letter dated August 6, 2010, the staff issued RAI 2.4.8-1 and asked that the applicant provide a more detailed description of the component types—"Reinforced Concrete: walls, floors and ceilings" and the "Partition Walls"—in order to clarify the difference and relationship between both since they are listed as separate component types but have the same intended function.

In its response to the RAI, dated September 24, 2010, the applicant stated that the intended functions of the "Reinforced Concrete: walls, floors, and ceilings" in the radwaste control building include the following:

- provide shelter or protection to safety-related equipment
- provide rated fire barrier to confine or retard a fire from spreading to or from adjacent areas
- provide shielding against radiation
- provide pressure boundary or essentially leak tight barrier to protect public health and safety in the event of postulated DBEs
- provide structural or functional support required to meet the NRC's regulations for any of the regulated events in 10 CFR 54.4(a)(3)
- provide structural or functional support to safety-related equipment

The applicant also stated that the "Partition Walls" are not included under "Reinforced Concrete: walls, floors, and ceiling" component because they are metal partitions.

In addition, the intended function of the metal partitions was incorrectly identified as "Support for Criterion (a)(3) Equipment (SRE)," since they are not credited for Fire Protection. The correct intended function of the partition walls is "Support for Criterion (a)(2) Equipment (SNS)," due to its proximity to safety-related equipment.

Based on its review, the staff finds the response to RAI 2.4.8-1 acceptable because the additional information on the "Reinforced Concrete: walls, floors and ceilings" and the "Partition Walls" clarified the difference and relationship between both, including their intended function. Therefore, the staff's concern described in RAI 2.4.8-1 is resolved.

2.4.8.3 Conclusion

The staff followed the evaluation methodology discussed in Section 2.4 and reviewed the LRA, UFSAR, and RAI responses to determine if the applicant failed to identify any SSCs within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any SCs subject to an AMR. On the basis of its review, the staff concluded that the applicant adequately identified the radwaste control building SCs within the scope of license renewal, as required by 10 CFR 54.4(a), and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.9 Service Building

2.4.9.1 Summary of Technical Information in the Application

The service building is a two-story Seismic Category II structure physically adjacent to the reactor building.

The service building houses two motor-operated auxiliary steam isolation valves that are safety-related components. The isolation of the auxiliary steam system is a safety-related function since it is a potential HELB source to the reactor building that could affect the qualified life of safety-related equipment.

The service building, reactor building, radwaste control building, turbine generator building, and the DG building are grouped together to form the plant complex. However, the buildings are separated from each other by gaps and are supported on separate foundation mats.

The service building meets the scoping criteria of 10 CFR 54.4(a)(2) because it is a Seismic Category II structure adjacent to a Seismic Category I structure (reactor building) and contains structural components that are nonsafety-related whose failure could prevent satisfactory accomplishment of safety-related functions.

LRA Table 2.4-9 identifies the components subject to an AMR for the service building by component type and intended function.

2.4.9.2 Conclusion

The staff followed the evaluation methodology discussed in Section 2.4 and reviewed the LRA and UFSAR to determine if the applicant failed to identify any SSCs within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any SCs subject to an AMR. On the basis of its review, the staff concluded that the applicant adequately identified the service building SCs within the scope of license renewal, as required by 10 CFR 54.4(a), and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.10 Turbine Generator Building

2.4.10.1 Summary of Technical Information in the Application

The turbine generator building is a reinforced concrete structure from the foundation up to the operating floor level. Above the operating floor, the exterior walls consist of insulated metal siding supported by a structural steel frame. The roof consists of insulated metal decking covered with built-up roofing. The building structure and the turbine generator pedestal are supported on a common concrete foundation mat. The turbine generator building foundation mat and structure are designed to withstand the effects of an safe shutdown earthquake (SSE) and maintain its structural integrity.

The purpose of the modified non-Seismic Category I turbine generator building is to house the turbine generator, condensing equipment, moisture separator re-heaters, feedwater heaters, 200-ton-capacity overhead crane and to provide protection for the MS lines designed as Seismic Category I. The turbine generator building is determined to be within scope because it provides structural or functional support to nonsafety-related equipment whose failure could prevent satisfactory accomplishment of required safety functions.

LRA Table 2.4-10 identifies the components subject to an AMR for the turbine generator building by component type and intended function.

2.4.10.2 Conclusion

The staff followed the evaluation methodology discussed in Section 2.4 and reviewed the LRA and UFSAR to determine if the applicant failed to identify any SSCs within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any SCs subject to an AMR. On the basis of its review, the staff concluded that the applicant adequately identified the turbine generator building SCs within the scope of license renewal, as required by 10 CFR 54.4(a), and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.11 Water Filtration Building

2.4.11.1 Summary of Technical Information in the Application

The water filtration building is a Seismic Category II structure. The diesel-driven fire pump, located in the water filtration building, delivers the secondary water supply for fire protection. The water filtration building has a reinforced concrete floor, insulated metal wall panels, and metal roof deck over structural steel framing.

The purpose of the water filtration building is to provide physical support and protection to the diesel driven fire pump. The water filtration building contains SCs that are relied upon during postulated fires.

LRA Table 2.4-11 identifies the components subject to an AMR for the water filtration building by component type and intended function.

2.4.11.2 Conclusion

The staff followed the evaluation methodology discussed in Section 2.4 and reviewed the LRA and UFSAR to determine if the applicant failed to identify any SSCs within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any SCs subject to an AMR. On the basis of its review, the staff concluded that the applicant adequately identified the water filtration building SCs within the scope of license renewal, as required by 10 CFR 54.4(a), and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.12 Yard Structures

2.4.12.1 Summary of Technical Information in the Application

The yard structures are structures not contained within or attached to buildings such as the reactor building, turbine generator building, DG buildings, or radwaste control building. However, one exception is the CW basin that is attached to the CW pump house. The CW basin is grouped into the yard structures. The yard structures evaluated for license renewal include foundations and structural arrangements for outside tanks, basins, SBO components, duct banks, cable trenches, manholes, valve pits, and electrical towers.

The following structures are within the scope of license renewal:

- CW basin
- condensate storage tank foundations and retaining area

- cooling tower basins
- diesel fuel polishing building
- fire water bladder tank embankment
- hydrogen storage and supply facility (HSSF)
- mobile fire response vehicle and trailer
- SBO component foundations and structures in the yard
- duct banks, cable trenches, manholes, valve pits, and electrical towers

The CW basin is a Seismic Category II and rectangular box-like basin connected to the south side of the CW pump house. The CW basin provides impoundment of the primary source of fire water and a bleed path in the feed-and-bleed mode, in the event that the spray pond spray headers are damaged by a tornado-generated missile.

The condensate storage tanks are Seismic Category II, and they are located inside a Seismic Category I concrete structure, which is designed to retain the condensate from both tanks. A minimum inventory of 135,000 gallons in the condensate storage tanks are reserved for the RCIC and HPCS pumps to ensure the immediate availability of a sufficient quantity of condensate for emergency core cooling and reactor shutdown.

The Seismic Category II cooling towers are located such that there can be no physical interaction between the cooling towers and the plant structures important to safety in the unlikely event of a tower collapse. Six cooling towers have the capacity to cool plant service water during normal operation and standby service water during shutdown operation. The cooling towers are not within the scope of license renewal, but the cooling tower basins are within license renewal scope since they are part of the bleed path in the feed-and-bleed mode in the event that the spray pond spray headers are damaged by a tornado-generated missile.

The diesel fuel polishing building is a Seismic Category II structure, and it is a commercial grade steel framed building installed on a concrete slab at grade located in the yard. The diesel fuel polishing building provides support and protection for the filter polisher skid which is an anchor for the nonsafety-related piping that is directly connected to safety-related piping in the diesel fuel oil system.

The fire water bladder tank embankment provides support and protection to the fire water bladder tank. The secondary source of fire water supply is drawn from a 400,000-gallon embankment supported bladder tank with a dedicated water supply of 284,640 gallons.

The HSSF is part of a hydrogen water chemistry system to prevent and mitigate inter-granular stress corrosion cracking in reactor internal structures and piping welds. The HSSF liquid hydrogen storage tank, foundation and anchorage are designed for Seismic Category I loads and ground motion as defined by Regulatory Guide 1.60. In addition, they were designed to remain in place for both design basis tornado characteristics and maximum probable flood. In addition, it is designed to remain in place for both design basis tornado characteristics and maximum probable flood.

A mobile fire response vehicle and trailer is equipped with the equivalent of three hose houses and provides sufficient hose so that a single fire at any plant location can be reached by an effective hose stream. The mobile fire response vehicle and trailer provide firefighting equipment storage for the equivalent of three hose houses that are relied upon during a fire protection regulated event.

The power sources supplied to the plant via startup transformer and backup transformer provide the SBO recovery path from the offsite power system and includes the Ashe relay house to the SBO path.

The purpose of the SBO component foundations and structures is to provide physical support for transformers and associated breakers, disconnect switches, controls, and batteries.

Duct banks, cable trenches, manholes, valve pits, and electrical towers located in the yard are structural component groups. They provide physical support and shelter to safety-related equipment, nonsafety-related equipment whose failure could prevent satisfactory accomplishment of required safety functions, and equipment relied upon to demonstrate compliance with the Station Blackout (10 CFR 50.63) regulated event.

LRA Table 2.4-12 identifies the components subject to an AMR for the yard structures by component type and intended function.

2.4.12.2 Conclusion

The staff followed the evaluation methodology discussed in Section 2.4 and reviewed the LRA and UFSAR to determine if the applicant failed to identify any SSCs within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any SCs subject to an AMR. On the basis of its review, the staff concluded that the applicant adequately identified the miscellaneous yard structures SCs within the scope of license renewal, as required by 10 CFR 54.4(a), and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.4.13 Bulk Commodities

2.4.13.1 Summary of Technical Information in the Application

The bulk commodities are SC groups that support in-scope structures and mechanical and electrical systems. They are common to multiple SSCs and share material and environment properties that allow a common program or inspection to manage their aging effects.

The bulk commodities is determined to be within scope because it contains the following:

- SCs that are safety-related and are relied upon to remain functional during and following DBEs
- SCs that are nonsafety-related whose failure could prevent satisfactory accomplishment of safety-related functions
- SCs that are relied on during postulated fires, ATWS, and SBO events

LRA Table 2.4-13 identifies the components subject to an AMR for the bulk commodities by component type and intended function.

2.4.13.2 Staff Evaluation

The staff reviewed the LRA Section 2.4.13 (only scoping and screening results of fire barriers), UFSAR, and license renewal drawings, using the evaluation methodology described in the SER Section 2.3 and guidance in SRP-LR, Section 2.3. During its review, the staff evaluated the system functions described in the LRA and UFSAR to verify that the applicant had not omitted from the scope of license renewal any components with intended functions pursuant to

10 CFR 54.4(a). The staff then reviewed those components that the applicant identified as within the scope of license renewal to verify that the applicant had not omitted any passive or long-lived components subject to an AMR, in accordance with 10 CFR 54.21(a)(1).

The staff also reviewed the following fire protection documents cited in the CLB, listed in the Columbia Operating License Condition 2.C(14):

- NUREG-0892, "Safety Evaluation Report related to the operation of WPPSS Nuclear Project No. 2," dated March 1982
- NUREG-0892, supplement 3 "Safety Evaluation Report related to the operation of WPPSS Nuclear Project No. 2," dated May 1983
- NUREG-0892, supplement 4 "Safety Evaluation Report related to the operation of WPPSS Nuclear Project No. 2," dated December 1983
- NRC SERs issued with letters dated November 11, 1987, and May 22, 1989

Based on the documents above, the staff reviewed the Columbia commitment to 10 CFR 50.48, "Fire protection" (i.e., approved Fire Protection Program). The review consisted of a point-by-point comparison with Appendix A to the BTP APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," May 1, 1976, documented in the UFSAR, Appendix F.

During its review of LRA Section 2.4.13, the staff identified areas in which additional information was necessary to complete its review of the applicant's scoping and screening results of fire barriers.

In a letter dated June 24, 2010, the staff issued RAI 2.4.13-1 and stated that LRA Section 2.1.2.2, "Screening of Structures," provides the methodology for determining the SCs, including fire barriers, within the scope of license renewal. LRA Section 2.4.13, "Bulk Commodities," and Table 2.4-13 provide the results of scoping and screening of structures, including fire barriers. However, scoping and screening results do not provide the type of fire barriers present in various fire areas of the plant.

The staff asked that the applicant provide details of fire barrier type and material in each plant fire area within scope of license renewal, in accordance with 10 CFR 54.4(a), and subject to an AMR, in accordance with 10 CFR 54.21(a)(1). For any fire barrier type or material that is excluded from the scope of license renewal and is not subject to an AMR, the staff asked that the applicant provide justification for the exclusion.

In a letter dated April 19, 2010, the applicant responded to RAI 2.4.13-1 and stated:

> All plant fire barrier types and materials are within the scope of license renewal to support 10 CFR 54.4(a)(3) criteria. There are no fire barriers or materials (in plant fire areas in-scope) that were excluded from the scope of license renewal. Energy Northwest performed the fire barriers AMR and determined that all fire doors, fire stops, fire proofing, and fire wraps are subject to an AMR. The fire barriers material, environment, aging effect requiring management, and AMP are addressed in LRA Table 3.5.2-13. Therefore, no fire barrier types or materials (in plant fire areas in-scope) were excluded from the scope of license renewal regardless of location in the plant.

Based on its review, the staff finds the applicant's response to RAI 2.4.13-1 acceptable because it clarified that fire barrier assemblies and components in question are within the scope of license renewal and are required to perform a fire barrier function. The applicant noted that no fire barriers were excluded from the scope of license renewal regardless of location in the plant. LRA Table 3.5.2-13 provides the AMR results for in-scope fire barriers. Furthermore, LRA Section 2.3.3.22, stated that fire barriers, fire dampers, fire doors, and fire penetration seals are within the scope of license renewal and subject to AMR. The staff's concern described in RAI 2.4.13-1 is resolved.

2.4.13.3 Conclusion

The staff followed the evaluation methodology discussed in Section 2.4 and reviewed the LRA, UFSAR, and RAI responses to determine if the applicant failed to identify any SSCs within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any SCs subject to an AMR. On the basis of its review, the staff concluded that the applicant adequately identified the miscellaneous bulk commodities SCs within the scope of license renewal, as required by 10 CFR 54.4(a), and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

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

This section documents the staff's review of the applicant's scoping and screening results for electrical and I&C systems. Specifically, this section discusses electrical and I&C component commodity groups

In accordance with the requirements of 10 CFR 54.21(a)(1), the applicant must list passive, long-lived systems as SSCs within the scope of license renewal and subject to an AMR. To verify that the applicant properly implemented its methodology, the staff's review focused on the implementation results. This focus allowed the staff to confirm that there were no omissions of electrical and I&C system components that meet the scoping criteria and are subject to an AMR.

The staff's evaluation of the information in the LRA was the same for all electrical and I&C systems. The objective was to determine if the applicant identified, in accordance with 10 CFR 54.4, components and supporting structures for electrical and I&C systems that appear to meet the license renewal scoping criteria. Similarly, the staff evaluated the applicant's screening results to verify that all in-scope passive, long-lived components were subject to an AMR in accordance with 10 CFR 54.21(a)(1).

In its scoping evaluation, the staff reviewed the applicable LRA sections, focusing on components that have not been identified as within the scope of license renewal. The staff reviewed the UFSAR for each electrical and I&C system to determine if the applicant omitted, from the scope of license renewal, components with intended functions delineated under 10 CFR 54.4(a).

After its review of the scoping results, the staff evaluated the applicant's screening results. For those SSCs with intended functions, the staff sought to determine if the functions are performed with moving parts or a change in configuration or properties or the SSCs are subject to replacement after a qualified life or specified time period, as described in 10 CFR 54.21(a)(1). For those meeting neither of these criteria, the staff sought to confirm that these SSCs were subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.5.1 Electrical and Instrumentation and Controls Component Commodity Groups

2.5.1.1 Summary of Technical Information in the Application

LRA Section 2.5 describes the electrical and I&C systems. The scoping method includes all plant electrical and I&C components. Evaluation of electrical systems includes electrical and I&C components in mechanical systems. The plant-wide basis approach for the review of plant equipment eliminates the need to show each unique component and its specific location and prevents improper exclusion of components from an AMR.

LRA Table 2.5-1 identifies the following electrical and I&C systems component types and their intended functions within the scope of license renewal and subject to an AMR:

- non-environmentally qualified insulated cables and connections—conduct electricity
- non-environmentally qualified, low-current instrument cables and connections—conduct electricity
- non-environmentally qualified, medium-voltage power cables—conduct electricity
- cable connections (metallic parts)—conduct electricity
- fuse holders (insulation, metallic clamp)—conduct electricity
- metal-enclosed bus, non-segregated (bus and connections)—conduct electricity
- metal-enclosed bus, non-segregated (enclosure assemblies)—support (structural)
- metal-enclosed bus, non-segregated (insulation and insulators)—insulation
- switchyard bus and connections—conduct electricity
- transmission conductors and connections—conduct electricity
- un-insulated ground conductors and connections—conduct electricity
- high-voltage insulators—insulation (and support)
- electrical equipment subject to 10 CFR 50.49 EQ requirements—various
- cable tie wraps (addressed in LRA Section 2.4)—support (structural)

2.5.1.2 Staff Evaluation

The staff reviewed LRA Section 2.5 and the UFSAR Sections 7 and 8, using the evaluation methodology described in SER Section 2.5 and the guidance in SRP-LR Section 2.5, “Scoping and Screening Results: Electrical and Instrumentation and Controls Systems.”

During its review, the staff evaluated the system functions described in the LRA and UFSAR to verify that the applicant has not omitted, from the scope of license renewal, any components with intended functions delineated under 10 CFR 54.4(a). The staff then reviewed those components that the applicant identified as within the scope of license renewal to verify that the applicant has not omitted any passive and long-lived components subject to an AMR, in accordance with the requirements of 10 CFR 54.21(a)(1).

General Design Criteria 17 of 10 CFR Part 50, Appendix A, requires that electric power from the transmission network to the onsite electric distribution system be supplied by two physically independent circuits to minimize the likelihood of their simultaneous failure. In addition, the staff noted that the guidance provided by letter, dated April 1, 2002 (ADAMS Accession No. ML020920464), "Staff Guidance on Scoping of Equipment Relied on to Meet the Requirements of the Station Blackout Rule (10 CFR 50.63) for License Renewal (10 CFR 54.4(a)(3))," and later incorporated in SRP-LR Section 2.5.2.1.1, states the following:

> For purposes of the license renewal rule, the staff has determined that the plant system portion of the offsite power system that is used to connect the plant to the offsite power source should be included within the scope of the rule. This path typically includes switchyard 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 system, and the associated control circuits and structures. Ensuring that the appropriate offsite power system long-lived passive SSCs that are part of this circuit path are subject to an AMR will assure that the bases underlying the station blackout (SBO) requirements are maintained over the period of extended license.

The applicant included the complete circuits between the onsite circuits up to, and including, switchyard breakers in the 230 kilovolt (kV) Ashe Substation and the 115 kV Columbia Substation (which includes the associated controls and structures) supplying startup transformer E-TR-S and backup transformer E-TR-B within the scope of license renewal. The circuit from the start-up transformer (E-TR-S) to the Class 1E buses is through the non-segregated bus to switchgear SM-1 and SM-3. Each of these nonsafety-related switchgear feed to the Class 1E switchgear for Division 1 and Division 2 (SM-7 and SM-8, respectively). The circuit from the backup transformer (E-TR-B) to the Class 1E buses is directly connected by cable (routed underground and then in tray) to the Class 1E switchgear for Division 1 and Division 2 (SM-7 and SM-8, respectively). Consequently, the staff concluded that the scoping is consistent with the guidance issued April 1, 2002, and later incorporated in SRP-LR Section 2.5.2.1.1.

2.5.1.3 Conclusion

The staff reviewed the LRA and the UFSAR to determine if the applicant failed to identify any SSCs within the scope of license renewal. In addition, the staff's review determined if the applicant failed to identify any components subject to an AMR. On the basis of its review, the staff concluded that the applicant appropriately identified the electrical and I&C systems components within the scope of license renewal, as required by 10 CFR 54.4(a), and those subject to an AMR, as required by 10 CFR 54.21(a)(1).

2.6 Conclusion for Scoping and Screening

The staff reviewed the information in LRA Section 2, "Scoping and Screening Methodology for Identifying Structures and Components Subject to Aging Management Review, and Implementation Results." The staff finds that the applicant's scoping and screening methodology is consistent with the requirements of 10 CFR 54.21(a)(1) and the staff's position on the treatment of safety-related and nonsafety-related SSCs within the scope of license renewal, and the SCs requiring an AMR are consistent with the requirements of 10 CFR 54.4 and 10 CFR 54.21(a)(1). On the basis of its review, the staff concluded that the applicant adequately identified those SSCs that are within the scope of license renewal, as required by 10 CFR 54.4(a), and those SCs that are subject to an AMR, as required by 10 CFR 54.21(a)(1).

SECTION 3

AGING MANAGEMENT REVIEW RESULTS

This section of the safety evaluation report (SER) evaluates aging management programs (AMPs) and aging management reviews (AMRs) for Columbia Generating Station (Columbia), by the staff of the U.S. Nuclear Regulatory Commission (NRC) (the staff).

In Appendix B of its license renewal application (LRA), Energy Northwest (the applicant) described the 53 AMPs it relies on to manage or monitor the aging of passive and long-lived structures and components (SCs).

In LRA Section 3, the applicant provided the results of the AMRs for those SCs identified in LRA Section 2 as within the scope of license renewal and subject to an AMR.

3.0 Applicant's Use of the Generic Aging Lessons Learned Report

In preparing its LRA, the applicant credited NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," Revision 1, dated September 2005. The GALL Report contains the staff's generic evaluation of the existing plant programs and documents the technical basis for determining where existing programs are adequate without modification and where existing programs should be augmented for the period of extended operation. The evaluation results documented in the GALL Report indicate that many of the existing programs are adequate to manage the aging effects for particular SCs for license renewal without change. The GALL Report also contains recommendations on specific areas for which existing programs should be augmented for license renewal. An applicant may reference the GALL Report in its LRA to demonstrate that the programs at its facility correspond to those reviewed and approved in the GALL Report.

The purpose of the GALL Report is to provide the staff with a summary of staff-approved AMPs to manage or monitor the aging of SCs subject to an AMR. If an applicant commits to implementing these staff-approved AMPs, the time, effort, and resources used to review an applicant's LRA will be greatly reduced, thereby improving the efficiency and effectiveness of the license renewal review process. The GALL Report also serves as a reference for applicants and staff reviewers to quickly identify those AMPs and activities that the staff has determined will adequately manage or monitor aging during the period of extended operation.

The GALL Report identifies the following:

- systems, structures, and components (SSCs)
- SC materials
- environments to which the SCs are exposed
- the aging effects associated with the materials and environments
- the AMPs credited with managing or monitoring the aging effects
- recommendations for further applicant evaluations of aging management for certain component types

The staff performed its review in accordance with the requirements of Title 10, Part 54 of the *Code of Federal Regulations* (10 CFR Part 54), "Requirements for Renewal of Operating Licenses for Nuclear Power Plants"; the guidance provided in NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants" (SRP-LR), Revision 1, dated September 2005; and the guidance provided in the GALL Report.

In addition to its review of the LRA, the staff conducted an onsite audit of selected AMRs and associated AMPs during the week of May 28, 2010, as described in the "Audit Report Regarding the Columbia Generating Station, License Renewal Application," dated January 21, 2011 (Agencywide Document Access and Management System (ADAMS) Accession No. ML102450757). The onsite audits and reviews are designed to maximize the efficiency of the staff's LRA review. The applicant can respond to questions, the staff can readily evaluate the applicant's responses, the need for formal correspondence between the staff and the applicant is reduced, and the result is an improvement in review efficiency.

3.0.1 Format of the License Renewal Application

The applicant submitted an application that followed the standard LRA format, as determined by the staff and the Nuclear Energy Institute (NEI) by letter dated April 7, 2003 (ADAMS Accession No. ML030990052). This LRA format incorporates lessons learned from the staff's reviews of previous LRAs, which used a format developed from information gained during a staff-NEI demonstration project conducted to evaluate the use of the GALL Report in the LRA review process.

The organization of LRA Section 3 parallels Chapter 3 of the SRP-LR. The AMR results information in LRA Section 3 is presented in the following two table types:

(1) Table 3.x.1—where "3" indicates the LRA section number, "x" indicates the subsection number from the GALL Report, and "1" indicates that this is the first table type in LRA Section 3

(2) Table 3.x.2-y—where "3" indicates the LRA section number, "x" indicates the subsection number from the GALL Report, "2" indicates that this is the second table type in LRA Section 3, and "y" indicates the system table number

The content of the previous LRAs and Columbia application are essentially the same. The intent of the format used for the LRA was to modify the tables in LRA Section 3 to provide additional information that would assist the staff in its review. In each Table 1, the applicant summarized the portions of the application that it considered to be consistent with the GALL Report. In each Table 2, the applicant identified the linkage between the scoping and screening results in LRA Section 2 and the AMRs in LRA Section 3.

3.0.1.1 Overview of Table 1s

Each Table 1 summarizes and compares how the facility aligns with the corresponding tables in the GALL Report. The tables are essentially the same as Tables 1 through 6 in the GALL Report, except that the "Type" column has been replaced by an "Item Number" column and the "Item Number in GALL" column has been replaced by a "Discussion" column. The "Item Number" column is a means for the staff reviewer to cross-reference Table 2s with Table 1s. In the "Discussion" column, the applicant provided clarifying information.

The following are examples of information that might be contained within this column:

- further evaluation recommended—information or reference to information on further evaluations
- name of a plant-specific program
- exceptions to GALL Report assumptions
- discussion of how the line item is consistent with the corresponding line item in the GALL Report when the consistency may not be obvious
- discussion of how the item is different from the corresponding line item in the GALL Report (e.g., when an exception is taken to a GALL Report AMP)

The format of each Table 1 allows the staff to align a specific row in the table with the corresponding GALL Report table row so that the consistency can be checked easily.

3.0.1.2 Overview of Table 2s

Each Table 2 provides the detailed results of the AMRs for components identified in LRA Section 2 as subject to an AMR. The LRA has a Table 2 for each of the systems or structures within a specific system grouping (e.g., reactor coolant system (RCS), engineered safety features (ESFs), auxiliary systems, etc.). For example, the ESF group has tables specific to the high-pressure core spray (HPCS), low-pressure core spray (LPCS), and residual heat removal (RHR) system. Each Table 2 consists of the following columns:

- Component type—The first column lists LRA Section 2 component types subject to an AMR in alphabetical order.
- Intended function—The second column identifies the license renewal intended functions, including abbreviations, where applicable, for the listed component types. Definitions and abbreviations of intended functions are in LRA Table 2.0-1.
- Material—The third column lists the particular construction material(s) for the component type.
- Environment—The fourth column lists the environments to which the component types are exposed. Internal and external service environments are indicated with a list of these environments in LRA Tables 3.0-1 and 3.0-2.
- Aging effect requiring management (AERM)—The fifth column lists AERMs. As part of the AMR process, the applicant determined any AERMs for each combination of material and environment.
- AMPs—The sixth column lists the AMPs that the applicant uses to manage the identified aging effects.
- NUREG-1801 Volume 2 Item—The seventh column lists the GALL Report item(s) identified in the LRA as similar to the AMR results. The applicant compared each combination of component type, material, environment, AERM, and AMP in LRA Table 2 with the GALL Report items. If there were no corresponding items in the GALL Report, the applicant indicated "N/A" [not applicable] in the column to identify the AMR results in the LRA tables corresponding to the items in the GALL Report tables.
- Table 1 Item—The eighth column lists the corresponding summary item number from LRA Table 1. If the applicant identifies in each LRA Table 2 AMR results consistent with the GALL Report, the Table 1 line item summary number should be listed in LRA

Table 2. If there is no corresponding item in the GALL Report, the applicant indicated "N/A" [not applicable] in the column. In this manner, the information from the two tables can be correlated.

- Notes—The ninth column lists the corresponding notes used to identify how the information in each Table 2 aligns with the information in the GALL Report. The notes, identified by letters, were developed by an NEI work group and will be used in future LRAs. Any plant-specific notes identified by numbers provide additional information about the consistency of the line item with the GALL Report.

3.0.2 Staff's Review Process

The staff conducted the following types of evaluations of the AMRs and AMPs:

- For items that the applicant stated were consistent with the GALL Report, the staff conducted either an audit or a technical review to determine consistency.
- For items that the applicant stated were consistent with the GALL Report with exceptions, enhancements, or both, the staff conducted either an audit or a technical review of the item to determine consistency. In addition, the staff conducted either an audit or a technical review of the applicant's technical justifications for the exceptions or the adequacy of the enhancements.

  The SRP-LR states that an applicant may take one or more exceptions to specific GALL Report AMP elements; however, any deviation from or exception to the GALL Report AMP should be described and justified. Therefore, the staff considers exceptions as being portions of the GALL Report AMP that the applicant does not intend to implement.

  In some cases, an applicant may choose an existing plant program that does not meet all the program elements defined in the GALL Report AMP. However, the applicant may make a commitment to augment the existing program to satisfy the GALL Report AMP prior to the period of extended operation. Therefore, the staff considers these augmentations or additions to be enhancements. Enhancements include, but are not limited to, activities needed to ensure consistency with the GALL Report recommendations. Enhancements may expand, but not reduce, the scope of an AMP.

- For other items, the staff conducted a technical review to verify conformance with 10 CFR 54.21(a)(3) requirements.

Staff audits and technical reviews of the applicant's AMPs and AMRs determine if the aging effects on SCs can be adequately managed to maintain its intended functions consistent with the plant's current licensing basis (CLB) for the period of extended operation, as required by 10 CFR Part 54.

3.0.2.1 Review of AMPs

For AMPs for which the applicant claimed consistency with the GALL Report AMPs, the staff conducted either an audit or a technical review to verify the claim. For each AMP with one or more deviations, the staff evaluated each deviation to determine if the deviation was acceptable and if the modified AMP would adequately manage the aging effect(s) for which it was credited. For AMPs not evaluated in the GALL Report, the staff performed a full review to determine its adequacy. The staff evaluated the AMPs against the following 10 program elements defined in SRP-LR Appendix A:

(1) Scope of the Program—Scope of the program should include the specific SCs subject to an AMR for 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 structure or component intended functions.

(4) Detection of Aging Effects—Detection of aging effects should occur before there is a loss of structure or component intended functions. This includes aspects such as method or technique (i.e., visual, volumetric, surface inspection), frequency, sample size, data collection, and timing of new and 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, as well as timely corrective or mitigative actions.

(6) Acceptance Criteria—Acceptance criteria, against which the need for corrective action will be evaluated, should ensure that the structure or component intended functions are maintained under all CLB design conditions during the period of extended operation.

(7) Corrective Actions—Corrective actions, including root cause determination and prevention of recurrence, should be timely.

(8) Confirmation Process—The confirmation process should ensure that preventive actions are adequate and that appropriate corrective actions have been completed and are effective.

(9) Administrative Controls—Administrative controls should provide for a formal review and approval process.

(10) Operating Experience—Operating experience of the 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 adequately managed so that the SC intended functions will be maintained during the period of extended operation.

Details of the staff's audit evaluation of Program Elements (1) through (6) are documented in SER Section 3.0.3.

The staff reviewed the applicant's Quality Assurance (QA) Program and documented its evaluations in SER Section 3.0.4. The staff's evaluation of the QA Program included an assessment of the "corrective actions," "confirmation process," and "administrative controls" program elements.

3.0.2.2 Review of AMR Results

Each LRA Table 2 contains information concerning whether or not the AMRs identified by the applicant align with the GALL Report AMRs. For a given AMR in a Table 2, the staff reviewed the intended function, material, environment, AERM, and AMP combination for a particular system component type. Item numbers in column 7 of the LRA, “NUREG-1801 Volume 2 Item,” correlate to an AMR combination as identified in the GALL Report. The staff also conducted onsite audits to verify these correlations. A blank in column 7 indicates that the applicant was unable to identify an appropriate correlation in the GALL Report. The staff also conducted a technical review of combinations not consistent with the GALL Report. The next column, “Table 1 Item,” provides a reference number that indicates the corresponding row in Table 1.

3.0.2.3 Updated Final Safety Analysis Report Supplement

Consistent with the SRP-LR for the AMRs and AMPs that it reviewed, the staff also reviewed the UFSAR supplement, which summarizes the applicant’s programs and activities for managing aging effects for the period of extended operation, as required by 10 CFR 54.21(d).

3.0.2.4 Documentation and Documents Reviewed

In its review, the staff used the LRA, LRA supplements, the SRP-LR, and the GALL Report. During the onsite audit, the staff also examined the applicant’s justifications to verify that the applicant’s activities and programs will adequately manage the effects of aging on SCs. The staff also conducted detailed discussions and interviews with the applicant’s license renewal project personnel and others with technical expertise relevant to aging management.

3.0.3 Aging Management Programs

SER Table 3.0-1 presents the AMPs credited by the applicant and described in LRA Appendix B. The table also indicates if the AMP is an existing or new program, the GALL Report AMP with which the applicant claimed consistency, and the section of this SER in which the staff’s evaluation of the program is documented.

Table 3.0-1 Columbia AMPs

Applicant AMP	SER section	New or existing program	Applicant comparison to the GALL Report	GALL Report AMPs	LRA section
Appendix J Program	3.0.3.1.1	Existing	Consistent	XI.S4, “10 CFR 50, Appendix J”	B.2.3
Boiling-Water Reactor (BWR) Feedwater (FW) Nozzle Program	3.0.3.1.2	Existing	Consistent	XI.M5, “BWR Feedwater Nozzle”	B.2.6
BWR Penetrations Program	3.0.3.1.3	Existing	Consistent	XI.M8, “BWR Penetrations”	B.2.7
BWR Stress-Corrosion Cracking (SCC) Program	3.0.3.1.4	Existing	Consistent	XI.M7, “BWR Stress Corrosion Cracking”	B.2.8
BWR Vessel ID Attachment Welds Program	3.0.3.1.5	Existing	Consistent	XI.M4, “BWR Vessel ID Attachment Welds”	B.2.9
BWR Vessel Internals Program	3.0.3.1.6	Existing	Consistent	XI.M9, “BWR Vessel Internals”	B.2.10
BWR Water Chemistry Program	3.0.3.1.7	Existing	Consistent	XI.M2, “Water Chemistry”	B.2.11

Applicant AMP	SER section	New or existing program	Applicant comparison to the GALL Report	GALL Report AMPs	LRA section
Chemistry Program Effectiveness Inspection	3.0.3.1.8	New	Consistent	XI.M32, “One-Time Inspection”	B.2.12
Cooling Units Inspection	3.0.3.1.9	New	Plant-Specific	XI.M32, “One-Time Inspection”	B.2.14
CRDRL Nozzle Program	3.0.3.1.10	Existing	Consistent	XI.M6, “BWR Control Rod Drive Return Line Nozzle”	B.2.15
Diesel Starting Air Inspection	3.0.3.1.11	New	Consistent	XI.M32, “One-Time Inspection”	B.2.16
Diesel Systems Inspection	3.0.3.1.12	New	Plant-Specific	XI.M32, “One-Time Inspection”	B.2.17
Diesel-Driven Fire Pumps Inspection	3.0.3.1.13	New	Plant-Specific	XI.M32, “One-Time Inspection”	B.2.18
Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification (EQ) Requirements Program	3.0.3.1.14	New	Consistent	XI.E1, “Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements	B.2.19
Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Used in Instrumentation Circuits Program	3.0.3.1.15	New	Consistent	XI.E2, “Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Used in Instrument Circuits”	B.2.20
EQ Program	3.0.3.1.16	Existing	Consistent	X.E1, “Environmental Qualifications of Electrical Components”	B.2.22
Heat Exchangers Inspection	3.0.3.1.17	New	Consistent	XI.M32, “One-Time Inspection”	B.2.30
Inaccessible Power Cables Not Subject to 10 CFR 50.49 EQ Requirements Program	3.0.3.1.18	New	Consistent	XI.E3, “Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements	B.2.32
Inservice Inspection (ISI) Program	3.0.3.1.19	Existing	Consistent	XI.M1, “[American Society of Mechanical Engineers] ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD”	B.2.33
ISI Program–IWE	3.0.3.1.20	Existing	Consistent	XI.S1, “ASME Section XI, Subsection IWE”	B.2.34
ISI Program–IWF	3.0.3.1.21	Existing	Consistent	XI.S3, “ASME Section XI, Subsection IWF”	B.2.35

Applicant AMP	SER section	New or existing program	Applicant comparison to the GALL Report	GALL Report AMPs	LRA section
Lubricating Oil Inspection	3.0.3.1.22	New	Consistent	XI.M32, “One-Time Inspection”	B.2.37
Monitoring and Collection Systems Inspection	3.0.3.1.23	New	Plant-Specific	XI.M32, “One-Time Inspection”	B.2.41
Reactor Head Closure Studs Program	3.0.3.1.24	Existing	Consistent	XI.M3, “Reactor Head Closure Studs”	B.2.45
Reactor Vessel Surveillance Program	3.0.3.1.25	Existing	Consistent	XI.M31, “Reactor Vessel Surveillance”	B.2.46
Selective Leaching Inspection	3.0.3.1.26	New	Consistent	XI.M33, “Selective Leaching of Materials”	B.2.47
Service Air System Inspection	3.0.3.1.27	New	Plant-Specific	XI.M32, “One-Time Inspection”	B.2.48
Small Bore Class 1 Piping Inspection	3.0.3.1.28	New	Plant-Specific	XI.M35, “One-Time Inspection of ASME Code Class 1 Small Bore-Piping”	B.2.49
Supplemental Piping/Tank Inspection	3.0.3.1.29	New	Consistent	XI.M32, “One-Time Inspection”	B.2.51
Thermal Aging and Neutron Embrittlement of Cast Austenitic Stainless Steel (CASS) Program	3.0.3.1.30	New	Consistent	XI.M13, “Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)”	B.2.52
Aboveground Steel Tanks Inspection	3.0.3.2.1	New	Consistent with exception	XI.M29, “Aboveground Steel Tanks”	B.2.1
Bolting Integrity Program	3.0.3.2.2	Existing	Consistent with exception	XI.M18, “Bolting Integrity”	B.2.4
Buried Piping and Tanks Inspection Program	3.0.3.2.3	Existing	Consistent with exceptions and enhancement	XI.M34, “Buried Piping and Tanks Inspection”	B.2.5
Closed Cooling Water Chemistry Program	3.0.3.2.4	Existing	Consistent with exceptions and enhancement	XI.M21, “Closed-Cycle Cooling Water System”	B.2.13
Electrical Cable Connections Not Subject to 10 CFR 50.49 EQ Requirements Inspection	3.0.3.2.5	New	Consistent with exception	XI.E6, “Electrical Cable Connections Not Subject to 10 CFR 50.49 EQ Requirements”	B.2.21
External Surfaces Monitoring Program	3.0.3.2.6	Existing	Consistent with enhancement	XI.M36, “External Surfaces Monitoring”	B.2.23
Fatigue Monitoring Program	3.0.3.2.7	Existing	Consistent with enhancement	X.M1, “Metal Fatigue of Reactor Coolant Pressure Boundary”	B.2.24

Applicant AMP	SER section	New or existing program	Applicant comparison to the GALL Report	GALL Report AMPs	LRA section
Fire Protection Program	3.0.3.2.8	Existing	Consistent with exceptions	XI.M26, “Fire Protection”	B.2.25
Fire Water Program	3.0.3.2.9	Existing	Consistent with enhancement	XI.M27, “Fire Water System”	B.2.26
Flexible Connection Inspection	3.0.3.2.10	New	Plant-Specific	XI.M32, “One-Time Inspection”	B.2.27
Flow-Accelerated Corrosion Program	3.0.3.2.11	Existing	Consistent with enhancement	XI.M17, Flow-Accelerated Corrosion”	B.2.28
Fuel Oil Chemistry Program	3.0.3.2.12	Existing	Consistent with exceptions	XI.M30, “Fuel Oil Chemistry”	B.2.29
Lubricating Oil Analysis Program	3.0.3.2.13	Existing	Consistent with enhancement	XI.M39, “Lubricating Oil Analysis”	B.2.36
Masonry Wall Inspection	3.0.3.2.14	Existing	Consistent with enhancement	XI.S5, “Masonry Wall Program”	B.2.38
Material Handling System Inspection Program	3.0.3.2.15	Existing	Consistent	XI.M23, “Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems”	B.2.39
Metal-Enclosed Bus (MEB) Program	3.0.3.2.16	New	Consistent with exceptions	XI.E4, “Metal-Enclosed Bus”	B.2.40
Open-Cycle Cooling Water Program	3.0.3.2.17	Existing	Consistent with exceptions and enhancement	XI.M20, “Open-Cycle Cooling Water System”	B.2.42
Structures Monitoring Program	3.0.3.2.18	Existing	Consistent with enhancement	XI.S6, “Structures Monitoring Program”	B.2.50
Water Control Structures Inspection	3.0.3.2.19	Existing	Consistent with enhancement	XI.S7, Regulatory Guide (RG) 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants”	B.2.53
Air Quality Sampling Program	3.0.3.3.1	Existing	Plant-Specific	Plant-Specific	B.2.2
Boron Carbide (B_4C) Monitoring Program	3.0.3.3.2	New	Plant-specific	Plant-Specific	B.2.54
Cooling Units Inspection Program	3.0.3.3.3	New	Plant-specific	Plant-Specific	B.2.14
Diesel-Driven Fire Pumps Inspection Program	3.0.3.3.4	New	Plant-specific	Plant-Specific	B.2.18
Diesel Systems Inspection Program	3.0.3.3.5	New	Plant-specific	Plant-Specific	B.2.17

Applicant AMP	SER section	New or existing program	Applicant comparison to the GALL Report	GALL Report AMPs	LRA section
Flexible Connection Inspection Program	3.0.3.3.6	New	Plant-specific	Plant-Specific	B.2.27
High-Voltage Porcelain Insulators AMP	3.0.3.3.7	Existing	Plant-specific	Plant-Specific	B.2.31
Monitoring and Collection Systems Inspection	3.0.3.3.8	New	Plant-specific	Plant-Specific	B.2.41
Potable Water Monitoring Program	3.0.3.3.9	Existing	Plant-specific	Plant-Specific	B.2.43
Preventive Maintenance (PM)—Reactor Core Isolation Cooling (RCIC) Turbine Casing	3.0.3.3.10	Existing	Plant-specific	Plant-Specific	B.2.44
Service Air System Inspection	3.0.3.3.11	New	Plant-specific	Plant-Specific	B.2.48
Service Level 1 Protective Coatings Programs	3.0.3.3.12	Existing	Plant-specific	Plant-Specific	B.2.55
Small Bore Class 1 Piping Program	3.0.3.3.13	New	Plant-specific	Plant-Specific	B.2.49

3.0.3.1 AMPs that are Consistent with the GALL Report

In LRA Appendix B, the applicant identified the following AMPs as being consistent with the GALL Report:

- Appendix J
- BWR FW Nozzle
- BWR Penetrations
- BWR SCC
- BWR Vessel ID Attachment Welds
- BWR Vessel Internals
- BWR Water Chemistry
- Chemistry Program Effectiveness Inspection
- Cooling Units Inspection
- CRDRL Nozzle
- Diesel Starting Air
- Diesel Systems Inspection
- Diesel-Driven Fire Pumps Inspection

- Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements
- Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Used in Instrumentation Circuits
- EQ
- Heat Exchangers Inspection
- Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements
- ISI
- ISI Program—IWE
- ISI Program—IWF
- Lubricating Oil Inspection
- Monitoring and Collection Systems Inspection
- Reactor Head Closure Studs
- RV Surveillance
- Selective Leaching Inspection
- Service Air System Inspection
- Small Bore Class 1 Piping Inspection
- Supplemental Piping and Tank Inspection
- Thermal Aging and Neutron Embrittlement of CASS

3.0.3.1.1 Appendix J

Summary of Technical Information in the Application. LRA Section B.2.3 describes the existing Appendix J Program as consistent with GALL Report AMP XI.S4, “10 CFR Part 50, Appendix J.” The applicant stated that its Appendix J Program is a monitoring program that detects degradation of the primary containment and systems penetrating the primary containment. According to the applicant, these elements include the containment shell and primary containment penetrations including (but not limited to) the personnel airlock, equipment hatch, control rod drive (CRD) hatch, and drywell head. The applicant further stated that the regulatory basis for the Appendix J Program includes 10 CFR Part 50, Appendix J, Option B, RG 1.163, "Performance-Based Containment Leak-Test Program," and NEI 94-01, "Industry Guideline for Implementing Performance Based Option of 10 CFR Part 50, Appendix J."

Staff Evaluation. During its audit, the staff reviewed the applicant’s claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant’s program to the corresponding elements of GALL Report AMP XI.S4. As discussed in the audit report, the staff confirmed that these elements are consistent with the corresponding elements of GALL Report AMP XI.S4. Based on its audit, the staff finds that elements one through six of the applicant’s Appendix J Program are consistent with the corresponding program elements of GALL Report AMP XI.S4; therefore, it is acceptable.

Operating Experience. LRA Section B.2.3 summarizes operating experience related to the Appendix J Program. According to the applicant, the Type A integrated leakage rate tests and the sum of Type B and Type C leakage rate tests, performed to date, have been less than the maximum allowable leakage rates specified in the technical specifications (TSs). The applicant further stated that no Type A tests failed to meet its acceptance criteria. During the 2007 refueling outage (RFO) (R18), the applicant reported that 25 Type B and 66 Type C tests were performed. The Type B tests included the personnel airlock barrel test. All Type B as-found leak rates were below its administrative limits with the exception of the containment-side flange (CEP-V-2A), which had a leak rate exceeding its administrative limit. This flange was checked using a soap solution with test pressure applied and showed no external leakage. This visual inspection confirmed that the recorded leakage was into the system rather than a breach of the containment penetration. For the Type C tests, all but eight valves had as-found leak rates below its administrative limits. The valves with leak rates in excess of its administrative limit required corrective actions to reduce its leak rates. Of the eight valves with as-found leak rates in excess of its administrative limits, five required disassembly and rework, and one valve was replaced. The remaining two valves were successfully flushed and as-left tested without disassembly.

The applicant also stated, in LRA Section B.2.3, that the total as-found leakage at the beginning of RFO 19 (R19), in May 2009, was 19,712 standard cubic centimeters per minute (sccm). This equates to 16.2 percent of the total allowable containment leakage of 121,536 sccm. The values from previous RFOs (R18) and (R17) were 13,683 sccm and 20,879 sccm, respectively. The total as-left leakage at the end of R19 was 13,098 sccm. This equates to 10.8 percent of the total allowable containment leakage of 121,536 sccm and well below the maximum allowable startup containment leakage rate of 60 percent of the total allowable containment leakage of 121,536 sccm. The values from the previous RFOs (R18) and (R17) were 14,051 sccm and 17,423 sccm, respectively. During the audit, the applicant provided the staff with the most recent integrated leak rate testing (ILRT) result that was obtained on June 14, 2009. The total leakage for this ILRT was 0.341785 percent, which is less than the acceptance limit of 0.50 percent.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.3 provides the UFSAR supplement for the Appendix J Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR

Table 3.5-2. The staff also notes that the applicant committed (Commitment No. 3) to ongoing implementation of the existing Appendix J Program for managing aging of applicable components during the period of extended operation. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Appendix J Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.2 BWR FW Nozzle Program

Summary of Technical Information in the Application. Section B.2.6 describes the existing BWR FW Nozzle Program as consistent with GALL Report AMP XI.M5, "BWR Feedwater Nozzle," designed to ensure that aging degradation due to intergranular stress corrosion cracking (IGSCC) is adequately managed for Columbia's FW nozzle components, so that its intended function is maintained through the end of the period of extended operation.

The Columbia BWR FW Nozzle Program consists of (a) enhanced ISI in accordance with the requirements of the ASME Code, Section XI, Subsection IWB, Table IWB 2500-1 (2001 edition including the 2002 and 2003 Addenda) and the recommendations of General Electric (GE) NE-523-A71 0594-A; and (b) system modifications to mitigate cracking. The program specifies periodic ultrasonic inspection of critical regions of the FW nozzles.

Mitigation of cracking in the FW nozzles at Columbia involved several elements, including material selection and processing, nozzle clad elimination, and thermal sleeve and sparger redesign. The Columbia sparger design includes a welded thermal sleeve such that there is no thermal sleeve bypass and no rapid thermal cycling of the blend radius for each FW nozzle. Stainless steel cladding of the Columbia FW nozzles was not included in the original design.

The original FW flow controller satisfied most of the recommended characteristics of a low flow controller. Consequently, replacement of this controller was not required at Columbia. Columbia rerouted the reactor water cleanup (RWCU) such that it discharges into all six FW nozzles.

Columbia performed a pre-service inspection ultrasonic examination of the FW nozzle inner radii, bore, and safe end regions. In addition, a pre-service liquid penetrant examination was performed on the accessible areas of all FW nozzle inner radius surfaces.

The BWR FW Nozzle Program credits portions of the ISI AMP. The BWR FW Nozzle Program at Columbia also includes augmented ISI examinations to monitor crack initiation and growth of the FW nozzles. The inspection schedule, examination techniques, and personnel qualification recommendations of GE NE-523-A71-0594-A have been incorporated into the ISI Program for Columbia's FW nozzles.

All ISI indications are required to be evaluated in accordance with ASME Code, Section XI requirements for the components involved. Evaluations are performed in accordance with established site procedures that require the use of ASME Code or other documents such as boiling water reactor vessel and internals project (BWRVIP) documents, if applicable. There have been no indications of cracking or other service-induced aging degradation in the FW nozzles at Columbia.

Staff Evaluation. During the audit, the staff reviewed the applicant's onsite basis documentation for the Columbia BWR FW Nozzle Program in order to determine whether Columbia's BWR FW Nozzle Program elements are consistent with the 10 elements in GALL Report AMP XI.M5. The staff also interviewed the applicant's technical staff and reviewed other onsite documentation for determining whether the Columbia BWR FW Nozzle Program, as described in LRA Section B.2.6, is consistent with GALL Report AMP XI.M5 and in compliance with regulatory requirements.

The staff reviewed the applicant's onsite basis documentation for the Columbia BWR FW Nozzle Program in order to verify that the elements of this program are consistent with GALL Report AMP XI.M5 program elements 1 through 10. Based on its audit of this AMP, the staff was able to initially confirm that these program elements, as discussed in LRA Section B.2.6 and the supporting basis documentation, are consistent with the GALL Report AMP XI.M5 program elements, with the exception of an issue concerning the qualification of ultrasonic non-destructive examination (NDE) systems. The applicant stated that inspections and flaw evaluations for Columbia's FW nozzle components are implemented in accordance with ASME Code, Section XI requirements and the recommendations of General Electric (GE) Report NE-523-A71-0594-A. The applicant stated that the control of RCS water chemistry for mitigating FW nozzle cracking at Columbia is implemented in accordance with the guidelines of applicable BWRVIP documents, as described in the Columbia BWR Water Chemistry Program. The staff verified that the applicant provided an adequate summary description of this program in LRA Section B.2.6.

During the audit, staff reviewed the Columbia ISI Program Plan for the current (third) 10-year interval ISI program to verify that the Columbia's ISI Program is compliant with ASME Code, Section XI, Subsection IWB requirements for inspections of the FW nozzles. The staff also reviewed operating experience reports, including a sample of CRs prepared by the applicant, and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any service-induced degradation not bounded by industry experience. The staff also verified that the relevant operating experience described in the applicant's basis documents and CRs is consistent with the plant-specific operating experience documented for this AMP, as discussed in LRA Section B.2.6.

Based on its audit and review of the Columbia BWR FW Nozzle Program, the staff found that several issues related to the applicant's implementation of ISI requirements for the FW nozzle components required further clarification. These issues are: (1) ASME Code, Section XI compliance related to the implementation of GE Report NE-523-A71-0594-A and (2) the qualification of ultrasonic NDE systems for ISI of the FW nozzles at Columbia. By letter dated July 13, 2010, the staff issued a request for additional information (RAI) to address these issues.

In RAI B.2.6-1, the staff requested that the applicant confirm whether the implementation of the GE Report NE-523-A71-0594-A inspection criteria results in plant-specific FW nozzle inspection requirements that are augmented with respect to the baseline ASME Code, Section XI requirements for FW nozzle inspections. The staff also requested that the applicant state whether ultrasonic (UT) examination systems, techniques, personnel, and procedures used to performing volumetric examinations of the FW nozzles are qualified in accordance with the ASME Code, Section XI, Appendix VIII performance demonstration initiative (PDI) requirements.

By letter dated September 3, 2010, the applicant stated that (1) Columbia's inspections of the FW nozzles are in full compliance with ASME Code, Section XI requirements, as modified and supplemented by 10 CFR 50.55a and that the implementation of GE Report NE-523-A71-0594-A results in augmented inspections of the nozzles relative to the ASME Code, Sections XI requirements; and (2) Energy Northwest uses (UT) examination systems, techniques, personnel, and procedures that are qualified in accordance with the ASME Code, Section XI, Appendix VIII PDI requirements when performing volumetric examinations of the FW nozzles at Columbia.

The staff found the applicant's RAI responses acceptable because the responses confirmed that (1) the applicant's FW Nozzle Program will ensure that the ISI of the FW nozzles at Columbia will remain in compliance with the requirements of the ASME Code, Section XI and 10 CFR 50.55a; and (2) volumetric ISIs of the FW nozzles at Columbia will be performed using ultrasonic NDE systems, procedures, and personnel that are qualified in accordance with the PDI requirements of the ASME Code, Section XI, Appendix VIII.

Based on its audit activities and its subsequent review of the applicant's responses to the staff's RAIs concerning the Columbia FW Nozzle Program, the staff determined that (1) the Columbia BWR FW Nozzle Program elements are consistent with and bounded by the corresponding program elements described in GALL Report AMP XI.M5, and (2) the Columbia BWR FW Nozzle Program is in compliance with the requirements of 10 CFR 50.55a. Therefore, the staff found the applicant's existing FW nozzle AMP, as described in LRA Section B.2.6, is acceptable for continued implementation through the end of the period of extended operation.

Operating Experience. LRA Section B.2.6 summarizes operating experience related to the BWR FW Nozzle Program. The applicant stated that its operating experience found no instances of cracking or unacceptable indications of the FW nozzles. The applicant also stated that it reviewed the recent industry operating experience for relevance and similar applications and identified a failure of a sparger bracket keeper, in 2007, which allowed interface wear between the mating surfaces of the sparger bracket and the vessel bracket. Temporary repairs were done to make the sparger bracket acceptable for continued use. The applicant further stated that future operating experience will be captured through the normal operating experience review process, which will continue through the period of extended operation.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.6, the applicant provided an UFSAR supplement summary description for the BWR FW Nozzle Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.1-2. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's BWR FW Nozzle Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.3 BWR Penetrations Program

Summary of Technical Information in the Application. LRA Section B.2.7 describes the existing BWR Penetrations Program as consistent with GALL Report AMP XI.M8, "BWR Penetrations." The applicant stated the BWR Penetrations Program is designed to ensure that aging degradation due to IGSCC is adequately managed for low alloy steel, stainless steel, and nickel alloy RV penetrations, including penetration welds, so that its intended function is maintained through the end of the period of extended operation. The BWR Penetrations Program at Columbia manages aging of the RV instrument penetrations, jet pump instrument penetrations, CRD penetrations, and incore instrument penetrations. This AMP implements examinations of all RV penetrations in accordance with the ISI requirements of the ASME Code, Section XI. This AMP supplements the ASME Code, Section XI ISI examinations with the inspection, evaluation, repair, and replacement criteria of approved BWRVIP reports that are applicable to aging management of RV penetrations.

Detecting and sizing cracks are in accordance with the guidelines of approved BWRVIP documents and the requirements of the ASME Code, Section XI, 2001 Edition, 2003 Addenda, Section XI, IWB-3000, "Standards for Examination Evaluations." Evaluation of flaws in accordance with established site procedures and ASME Code or BWRVIP requirements may result in reinspection or sample expansion. Acceptance of components for continued service is in accordance with the ASME code or the BWRVIP program guidance, as applicable. Repair and replacement would include the guidance in BWRVIP-53 and BWRVIP-57.

The BWR Penetrations Program incorporates BWRVIP-49-A guidelines and will be revised if future revisions to BWRVIP-49-A require further inspections. The Columbia instrumentation penetrations are low alloy steel, welded to the RV with nickel alloy weld material. This configuration is addressed in BWRVIP-49-A and no further inspections beyond the ASME Code, Section XI requirements are recommended.

The standby liquid control (SLC) system injects through the core spray nozzles rather than the SLC nozzle. Thus, consistent with Section 1.1 of BWRVIP-27-A, this BWRVIP document does not apply to Columbia. Consequently, cracking of Columbia's SLC penetration is managed by the ISI Program rather than the BWR Penetrations Program. The BWR Penetrations Program incorporates BWRVIP-27-A and will be revised if future revisions to BWRVIP-27-A make it applicable to Columbia.

The Columbia drain nozzle is low alloy steel and is not susceptible to SCC and IGSCC. Degradation of this penetration is managed by the Columbia ISI Program rather than BWR Penetrations Program. The BWR Penetrations Program credits portions of the ISI Program.

Staff Evaluation. During the audit, the staff reviewed the applicant's onsite basis documentation for the Columbia BWR Penetrations Program in order to determine whether Columbia's BWR Penetrations Program elements are consistent with the BWR penetrations AMP specified in GALL Report AMP XI.M8. The staff also interviewed the applicant's technical staff and reviewed other onsite documentation for determining whether the Columbia BWR Penetrations Program, as described in LRA Section B.2.7, is consistent with and bounded by GALL Report AMP XI.M8 and in compliance with 10 CFR 50.55a requirements.

The staff reviewed the applicant's onsite basis documentation for the BWR Penetrations Program in order to verify that the elements of this program are consistent with the GALL Report AMP XI.M8 program elements 1 through 10. The staff found that the onsite basis documentation adequately discussed these program elements. The staff found that these program elements, as discussed in LRA Section B.2.7 and the supporting basis documentation, are consistent with the GALL Report AMP XI.M8 program elements. The applicant stated that inspection and flaw evaluation for these components is carried out in accordance with the ASME Code, Section XI requirements and the guidelines of applicable BWRVIP documents. The applicant stated that the control of RCS water chemistry for mitigating SCC is implemented in accordance with the guidelines of applicable BWRVIP documents, as described in the BWR Water Chemistry Program. The staff verified that the applicant provided an adequate summary description of this AMP in LRA Section B.2.7.

During the audit, staff also reviewed the Columbia ISI Program Plan for the current (third) 10-year interval ISI program and the BWRVIP documents that are applicable to the BWR Penetrations Program. Specifically, the staff verified that the BWR Penetrations Program fully addresses the applicable ASME Code, Section XI requirements and the BWRVIP-49-A guidelines for inspection and evaluation of RV penetrations. The staff also verified that the BWR Penetrations Program requires that any repair or replacement activities for RV penetrations be implemented in accordance with the guidelines of BWRVIP-53 and BWRVIP-57. The staff notes that plant-specific operating experience for this AMP has thus far identified no evidence of service-induced aging degradation in the RV penetrations at Columbia.

Based on its audit and review activities for this AMP, the staff found no issues of concern related to the applicant's continued implementation of the BWR Penetrations Program. All ASME Code, Section XI requirements and BWRVIP documents applicable to aging management of the Columbia RV penetrations components will continue to be implemented by this program. Accordingly, the staff concluded that the elements of the BWR Penetrations Program are consistent with and bounded by the program elements described in GALL Report AMP XI.M8.

Operating Experience. LRA Section B.2.7 summarizes operating experience related to the BWR Penetration Program. The applicant stated that its operating experience found no indications of cracking in the RV penetrations. The applicant also stated that it reviewed the recent industry operating experience for relevance and similar applications and found an instance where an inspection of weld susceptible to IGSCC identified flaw indications on three recirculation riser nozzle-to-safe-end welds. The original scope of the examination included three recirculation risers and one core spray nozzle-to-safe-end weld. The inspection scope was, therefore, expanded to include all the remaining welds, as well as other similarly designed core spray welds. One weld was ground flush and reinspected, and it has been dispositioned. The other two welds were repaired using weld overlays. The applicant further stated that future operating experience will be captured through the normal operating experience review process, which will continue through the period of extended operation. Also, as a participant in the BWRVIP, Columbia is committed to incorporate lessons learned from operating experiences of the entire BWR fleet.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. The staff also interviewed the applicant's technical staff to confirm that plant-specific operating experience did not reveal any aging degradation not bounded by industry experience. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.7 provides the UFSAR supplement for the BWR Penetrations Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.1-2. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d). The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's BWR Penetrations Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.4 BWR SCC

Summary of Technical Information in the Application. LRA Section B.2.8 describes the existing BWR Stress Corrosion Cracking Program as consistent with GALL Report AMP XI.M7, "BWR Stress Corrosion Cracking." The BWR Stress Corrosion Cracking Program manages stress corrosion cracking for stainless steel and nickel alloy piping, nozzle safe ends, nozzle thermal sleeves, valves, flow elements, and pump casings. The program to manage stress corrosion cracking and intergranular attack (SCC and IGA) in reactor coolant pressure boundary (RCPB) piping made of stainless steel and components made of stainless steel or nickel alloy is delineated in NUREG-0313, Revision 2, Generic Letter (GL) 88-01, "NRC Position on IGSCC in

BWR Austenitic Stainless Steel Piping," and GL 88-01 Supplement 1, "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping, Supplement 1." The material includes base metal and welds. The BWR Stress Corrosion Cracking Program meets the requirements of GL 88-01 and BWRVIP-75. The program consists of preventive measures to mitigate SCC and IGA, and inspection and flaw evaluation to monitor SCC and IGA and its effects. The staff-approved BWRVIP-75 report modified the inspection scope in the GL 88-01 program.

Columbia mitigates stress corrosion cracking by using, and continuing to use, materials resistant to SCC for component replacements and repairs following the recommendations delineated in GL 88-01. Prior to initial plant startup and during the first RFO, an induction heating stress improvement process was used on 148 SCC and IGA susceptible piping welds. In the 1994 RFO, Columbia performed a mechanical stress improvement process for multiple RPV nozzle to safe end and safe end to pipe welds. Columbia mitigates aging by maintaining water chemistry in accordance with the current BWRVIP guidelines, as detailed in the BWR Water Chemistry Program. Columbia has implemented hydrogen water chemistry (HWC) and noble metal chemical application (NMCA) to mitigate IGSCC.

The SCC Program detects and sizes cracks in accordance with the requirements of the ASME Code, Section XI, supplemented by guidelines of approved BWRVIP documents. Inspection of piping to detect and size cracks is performed in accordance with the schedule, methods, and personnel and sample expansion included in GL 88-01 and BWRVIP-75. If indications are found, sample expansion occurs per BWRVIP-75. In response to GL 88-01, Columbia committed to using Article IWB-3600 of the ASME Code, Section XI for analytical evaluations of piping flaws that do not meet the initial screening criteria of Article IWB-3500 of the ASME Code, Section XI, for continued operation without repair or evaluation. Columbia committed to notify the NRC if a flaw is found that does not meet ASME Code, Section XI, IWB-3500 screening criteria for continued operation without repair or evaluation.

Furthermore, Columbia committed to submit flaw evaluations justifying continued operation or component repair plans to the NRC for approval prior to resuming plant operation. Resumption of operations will not be authorized until NRC approval has been granted.

Staff Evaluation. During the audit, the staff reviewed the applicant's onsite basis documentation for the BWR SCC Program to determine if the program elements are consistent with the 10 elements in GALL Report AMP XI.M7. The staff also interviewed the applicant's technical staff and reviewed other onsite documentation to determine if the BWR SCC Program, as described in LRA Section B.2.8, is consistent with GALL Report AMP XI.M7.

The staff reviewed the applicant's onsite basis documentation for the Columbia BWR SCC Program to verify that the elements of this program are consistent with GALL Report AMP XI.M7 Program Elements one through six. Based on its audit and review of the Columbia BWR SCC Program, the staff found several issues related to the applicant's implementation of ASME Code, GL-88-01, and BWRVIP criteria; management of aging degradation and disposition of flaws for the RCPB components; and qualification of ultrasonic examination systems that needed further clarification. These issues include the following:

- the exact scope of components covered by this AMP, relative to ASME Code and GL 88-01 component categorization criteria
- ASME Code, Section XI, and 10 CFR 50.55a compliance related to the implementation of BWRVIP-75-A criteria for reduction in inspection sample size for RCPB components, relative to Code requirements

- the disposition and change in inspection status of RCPB piping welds with flaws previously categorized under GL 88-01 criteria
- the qualification of ultrasonic NDE systems for inspecting RCPB components in accordance with ASME Code, Section XI requirements

By letter dated July 13, 2010, the staff issued RAI B.2.8-1 asking the applicant to state the following:

- whether this AMP addresses SCC of RCPB piping alone or any other structures, systems, or components (SSCs) other than RCPB piping
- the scope of the ASME Code, Section XI component examination categories addressed by this AMP
- the scope of components examined by this AMP relative to GL 88-01 criteria, as modified by BWRVIP-75-A

By letter dated September 3, 2010, the applicant provided responses to the staff's RAIs concerning the BWR SCC Program. In its response to RAI B.2.8-1(a), the applicant stated that the scope of the BWR SCC Program includes thermal sleeves inside the RV and the following RCPB components: safe ends, piping, pump casings, flow elements, and valve bodies. The applicant referenced the applicable component line items from LRA Tables 3.1.2-1 and 3.1.2-2, which were identified based on the applicant's AMRs for the RCPB. The staff reviewed the applicable line items from these LRA tables and confirmed that these line items are consistent with the components listed in the RAI B.2.8-1(a) response above and that the BWR SCC program adequately addresses all stainless steel and nickel alloy RCPB components. In its response to RAI B.2.8-1(b), the applicant stated that the BWR SCC Program addresses SCC in all RCPB components irrespective of the components' designated ASME Code Class or Examination Category. In its response to RAI B.2.8-1(c), the applicant stated that the scope of components addressed by the BWR SCC program includes non-piping RCPB components listed in its response to RAI B.2.8-1(a) in addition to the RCPB piping components addressed by GL 88-01. The applicant also noted that the BWRVIP-75-A modification to the GL 88-01 criteria redefines only the inspection schedule for the scope of RCPB piping components defined in GL 88-01 and NUREG-0313, Revision 2. The actual scope of components covered by this AMP is unchanged by the BWRVIP-75-A modifications to the GL 88-01 and NUREG-0313, Revision 2 criteria.

The staff found the applicant's response to RAI B.2.8-1, parts (a), (b), and (c) acceptable because the applicant provided an acceptable description of the scope of components covered by this program, relative to ASME Code and GL 88-01 component categorization criteria. Additionally, the applicant demonstrated that this program is comprehensive in its coverage of austenitic RCPB components that are potentially susceptible to SCC. The staff's concerns described in RAI B.2.8-1 are resolved.

By letter dated July 13, 2010, the staff issued RAI B.2.8-2 requesting the applicant state whether Columbia formally credits the use of HWC or NMCA or both in establishing plant-specific piping inspection sampling, sample expansion, and frequency requirements based on the criteria of NUREG-0313, Revision 2; GL 88-01 and GL 88-01, Supplement 1; and BWRVIP-75.

By letter dated September 3, 2010, the applicant stated that it does not formally credit the use of HWC or NMCA in establishing plant-specific piping inspection sampling, sample expansion, and frequency requirements based on the criteria of NUREG-0313, Revision 2; GL 88-01 and GL 88-01, Supplement 1; and BWRVIP-75-A. The current plant-specific request for NRC approval to implement BWRVIP-75-A modifications to GL 88-01 inspection criteria authorizes only the use of inspection sampling, sample expansion, and frequency criteria, based on normal water chemistry (NWC) conditions.

The staff found the applicant's response to RAI B.2.8-2 acceptable because the applicant stated that the BWR SCC Program's implementation of the BWRVIP-75-A modified inspection criteria is only for NWC conditions, thereby providing more comprehensive and bounding piping inspection sampling criteria, relative to those specified in BWRVIP-75-A for HWC or NMCA conditions or both. The staff's concerns described in RAI B.2.8-2 are resolved.

The staff's position on the plant-specific implementation of BWRVIP-75-A for ASME Code, Section XI Examination Category B-J and B-F components is that licensees must submit to the NRC a request for alternative to the ASME Code, Section XI requirements, in order to implement the BWRVIP-75-A modifications to the piping inspection criteria of GL 88-01 and obtain NRC authorization for this alternative under 10 CFR 50.55a(a)(3)(i).

By letter dated July 13, 2010, the staff issued RAI B.2.8-3 requesting that the applicant state whether Columbia is currently operating with an NRC-approved alternative, granted under 10 CFR 50.55a(a)(3)(i), authorizing the implementation of the alternative inspection criteria of BWRVIP-75-A for the current (third) 10-year ISI Interval Program at Columbia. If so, the staff requested that the applicant indicate the ASME Code, Section XI, Table IWB-2500-1 examination categories (e.g., examination Category B-J, B-F, etc.) that this alternative covers. If Columbia does not currently have this alternative authorized, the staff requested that the applicant indicate whether or not Columbia currently meets all ASME Code, Section XI requirements for ASME Code, Section XI, examination Category B-F components.

In its response by letter dated September 3, 2010, the applicant stated that it does not have an NRC-approved alternative to the ASME Code, Section XI, inservice examination requirements authorizing the implementation of BWRVIP-75-A alternative inspection sampling criteria for Table IWB-2500, examination Category B-F components for the current 10-year interval ISI Program. The applicant currently meets all ASME Code, Section XI examination requirements for examination Category B-F components. However, by letter dated March 11, 2010 (ADAMS Accession No. ML100770221), the applicant submitted its request for alternative to the NRC under 10 CFR 50.55a(a)(3)(i) to use the BWRVIP-75-A weld inspection criteria in lieu of ASME Code, Section XI examination requirements and GL 88-01 augmented requirements.

By letter dated February 3, 2011 (ADAMS Accession No. ML110110172), the staff issued its safety evaluation to the request for alternative to 10 CFR 50.55a(a)(3)(i) to use the BWRVIP-75-A weld inspection criteria in lieu of the ASME Code, Section XI examination requirements and GL 88-01 augmented requirements and the staff concluded that the BWRVIP-75-A weld inspection criteria proposed by the applicant provided an acceptable level of safety.

The staff conducting the license renewal review reviewed the applicant's response to RAI B.2.8-3 and determined that the applicant's 10 CFR 50.55a(a)(3)(i) request for alternative to the ASME Code, Section XI inservice examination requirements is acceptable because the applicant is conducting inservice examinations of the subject examination Category B-F and B-J components in accordance with Code requirements (as modified by other NRC-authorized alternatives for examination of Category B-J components) for the current 10-year interval ISI Program. The staff finds the Columbia SCC Program's reference to BWRVIP-75-A alternative inspection sample criteria acceptable for all subsequent ISI intervals, including ISI intervals during the extended operating term, because in its February 3, 2011, SER, NRC approved the 10 CFR 50.55a(a)(3)(i) request for alternative for the applicable 10-year interval ISI Program.

However, the staff notes that NRC authorization of requests for alternatives to the requirements of the ASME Code, Section XI to implement the BWRVIP-75-A piping inspection sampling criteria is granted only on a 10-year “interval-by-interval” basis for BWR licensees’ ISI Programs. Therefore, the applicant may submit 10 CFR 50.55a(a)(3)(i) alternative requests to the NRC to use BWRVIP-75-A piping inspection criteria, in lieu of ASME Code, Section XI, examination Category B-F and B-J ISI requirements, for all ISI intervals subsequent to the ISI interval applicable to the subject alternative request referenced in response to RAI B.2.8-3, as required by 10 CFR 50.55a(g)(4). If the applicant does not submit subsequent requests for alternatives, the applicant must follow ASME Code, Section XI examination requirements. The staff's concerns described in RAI B.2.8-3 are resolved.

LRA Section B.2.8 describes Columbia operating experience with the BWR SCC Program and inspection results for the program. It states that one relevant indication (e.g., flaw) was identified in stainless steel recirculation system piping-to-valve weld 20RRC(6)-8 in 1991. Columbia states that this flaw has been monitored for 10 years and has shown no identifiable growth. The weld with the flaw was examined in 2001 using Electric Power Research Institute (EPRI) PDI qualified techniques and systems, and it was determined that the flaw was not caused by IGSCC. Consequently, the GL 88-01-based categorization for the weld with the flaw was changed to Category B.

By letter dated July 13, 2010, the staff issued RAI B.2.8-4, requesting that the applicant provide additional information concerning this flaw. RAI B.2.8-4 consists of parts (a) through (e). Parts (a) through (e) of the RAI and the applicant’s response to each part, dated September 3, 2010, are discussed below:

(a) In RAI B.2.8-4(a), the staff requested that the applicant state whether the subject flaw is located in the actual weld metal or in the base metal heat-affected zone (HAZ) adjacent to the weld. In its response to RAI B.2.8-4(a), by letter dated September 3, 2010, the applicant stated that the subject flaw is located in the base metal HAZ at the top of the recirculation system pipe.

(b) In RAI B.2.8-4(b), the staff requested that the applicant state whether this is a surface-breaking indication or a subsurface indication. In response to part (b), by letter dated September 3, 2010, the applicant stated that this is a surface indication.

(c) Columbia states in LRA Section B.2.8 that this indication was determined to be “acceptable for continued operation without repair.” Therefore, in RAI B.2.8-4(c), the staff requested that the applicant state how this was determined. Specifically, the staff requested that the applicant state whether the subject flaw was screened using the ASME Code, Section XI, IWB-3500 acceptance standards. If this flaw did not pass the IWB-3500 acceptance standards, the staff requested that the applicant state whether the flaw received an analytical evaluation in accordance with IWB-3600 requirements for analytical evaluation of flaws that do not meet IWB-3500 acceptance standards. The staff also requested the applicant state the findings of any analytical evaluations performed for this flaw and provide references to any analytical flaw evaluation reports submitted to the NRC for determining that the subject RCPB component was acceptable for continued service without repair.

In response to part (c), by letter dated September 3, 2010, the applicant provided the requested information concerning its determination that the RCPB weld containing the flaw was acceptable for continued service. According to the applicant, upon discovery in 1991, the flaw was initially screened using the ASME Code, Section XI, IWB-3500 acceptance standards and determined to be unacceptable for continued service without repair or analytical evaluation. The flaw was then analytically evaluated in accordance with Article IWB-3600 requirements for analytical flaw evaluations and determined to be acceptable under IWB-3600 analytical acceptance criteria until the next RFO, based on the evaluation's original determination that the subject flaw may have been caused by IGSCC (see applicant's response to part (d) below). The subject flaw was subsequently reinspected and re-evaluated on an annual basis through 1995 to track flaw growth and determine acceptability in accordance with IWB-3600 analytical acceptance criteria for each 1-year flaw evaluation period. The inspection results and flaw evaluations for each evaluation period were submitted to the NRC, in accordance with the GL 88-01 criteria. The applicant provided the following references for the subject flaw evaluation reports:

- Parrish, J.V., letter to NRC, "Report on Flaw in Reactor Recirculation System Piping," May 21, 1993.
- Parrish, J.V., letter to NRC, "Report on Flaw in Reactor Recirculation System Piping," June 9, 1994.
- Parrish, J.V., letter to NRC, "Report on Flaw in Reactor Recirculation System Piping," May 15, 1995.
- Sorensen, G.C., letter to NRC, "Report on Flaw in Reactor Recirculation System Piping (TAC No. 80358)," May 10, 1991.
- Sorensen, G.C., letter to NRC, "Report on Flaw in Reactor Recirculation System Piping (TAC No. 80358)," May 15, 1991.
- Sorensen, G.C., letter to NRC, "Report on Flaw in Reactor Recirculation System Piping (TAC No. 80358)," May 14, 1992.

The staff reviewed the flaw evaluation reports listed above and determined that the applicant's existing SCC Program is acceptable for evaluating RCPB flaws and determining flaw acceptability, in accordance with Code requirements. The staff also finds the applicant's response, by letter dated September 3, 2010, acceptable because the the applicant screened the subject flaw using the ASME Code Section XI, IWB-3500 acceptance standards and when the applicant determined the flaw was unacceptable, the applicant conducted an analytical evaluation in accordance with IWB-3600 requirements for flaws that do not meet IWB-3500 acceptance standards and determined the flaw to be acceptable under IWB-3600 analytical acceptance criteria. The applicant subsequently reinspected and re-evaluated the subject flaw on an annual basis through 1995 to track flaw growth and determine acceptability in accordance with IWB-3600 analytical acceptance criteria for each 1-year flaw evaluation period.

(d) In RAI B.2.8-4(d), the staff requested that the applicant state whether the weld with the indication is currently designated a GL 88-01 Category B weld. Furthermore, the staff requested that the applicant state whether the NRC had been notified of and concurred with Columbia's determination that this weld may be designated a Category B weld. If the NRC had not been previously notified of the change from Category E to Category B, the staff requested that the applicant provide technical justification as to how and why

Columbia determined that this weld's categorization could be changed from Category E to Category B.

In response to part (d), by letter dated September 3, 2010, the applicant confirmed that reactor recirculation system weld No. 20RRC(6)-8 is currently categorized as a GL 88-01 Category B weld, as it was originally categorized, prior to the discovery of the subject flaw. Upon discovery of the subject flaw in 1991, the weld was conservatively categorized as GL 88-01 Category F because, at the time of discovery, it could not be demonstrated that the subject flaw was not service-induced. The subject flaw was reexamined and re-evaluated during the next four RFOs (1992–1995) in accordance with ASME Code, Section XI and GL 88-01 requirements, and no growth was observed for the subject flaw. Accordingly, the weld with the flaw was assessed as a Category E weld in 1996 after four successive inspections, in accordance GL 88-01 piping weld categorization criteria. The NRC staff was informed of the weld status change and concurred with the change in weld status from Category F to Category E.

The weld containing the flaw was reexamined again in 2001, in accordance with ASME Code, Section XI, Appendix VIII PDI-qualified ultrasonic examination systems and improved analysis software. The data from previous reexaminations of the subject flaw were re-evaluated with the new software in 2001 to determine that the flaw dimensions had not changed in the previous 10 years.

According to the applicant, the ultrasonic examinations performed on this weld during the 10-year interval noted that the subject flaw did not exhibit signals characteristic of IGSCC. The damage mechanism assessment performed for this weld for Columbia's authorized risk-informed ISI (RI-ISI) Program identified IGSCC as the only service-induced damage mechanism that could be present. The inservice examinations performed for this weld did not identify any other unknown damage mechanism for this weld. Based on the results of the examinations performed on this weld during the 1991-2001 interval and the damage mechanism assessment, the applicant concluded that the subject flaw was not service-induced. Accordingly, the subject weld was re-designated a GL 88-01 Category B weld.

The staff reviewed the applicant's explanation concerning the change in the weld's GL 88-01 designation from Category E to Category B and determined that the applicant provided an acceptable basis for this change. The staff's determination is based on the fact that the flaw size parameters had not changed during the 10-year interval when the weld was assessed as a Category F weld and, subsequently, a Category E weld, as well as the applicant's explanation that the previous inservice examination data for subject flaw's ultrasonic response did not have the signature characteristics of IGSCC.

The staff finds the applicant's response to the change in the subject weld's GL 88-01 categorization from Category E to Category B acceptable because, the applicant conducted inspections of the subject weld during the periods between 1996 and the present, indicating no change in flaw size and the ultrasonic examinations performed on this weld during the 10-year interval noted that the subject flaw did not exhibit signals characteristic of IGSCC.

(e) In RAI B.2.8-4(e), the staff requested that the applicant discuss whether the subject flaw is considered a fabrication flaw or a service-induced flaw. The staff also requested that, if the subject flaw is believed to be a service-induced flaw, the applicant discuss the aging affect or mode of degradation that resulted in the formation of the subject RCPB piping flaw.

In its response to RAI B.2.8-4(e), the applicant stated that previous examinations and analyses of the subject flaw have concluded that the flaw was caused by fabrication. The only damage mechanism associated with this class of RCPB weld material is IGSCC. According to the applicant, all previous ultrasonic examinations reported that the flaw does not exhibit signature characteristics of IGSCC. The applicant stated that the dimensions of the subject flaw have remained unchanged since discovery in 1991. This weld is part of the ASME Code, Section XI, Examination Category B-J inspection sample (based on the applicant's authorized RI-ISI Program) and is scheduled for reinspection in 2011. The staff found the applicant's response to part (e) acceptable because the applicant stated that the subject flaw was determined to be fabrication-related.

The staff found the applicant's responses to RAI B.2.8-4 acceptable because the applicant provided all of the requested information concerning the flaw in the HAZ of recirculation system pipe Weld 20RRC(6)-8. The staff agreed with applicant's assessment that the subject flaw was likely not caused by IGSCC or other service-induced aging effects, given that the parameters of the subject flaw have remained unchanged since discovery in 1991. Accordingly, the current GL 88-01 categorization of B for the weld with the subject flaw is appropriate.

The staff also noted that the Columbia BWR SCC Program requires (based on Columbia's response to GL 88-01) that flaws that do not pass the IWB-3500 acceptance standards receive an analytical evaluation in accordance with ASME Code, Section XI, IWB-3600 requirements, or components containing such flaws must be repaired in accordance with Code requirements. Columbia committed to notify the NRC if a flaw is discovered in any RCPB component that does not meet ASME Code, Section XI, IWB-3500 screening criteria for continued operation without evaluation or repair. Furthermore, for any such flaws, Columbia committed to submit to the NRC either an IWB-3600 analytical evaluation of the flaw justifying continued operation without repair or repair plans for NRC approval prior to resuming plant operation. Resumption of plant operations will not be authorized until NRC approval has been granted, as noted in the applicant's program description. Therefore, the staff determined that the Columbia BWR SCC Program provides the necessary requirements for monitoring and evaluating the subject weld on an interval-by-interval basis, in accordance with ASME Code, Section XI requirements. The staff's concerns described in RAI B.2.8-4 are resolved.

By letter dated July 13, 2010, the staff issued RAI B.2.8-5, requesting that the applicant state whether ultrasonic examinations of RCPB components at Columbia are conducted using systems, personnel, and procedures that are qualified in accordance with ASME Code, Section XI, Appendix VIII PDI criteria.

In its response dated September 3, 2010, the applicant stated that it uses ultrasonic examination systems, personnel, and procedures that are qualified in accordance with ASME Code, Section XI, Appendix VIII PDI criteria when performing ultrasonic examinations of RCPB piping. The staff found the applicant's response to RAI B.2.8-5 acceptable because the applicant confirmed that ultrasonic examinations of RCPB piping are conducted using PDI-qualified systems. The staff's concerns described in RAI B.2.8-5 are resolved.

Based on its audit activities and its subsequent review of the applicant's responses to the staff's RAIs concerning the Columbia BWR SCC Program, as discussed above, the staff determined the following:

- The Columbia BWR SCC Program elements are consistent with and bounded by the corresponding program elements described in GALL Report AMP XI.M7.
- The Columbia BWR SCC Program complies with the requirements of 10 CFR 50.55a.
- The Columbia BWR SCC Program implements the inspection and evaluation criteria of GL 88-01 and BWRVIP-75-A.

Therefore, the staff found that the applicant's existing SCC AMP, as described in LRA Section B.2.8, is acceptable for continued implementation through the end of the period of extended operation.

Operating Experience. LRA Section B.2.8 summarizes operating experience related to the BWR SCC Program. The applicant identified two instances of operating experience, as stated below:

> One indication was identified in stainless steel recirculation system piping to valve weld 20RRC(6)-8 during Refuel Outage 6 (1991). The sample size was expanded in accordance with GL 88-01. The indication did not show IGSCC characteristics; however, it was evaluated as IGSCC. The indication was determined to be acceptable for continued operation without repair. In 1996, after four successive inspections without significant change in the indication, the indication was reclassified to an IGSCC Category E weld in accordance with GL 88-01. The NRC staff was kept informed of the indication status and concurred with the actions taken and the reclassification of the indication. The weld was examined in 2001 using technology approved as part of the EPRI Performance Demonstration Initiative and no indications associated with IGSCC were identified. It was determined that the indication was not due to IGSCC and the weld was reclassified as Category B. All previous examinations were reevaluated using the 2001 methods, and it was concluded that the indication had shown no identifiable growth in either length or depth in the 10 years that it had been monitored.
>
> A second indication, identified in RRC nozzle-to-safe end weld 24RRC(2)A-1 in 1998, has been verified to be an original construction weld repair. There is no indication of IGSCC in this weld.

The applicant also stated that it reviewed the recent industry operating experience for relevance and similar applications and found an instance where an inspection of welds susceptible to IGSCC identified flaw indications on three recirculation riser nozzle-to-safe-end welds. The original scope of the examination included three recirculation risers and one core spray nozzle-to-safe-end weld. The inspection scope was, therefore, expanded to include all the remaining welds, as well as other similarly designed core spray welds. One weld was ground flush and reinspected and has been dispositioned. The other two welds were repaired using weld overlays. The applicant further stated that future operating experience will be captured through the normal operating experience review process, which will continue through the period of extended operation.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. In LRA Section A.1.2.8, the applicant provided an UFSAR supplement summary description for the BWR SCC Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.1-2. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's BWR SCC Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.5 BWR Vessel ID Attachment Welds Program

Summary of Technical Information in the Application. LRA Section B.2.9 describes the existing BWR Vessel inside diameter (ID) Attachment Welds Program as consistent with GALL Report AMP XI.M4, "BWR Vessel ID Attachment Welds." The BWR Vessel ID Attachment Welds Program manages cracking due to SCC and IGA of the welds for internal attachments to the RV. The BWR Vessel ID Attachment Welds Program performs examinations and inspections, as required by ASME Section XI, augmented by BWRVIP-48-A. These inspections include enhanced visual inspections with resolution to the guidelines in BWRVIP-03.

Inspections are scheduled in accordance with the ASME Code, Section XI. Approval for any exceptions to the ASME Code requirements is requested from the NRC via a relief request or an exemption request. Columbia has scheduled inspections in accordance with ASME Code, Section XI, IWB-2400 requirements and approved BWRVIP-48-A guidelines. If flaws are detected, the scope of the examination is expanded, in accordance with ASME Section XI and BWRVIP-48-A.

Cracks are detected and sized by inspection in accordance with the guidelines of approved BWRVIP documents and the requirements of the ASME Code, Section XI. Evaluation is performed in accordance with established site procedures that require use of the ASME Code and other applicable documents, such as BWRVIP reports.

The program includes preventive measures to mitigate cracking by maintaining water chemistry in accordance with the current BWRVIP guidelines using the BWR Water Chemistry Program.

The BWR Vessel ID Attachment Welds Program credits portions of the BWR Water Chemistry Program, the BWR Vessel Internals Program and the ISI Program.

Staff Evaluation. During the audit, the staff reviewed the applicant's onsite basis documentation for the Columbia BWR Vessel ID Attachment Welds Program to determine if the elements of this AMP are consistent with the 10 elements of a successful BWR Vessel ID Attachment Welds AMP specified in GALL Report AMP XI.M4. The staff also interviewed the applicant's technical staff and reviewed other onsite documentation to determine if the Columbia BWR Vessel ID Attachment Welds Program, as described in LRA Section B.2.9, is consistent with and bounded by GALL Report AMP XI.M4 and complies with 10 CFR 50.55a requirements.

The staff reviewed the applicant's onsite basis documentation for the Columbia BWR Vessel ID Attachment Welds Program to verify that the elements of this program are consistent with the GALL Report AMP XI.M4 Program Elements one through six. The staff found that the onsite basis documentation adequately discussed these program elements. The staff found that these program elements, as discussed in LRA Section B.2.9 and the supporting basis documentation, are consistent with the GALL Report AMP XI.M4 program elements. The applicant stated that inspection and flaw evaluation for these components is carried out in accordance with the ASME Code, Section XI requirements and augmented by the guidelines of the applicable BWRVIP document—specifically, the BWRVIP-48-A report, which provides comprehensive guidelines for inspection and evaluation of RV inside diameter (ID) attachment components. The applicant stated that the control of RCS water chemistry for mitigating SCC is implemented in accordance with the guidelines of applicable BWRVIP documents, as described in the Columbia BWR Water Chemistry Program. The staff verified that the applicant provided an adequate summary description of this AMP in LRA Section B.2.9.

During the audit, the staff also reviewed the Columbia ISI Program plan for the current (third) 10-year interval ISI Program and the BWRVIP documents that are applicable to the Columbia BWR Vessel ID Attachment Welds Program. Specifically, the staff verified that the Columbia BWR Vessel ID Attachment Welds Program fully addresses the applicable ASME Code, Section XI requirements (Table IWB-2500-1, Examination Category B-N-2) and the BWRVIP-48-A guidelines for augmented inspection and evaluation of Columbia's RV penetrations. The staff also verified that the Columbia BWR Vessel ID Attachment Welds Program requires that any repair or replacement activities for the RV ID attachments be implemented in accordance with the guidelines of the ASME Code, Section XI. The staff notes that plant-specific operating experience for this AMP has, thus far, identified no evidence of service-induced aging degradation in the RV penetrations at Columbia.

Based on its audit and review activities for this AMP, the staff found no issues of concern related to the applicant's continued implementation of the Columbia BWR Vessel ID Attachment Welds Program. All ASME Code, Section XI requirements and BWRVIP documents applicable to aging management of the Columbia RV ID attachment components will continue to be implemented by this program. Accordingly, the staff concluded that the elements of the Columbia BWR Vessel ID Attachment Welds Program are consistent with and bounded by the program elements described in GALL Report AMP XI.M4.

Operating Experience. LRA Section B.2.9 summarizes operating experience related to the BWR Vessel ID Attachment Welds Program. The applicant stated that its operating experience has not detected any flaws in the RV attachment welds. Inspections of the core spray sparger and supply piping attachment welds and five jet pump riser brace attachment welds during RFO 16 (2003) found no recordable indications. Inspection of the remaining attachment welds during

RFO 17 (2005)—including the FW bracket, steam dryer, and specimen holders—found no recordable indications. The applicant also stated that it reviewed the recent industry operating experience for relevance and similar applications but none were found. The applicant further stated that future operating experience will be captured through the normal operating experience review process, which will continue through the period of extended operation.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. The staff also interviewed the applicant's technical staff to confirm that plant-specific operating experience did not reveal any aging degradation not bounded by industry experience. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. In LRA Section A.1.2.9, the applicant provided an UFSAR supplement summary description for the BWR Vessel ID Attachment Welds Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.1-2. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's BWR Vessel ID Attachment Welds Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.6 BWR Vessel Internals

Summary of Technical Information in the Application. LRA Section B.2.10 describes the existing BWR Vessel Internals Program as consistent with GALL Report AMP XI.M9, "BWR Vessel Internals." The BWR Vessel Internals Program manages cracking due to stress corrosion cracking (SCC) and irradiation-assisted stress corrosion cracking (IASCC), SCC and inter-granular attack (IGA), flaw growth, and flow-induced vibration (FIV) for various components and subcomponents of the reactor vessel internals (RVI). The Columbia program includes mitigation, inspection, and repair. The applicant states that the BWR Vessel Internals Program incorporates all of the BWRVIP guidance documents and credits portions of the BWR Water Chemistry Program and the ISI Program.

Columbia mitigates RVI cracking by maintaining water chemistry in accordance with the current BWRVIP guidelines using the BWR Water Chemistry Program.

Inspection is performed by the ISI Program as required by the ASME Code, Section XI. Augmented inspections as recommended by the BWRVIP program are performed by the BWR Vessel Internals Program. The BWRVIP requirements typically include more stringent inspections and components beyond the ASME Code, Section XI requirements. The Columbia program includes enhanced visual examinations, including the equipment and environmental conditions necessary to achieve the resolution recommended by the BWRVIP guidelines.

Columbia implements all the BWRVIP requirements, including reinspection and sample expansion requirements. Columbia detects and sizes cracks in accordance with the guidelines of approved BWRVIP documents and the requirements of the ASME Code, Section XI.

Columbia evaluates all flaws in accordance with either the ASME code or BWRVIP guidance. Flaw evaluations that deviate from the guidance in BWRVIP reports are submitted to the NRC for approval.

Repair or replacement, as necessary, is performed in accordance with approved BWRVIP documents and the ASME Code, Section XI, as applicable.

Staff Evaluation. During the audit, the staff reviewed the applicant's onsite basis documentation for the BWR Vessel Internals Program in order to determine whether the BWR Vessel Internals Program elements are consistent with the 10 elements in GALL Report AMP XI.M9. The staff also interviewed the applicant's technical staff and reviewed other onsite documentation for determining whether the BWR Vessel Internals Program, as described in LRA Section B.2.10, is consistent with GALL Report AMP XI.M9 and in compliance with regulatory requirements.

The applicant stated that the ISI Program performs inspection of Columbia's RVI in accordance with ASME Code, Section XI (the Code) requirements, as required by 10 CFR 50.55a. The Code requirements for inservice examination of RVI components are limited to VT-1 and VT-3 visual examinations of RV interior attachments and VT-3 visual examinations of the core support structure (according to ASME Code, Section XI, Examination Category B-N-2). Therefore, the BWR Vessel Internals Program implements the augmented inspection and evaluation guidelines of all BWRVIP documents applicable to inspection and evaluation of RVI components to ensure compliance with the quality assurance requirements of 10 CFR Part 50, Appendix B. The applicant further stated that the control of the RCS water chemistry for mitigating SCC in RVI components at Columbia is implemented in accordance with the guidelines of applicable BWRVIP documents, as described in the BWR Water Chemistry Program.

During the audit, staff reviewed the BWRVIP Program Plan and ISI Program Plan for the current (third) 10-year interval ISI program to verify that the BWR Vessel Internals Program is compliant with ASME Code, Section XI requirements and incorporates the guidelines of all BWRVIP documents that are applicable to aging management of the RVI at Columbia. The staff also reviewed operating experience reports, including a sample of CRs prepared by the applicant, and interviewed the applicant's technical staff to verify that plant-specific operating experience did not reveal any service-induced degradation not bounded by industry experience. The staff also verified that the relevant operating experience described in the applicant's basis documents and CRs is consistent with the plant-specific operating experience documented for this AMP, as discussed in LRA Section B.2.10.

Based on its site audit activities, the staff was able to initially confirm that the applicant's RVI program elements, as discussed in LRA Section B.2.10 and the supporting basis documentation, are consistent with the GALL Report AMP XI.M9 program elements, with the exception of aging management issues related to (1) the implementation of BWRVIP documents for the core shroud, steam dryer, and access hole covers; (2) plant-specific operating experience with respect to inspection, evaluation, and monitoring of aging effects; (3) the inspection and evaluation of jet pump assembly components to incorporate previous industry operating experience; (4) corrective action for existing indications in the core shroud and (5) fracture toughness and neutron embrittlement analyses for the core shroud. The staff's acceptance of the applicant's BWR Vessel Internals Program for continued implementation for the period of extended operation at Columbia is based, in part, on resolution of each of the above issues through the issuance of a request for additional information (RAI) addressing these issues and the applicant's satisfactory response to the RAI. The staff's RAI and the applicant's RAI responses for addressing the above issues are discussed below.

By letter dated July 13, 2010, the staff issued RAIs to address the above issues related to the BWR Vessel Internals Program. By letter dated September 3, 2010, the applicant provided responses to the staff's RAIs.

The staff noted that LRA Section B.2.10 includes a statement indicating that the BWR Vessel Internals Program at Columbia incorporates all of the BWRVIP guidance documents, including those specifically in GALL Report AMP XI.M9. LRA Section B.2.10 also states that augmented inspections (beyond the ASME Code, Section XI requirements) required by the BWRVIP program documents are performed by the BWR Vessel Internals Program, and that the program implements all BWRVIP requirements for the reactor internals components. Columbia's plant-specific commitments to specific BWRVIP programs are documented in Appendix C of the LRA through its responses to specific license renewal applicant action items (AAIs) for each BWRVIP document.

The staff noted that Appendix C of the LRA contains no reference to BWRVIP documents specifying inspection and evaluation guidelines for several RVI components. Furthermore, the staff could not locate any statement anywhere in the LRA indicating that the BWR Vessel Internals Program commits to and implements the guidelines described in these BWRVIP documents for the following components:

i. Core Shroud—BWRVIP-76, "BWR Core Shroud Inspection and Flaw Evaluation Guidelines"

ii. Steam Dryer—BWRVIP-139, "Steam Dryer Inspection and Flaw Evaluation Guidelines"

iii. Access Hole Covers—BWRVIP-180, "BWR Access Hole Covers Inspection and Flaw Evaluation Guidelines"

Therefore, in RAI B.2.10-1, the staff requested that, for each of the above reactor internal components, the applicant provide a statement indicating whether Columbia commits to programs described in the corresponding BWRVIP document for the component and whether the BWR Vessel Internals Program implements all the guidelines of these BWRVIP documents.

In its response to RAI B.2.10-1, the applicant stated that the BWR Vessel Internals Program incorporates all of the BWRVIP documents applicable to aging management of RVI components. This specifically includes the guidelines of BWRVIP-76 for the core shroud, BWRVIP-139 for the steam dryer, BWRVIP-180 for the shroud support plate access hole covers, as well as any subsequent BWRVIP publications, as it applies to Columbia's RV internals components. The staff found the applicant's response to RAI B.2.10-1 acceptable because the applicant stated that the BWR Vessel Internals Program incorporates the guidelines for the above three BWRVIP documents.

In RAI B.2.10-2, the staff requested that the applicant provide a brief description of the RCS water chemistry conditions that are used for mitigating cracking and other forms of aging degradation in the reactor internal and pressure boundary components at Columbia, including whether HWC and noble metal chemical additions are implemented. The staff also requested that applicant state the BWRVIP programs (by BWRVIP document number or title or both) that Columbia implements for managing RCS Water Chemistry.

In its response to RAI B.2.10-2, the applicant stated that the BWR Vessel Internals Program mitigates cracking in the RVI components by maintaining RCS water chemistry in accordance with current BWRVIP guidelines, as required by the BWR Water Chemistry Program. In accordance with BWRVIP water chemistry guidelines, Columbia has implemented HWC and NMCA Programs to mitigate SCC in RVI components. Columbia is committed to managing RCS water chemistry in accordance with the latest RCS water chemistry guidelines. The current implementation document is BWRVIP-190, "Water Chemistry Guidelines—2008 Revision." The staff found the applicant's response to RAI B.2.10-2 acceptable because the applicant confirmed that aging effects for the RVI are mitigated through the implementation of HWC and NMCA programs, in accordance with BWRVIP-190 guidelines.

The staff noted that LRA Section B.2.10 describes plant-specific operating experience pertaining to inspection results for various RVI components. Specifically, LRA Section B.2.10 describes indications of cracking in the core shroud, cracking in the steam dryer, gaps on the jet pump set screws, and wear of the jet pump wedges. In RAI B.2.10-3, the staff requested that the applicant provide the following additional information concerning these indications:

(a) The staff requested that the applicant state whether there were ever any other flaws or relevant indications discovered in any RV internal component covered under LRA Section B.2.10, other than those indications already described.

(b) The staff requested that the applicant state whether the RVI indications discussed in LRA Section B.2.10 were documented in accordance with Columbia's site corrective action program.

(c) The staff requested that the applicant discuss how the RVI indications discussed in LRA Section B.2.10 are being monitored, including whether Columbia is monitoring these indications in accordance with the inspection and evaluation guidelines of the BWRVIP documents applicable to the components with the indications.

In its response to RAI B.2.10-3(a), the applicant stated that LRA Section B.2.10 addresses all flaws and relevant indications found in RVI components covered by the BWRVIP program. The applicant also stated that the BWRVIP Program Plan also discusses indications in RVI that are outside of the industry-wide BWRVIP Program scope. These indications were found by additional inspections performed in accordance with Columbia's BWRVIP Program Plan that go beyond the industry-wide BWRVIP program scope. It included a jet pump sensing line crack, thermal stress cracks around the FW sparger flow holes, minor dents on the steam separator, shroud head bolt pin wear, and rub marks on the FW sparger end brackets.

The staff found the applicants response to part (a) above acceptable because the applicant confirmed that LRA Section B.2.10 addresses all flaws and relevant indications found in RVI components that are covered by the BWRVIP documents. With respect to the other indications discussed in the applicant's response to part (a) above, the staff agrees that these indications are in components that are outside of the current scope of components covered by the applicable BWRVIP documents, and BWRVIP's scope of internal components is the same as the scope of components addressed by this AMP. Furthermore, these other indications were found on components with little safety significance, and the indications are relatively minor in terms of its impact on component functionality.

In its response to RAI B.2.10-3(b), the applicant stated that the RVI indications discussed in LRA Section B.2.10 were reported under Columbia's site corrective action program, as directed by site programs and procedures for management of RVI integrity, as well as NDE data evaluation procedures. The staff found the applicant's response to part (b) acceptable because the applicant confirmed that the indications discussed on LRA Section B.2.10 have been documented in accordance with Columbia's corrective action program.

In its response to RAI B.2.10-3(c), the applicant stated that the indications in question are, at a minimum, tracked, reinspected, and monitored in accordance with the inspection and evaluation guidelines specified in the latest revisions of the applicable BWRVIP documents, specifically BWRVIP-139 for the cracking indications in the steam dryer, BWRVIP-41 for the indications of wear of the jet pump wedges and the gaps on the jet pump set screws, and BWRVIP-76 for the cracking indications in the core shroud. The staff found the applicant's response to part (c) acceptable because the applicant confirmed that the subject indications are being monitored in accordance with the inspection and evaluation guidelines specified in the latest revisions of the applicable BWRVIP documents, as specified above.

Based on the applicant’s acceptable response to parts (a), (b), and (c) of RAI B.2.10-3, as discussed above, the staff found that RAI B.2.10-3 is resolved.

In RAI B.2.10-4, the staff requested that the applicant identify the materials from which the core shroud is fabricated, including both welds and base metal (e.g., 304 stainless steel (SS), 304L SS, any nickel alloys, etc.). The staff also requested that the applicant identify the core shroud designation at Columbia (e.g., Category “A,” “B,” or “C”) based on BWRVIP-76-A core shroud designation criteria.

In its response to RAI B.2.10-4, the applicant stated that all core shroud base materials at Columbia are American Iron and Steel Institute Type 304L stainless steel. The core shroud weld metal includes American Iron and Steel Institute Type 308 or 308L, per GE Specification and UFSAR Section 4.5.2.1. The applicant further stated that, based on the program criteria provided in BWRVIP-76-A, Figure 2-1, the core shroud at Columbia is designated a Category "B" shroud because (1) the core shroud base metal is Type 304L, (2) the core shroud has been in service for more than 8 years, under irradiated conditions, and (3) the average reactor coolant water conductivity has remained under 0.3 μS/cm.

The staff found the applicant's response to RAI B.2.10-4 acceptable because the applicant provided the information required for the staff to confirm that applicant's shroud is correctly designated a Category "B" shroud, in accordance with BWRVIP-76-A criteria.

LRA Section B.2.10 includes a brief statement indicating that Columbia has found indications of cracking of the core shroud. Therefore, in RAI B.2.10-5(a), the staff requested that the applicant identify where the core shroud cracking indications were found. Specifically, the staff requested that the applicant state whether the indications of cracking were found in the core shroud welds, base material, or HAZ. If cracking indications were found in or near shroud welds, the staff requested that the applicant identify which welds were found to have indications of cracking, based on the BWRVIP-76-A nomenclature. In RAI B.2.10-5(b), the staff requested that the applicant provide a brief description of the nature of these indications, including the overall number of shroud cracking indications, the length of the indications (expressed as a percentage of total weld length or shroud height/circumference), and the orientation of the indications (e.g., axial or circumferential flaws).

In its response to RAI B.2.10-5 parts (a) and (b), the applicant provided the requested information concerning the core shroud cracking indications, as follows:

> <u>One “H5” indication</u>: Identified in 1998, this indication was found in the heat affected zone of the upper core shroud plate, adjacent to the “H5” horizontal weld. This indication was conservatively estimated at 0.2 percent of the “H5” weld length with an axial orientation. The applicant noted that the indication did not exhibit typical SCC characteristics and therefore, it is not believed to be the result of service-induced aging degradation.
>
> <u>Six “H3” Indications</u>: Identified in 2007, these SCC indications were found in core shroud plate heat affected zone, adjacent to the “H3” horizontal weld. The six indications total 2.66 percent of the weld length and are circumferentially oriented.
>
> <u>Three “H4” Indications</u>: Identified in 2007, these SCC indications were found in core shroud plate heat affected zone, adjacent to the “H4” horizontal weld. The three indications total 6.18 percent of the weld length and are circumferentially oriented.

The staff found the applicant’s response to RAI B.2.10-5 acceptable because the applicant provided the requested information concerning the cracking indications in the core shroud. The staff determined that the subject indications are consistent with the types of service-induced aging effects managed under BWRVIP-76-A and that the applicant’s BWR Vessel Internals Program provides for adequate monitoring of the subject indications through its implementation of BWRVIP-76-A guidelines.

In RAI B.2.10-6, the staff requested that the applicant state whether there have been any other aging effects (other than SCC) identified for the core shroud at Columbia. The staff also requested that the applicant discuss whether the implementation of the BWRVIP-76-A core shroud inspection and evaluation guidelines provide adequate aging management for all potential forms of degradation that are applicable to the core shroud, including pitting, crevice corrosion, and cumulative fatigue damage.

In its response to RAI B.2.10-6, the applicant stated that there have been no other aging effects identified for Columbia’s core shroud other than SCC. The applicant stated that the indication identified in 1998 appears to be geometric in nature and therefore, not caused by service-induced degradation. The other nine indications identified in HAZs adjacent to horizontal welds “H3” and “H4” (discussed above) were all determined to be the result of SCC. Based on these inspection findings, the applicant concluded that implementation of BWRVIP-76-A guidelines is sufficient for aging management of the core shroud. The staff found the applicant’s response to RAI B.2.10-6 acceptable because the applicant confirmed that SCC is the only aging effect identified for Columbia’s core shroud based on the inspection results and cracking indications discussed above. Therefore, the staff finds that Columbia's continued implementation of the BWRVIP-76-A guidelines will provide adequate aging management for the core shroud.

In RAI B.2.10-7, the staff requested that the applicant state whether Columbia has implemented any tie rod repairs or other repairs to the core shroud. If no tie rod repairs or other repairs have been implemented, the staff requested that the applicant state whether Columbia has current plans to implement tie rod repairs or other repairs to the core shroud in the future. If there are no current plans to implement tie rod repairs or other repairs to the core shroud in the future, the staff requested that the applicant discuss the reasons for not implementing repairs, such as the extent of shroud cracking and the implementation of BWRVIP-76-A core shroud inspection and evaluation guidelines that would be sufficient to manage aging effects for the core shroud without implementing tie rod repairs.

In its response to RAI B.2.10-7, the applicant stated that no shroud repair has been performed to date. Energy Northwest does not currently plan to perform a pre-emptive repair of its core shroud, based on the current inspection findings. Energy Northwest will repair the core shroud if future inspections find more extensive cracking indications that would necessitate a core shroud repair in accordance with BWRVIP-76-A guidelines. The applicant noted that its implementation of BWRVIP-76-A inspection and evaluation guidelines is sufficient for aging management of its core shroud without implementing tie rod repairs, based on the current inspection findings. The staff found the applicant's response to RAI B.2.10-7 acceptable because the applicant provided the requested information concerning repairs or future repairs to its core shroud. The staff agreed that the applicant's implementation of BWRVIP-76-A inspection and evaluation guidelines is currently sufficient for aging management of its core shroud without implementing tie rod repairs, based on the current inspection findings.

In RAI B.2.10-8, the staff requested that the applicant state whether Columbia follows the guidelines of BWRVIP-100-A pertaining to updated fracture toughness analyses for neutron-irradiated stainless steels in the core shroud.

In its response to RAI B.2.10-8, the applicant stated that Columbia is committed to following all applicable BWRVIP guidelines. Therefore, Columbia has implemented the guidelines of BWRVIP-100-A for plant-specific core shroud fracture toughness analyses. The staff found the applicant's response to RAI B.2.10-8 acceptable because the applicant confirmed that Columbia has implemented the guidelines of BWRVIP-100-A pertaining to updated core shroud fracture toughness analyses.

In RAI B.2.10-9, the staff requested that the applicant provide the following additional information concerning the inspection and examination volume for the jet pump holddown beams at Columbia, as follows:

(a) The staff requested that the applicant state whether the locations designated in BWRVIP-41 as "BB-1" and "BB-2" are inspected using ultrasonic testing (UT) with high priority, according to BWRVIP-41 inspection and evaluation guidelines.

(b) The staff requested that the applicant state whether the taper region of the holddown beams is inspected for cracking or other degradation. The staff noted in part (b) of RAI B.2.10-9 that the holddown beam taper region is the location of the jet pump holddown beam failure at Quad Cities in 2002.

(c) The staff requested that the applicant state whether the jet pump holddown beams at Columbia are of the same, similar, or different design from the Quad Cities jet pump holddown beams, at the time of failure.

In its response to RAI B.2.10-9(a), the applicant stated that jet pump holddown beam inspections include locations “BB-1” and “BB-2.” These inspections are performed using UT, with techniques demonstrated in accordance with BWRVIP-03, as required by BWRVIP-41. Inspections of the holddown beams are scheduled and performed in accordance with the latest revision of the BWRVIP-41 guidelines and BWRVIP-138, “BWR Vessel and Internals Project, Updated Jet Pump Beam Inspection and Evaluation Guidelines.” The staff found the applicant’s response to part (a) acceptable because the applicant confirmed that jet pump holddown beams regions designated as “BB-1” and “BB-2” per BWRVIP-41 are inspected using UT, and the inspections are scheduled and performed in accordance with BWRVIP-41 and BWRVIP-138 guidelines.

In its response to RAI B.2.10-9(b), the applicant stated that the taper region of the jet pump holddown beams (e.g., region “BB-3” under BWRVIP-41 guidelines) is also examined for aging degradation using UT in accordance with BWRVIP-41 guidelines. The staff found the applicant’s response to part (b) acceptable because the applicant confirmed that the taper region of the jet pump holddown beams is inspected in accordance with BWRVIP-41 guidelines.

In its response to RAI B.2.10-9(c), the applicant stated that the 2002 Quad Cities jet pump holddown beam failure occurred due to SCC in the taper region. The specific Quad Cities jet pump holddown beam was a 30-year-old “Group I” design. Columbia does not currently use the “Group I” holddown beam design identified in the 2002 failure. There are three GE holddown beam designs (“Group I, II, and III”), and all domestic BWR plants have replaced the “Group I” beams with “Group II or III.” Columbia replaced its holddown beams with beams of the “Group II” design in 1994. There is no field experience associated with failure of the “Group II or III” designs. The staff found the applicant’s response to part (c) acceptable because the applicant confirmed that the jet pump holddown beams at Columbia are of a different design (“Group II”) than those that failed at Quad Cities in 2002 (“Group I”).

In RAI B.2.10-10, the staff requested that the applicant state whether neutron fluence values for the core shroud were calculated using an NRC-approved fluence methodology that is consistent with NRC RG 1.190, “Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence,” March 2001. In its response to RAI B.2.10-10, the applicant stated that the core shroud fluence values are calculated using the methodology of NEDC-32983P, “General Electric Methodology for Reactor Pressure Vessel Fast Neutron Flux Evaluation.” The applicant stated that NEDC-32983P was approved by NRC letter dated September 14, 2001 (S. A. Richards, USNRC, to J. F. Klapproth, GE Nuclear Energy, “Safety Evaluation for NEDC-32983P, ‘General Electric Methodology for Reactor Pressure Vessel Fast Neutron Flux Evaluation’ (TAC No. MA9891),” MFN 01-050, September 14, 2001), with acceptability based on the fact that the fluence methodology followed the guidance in RG 1.190. The staff found the applicant’s response to RAI B.2.10-10 acceptable because the applicant confirmed that neutron fluence values for the core shroud are calculated using an NRC-approved fluence methodology that follows the guidance of RG 1.190.

In its original LRA submitted on January 19, 2010, the applicant stated that Columbia had core plate wedges installed around the periphery of the core plate within the shroud. Core plate wedges prevent lateral motion of the core plate and are not subject to stress relaxation. However, in a conference call and in a letter dated May 6, 2011, the applicant stated that it had discovered that there were no core plate wedges located around the periphery of the core plate within the shroud. Having no core plate wedges results in the applicant having to perform bolt inspection as described in BWRVIP-25, "BWR Core Plate Inspection and Flaw Evaluation Guidelines." However, the applicant also stated that the nuclear industry research organization, EPRI (Electric Power Research Institute), is currently working on developing revised guidance for the core plate hold-down bolts and that the applicant would deviate from BWRVIP-25 inspection guidance, until December 31, 2015, (Deviation Disposition DD-09) because it does not plan to inspect the hold-down bolts for cracking due to difficulties performing the inspection. The staff reviewed the applicant's submittal letter regarding its intent to deviate from BWRVIP-25 inspection guidelines and had concerns that the effects of aging will not be adequately managed without performing the inspections. This was included and considered as part of the core plate hold-down bolts open item (OI) 4.7.4-1 in the SER with open items.

The staff notes that if core plate wedges are not installed, core plate rim hold-down bolts perform the function of preventing lateral motion of the core plate. However, core plate rim hold-down bolts are susceptible to loss of preload due to stress relaxation and as described in the staff's SE for the BWRVIP-25 Report related to license renewal, dated December 7, 2000, "due to susceptibility of the rim hold-down bolts to stress relaxation, applicants referencing the BWRVIP-25 report for license renewal should identify and evaluate the projected stress relaxation as a potential TLAA issue."

By letter dated June 2, 2011, the staff issued RAI B.2.10-2 requesting the applicant to:

a. Describe the details of the field investigation, and any uncertainties, regarding whether Columbia has wedges installed to prevent lateral motion of the core plate in the event of stress relaxation of the core plate rim hold-down bolts.

b. If wedges are not installed to prevent lateral motion of the core plate, revise, as necessary, the applicable sections of the Columbia LRA.

c. Provide a specific license renewal commitment and UFSAR supplement to manage the effects of loss of preload in the core plate rim holddown bolts

In its response to RAI B.2.10-2 (a) dated June 29, 2011, the applicant stated that it received documentation by GE informing the applicant to investigate its plant because it may not have core plate wedges installed. The applicant performed a visual examination using an underwater camera during RFO 20 of the core plate and confirmed that Columbia does not have core plate wedges.

In its response to RAI B.2.10-2 (b) dated June 29, 2011, the applicant stated that the applicable sections of the LRA were revised in its LRA Amendment 36 dated June 29, 2011. The following LRA sections were revised:

i. Table C-2 from Appendix C of the LRA has been revised in LRA Amendment 36 to address the lack of core plate wedges.

ii. The description of the BWR Vessel Internals AMP in LRA Section B.2.10 has been revised in LRA Amendment 36.

iii. LRA Section 4.0 and the USFAR Supplement addressing TLAAs have been revised in LRA Amendment 36. Commitment No. 71 states that Columbia will perform either of the following options two years prior to the period of extended operation.

(1) Install wedges to prevent lateral motion of the core plate in the event of stress relaxation of the core plate rim hold-down bolts.

(2) Submit a plant-specific TLAA addressing the stress relaxation of the core plate rim hold-down bolts to the NRC for review and approval at least two years prior to the beginning of the period of extended operation. This TLAA shall analyze stress relaxation of the core plate rim hold-down bolts due to exposure of the pre-loaded bolts to neutron radiation over the life of the plant, and the analysis methods shall be consistent with the generic BWR core plate analysis specified in Appendix B of BWRVIP-25.

In its response to RAI B.2.10-2 (c) dated June 29, 2011, the applicant stated that prior to the period of extended operation, Columbia will perform either of the following:

i. Install wedges to prevent lateral motion of the core plate in the event of stress relaxation of the core plate rim hold-down bolts at least two years prior to the beginning of the period of extended operation, or

ii. Submit a plant-specific TLAA addressing the stress relaxation of the core plate rim hold-down bolts to the NRC for review and approval at least two years prior to the beginning of the period of extended operation. This TLAA shall analyze stress relaxation of the core plate rim hold-down bolts due to exposure of the pre-loaded bolts to neutron radiation over the life of the plant, and the analysis methods shall be consistent with the generic BWR core plate analysis specified in Appendix B of BWRVIP-25.

The staff reviewed the applicant's response and noted that the applicant had submitted a TLAA for the core plate rim hold-down bolts but had not selected one of the three options of 10 CFR 54.21(c)(1) to demonstrate its evaluation of the TLAA. Also, the applicant did not provide an AMR line item for the core plate rim hold-down bolts with the aging effect of loss of preload due to stress relaxation. Further, the applicant stated that it intended to deviate from BWRVIP-25 inspection guidelines, which could result in inadequate management of the aging effect. This issue was open item OI 4.7.4-1 in the SER with open items.

By letter dated November 4, 2011, the applicant provided LRA Amendment 44, which included revisions to all LRA sections related to the aging management and the TLAA of the core plate rim hold-down bolts. These LRA revisions were provided to address the staff's concerns identified in OI 4.7.4-1, regarding the applicant's ability to manage aging of the core plate rim hold-down bolts during the period of extended operation.

LRA Amendment 44 revised the UFSAR supplement (Section A.1.3.7.4) and Commitment No. 71. These revisions state an intent to install core plate wedges at least two years prior to the period of extended operation unless (1) a site-specific analysis is approved by the NRC that resolves core plate bolt loss of preload due to both stress relaxation and cracking; or (2) an NRC-approved method is developed to inspect the core plate bolts for cracking and a site-specifc analysis for loss of preload due to stress relaxation of the core plate bolts is approved by the NRC.

LRA Amendment 44 also revised the TLAA identified in LRA Section 4.7.4, "Core Plate Rim Hold-Down Bolts," to (1) identify this TLAA as dispositioned consistent with 10 CFR 54.21(c)(1)(iii), and (2) identify the revised commitment related to the core plate rim hold-down bolts, consistent with the amended UFSAR supplement Section A.1.3.7.4.

In addition to the above, the applicant also revised items for the core plate rim hold-down bolts in LRA Table 3.1.1, Item 3.1.1-44 and LRA Table 3.1.2-2 to include (a) loss of preload as an aging effect that is addressed by a TLAA, (b) cracking as an aging effect that is managed by the BWR Vessel Internals Program, and (c) cracking as an aging effect that is managed by the BWR Water Chemistry Program.

Lasty, LRA Amendment 44 modified the LRA Appendix C, Table C-2 BWRVIP-25 action item responses to address (a) the BWRVIP-25 Deviation Disposition DD-09, as it applies to BWRVIP-25 Applicant Action Item Nos. (1) and (5); and (b) the revised commitment related to the core plate rim hold-down bolts (Commitment No. 71).

The staff reviewed the applicant's revised LRA sections related to the core plate rim hold-down bolts, as provided in LRA Amendment 44, and determined the applicant's response acceptable because:

(1) the applicant appropriately cited the requirements of 10 CFR 54.21(c)(1)(iii) to demonstrate its evaluation of the TLAA for the core plate rim hold-down bolts;

(2) the applicant provided an acceptable UFSAR supplement and commitment (Commitment No. 71) for ensuring that core plate wedges will be installed at least two years prior to the period of extended operation, unless the NRC approves specific analyses and/or inspection methodologies that would resolve issues regarding cracking and loss of preload due to stress relaxation for the core plate rim hold-down bolts during the period of extended operation;

(3) the applicant provided the necessary AMR line items in LRA Table 3.1.2-2 for comprehensively identifying the aging effects, TLAA, and aging management programs related to the core plate rim hold-down bolts; and

(4) the applicant appropriately identified BWRVIP-25 Deviation Disposition DD-09 and addressed Commitment No. 71, as revised, in the LRA Appendix C, Table C-2 BWRVIP-25 action item responses.

Furthermore, the staff determined that the revised UFSAR supplement and Commitment No. 71, pertaining to the installation of core plate wedges at least two years prior to the period of extended operation, ensure that BWRVIP-25 Deviation Disposition DD-09 will not represent an aging management concern for the hold-down bolts during the period of extended operation because the installation of wedges would ensure adequate lateral restraint of the core plate even if the hold-down bolts undergo a significant loss of preload. The Deviation Disposition DD-09 is scheduled to end on December 31, 2015. Before the Deviation Disposition DD-09 schedule ends, the applicant will provide to the NRC its alternative to managing the hold down bolts for cracking, which may include inspecting the hold down bolts, following the new guidance established by EPRI, or submitting a new deviation. The staff notes that additional measures may be taken between December 31, 2015, and the date of installation of the core plate wedges (two years prior to entering the period of extended operation in 2023). Therefore, the staff finds that all concerns addressed by OI 4.7.4-1 have been resolved by the LRA revisions provided in LRA Amendment 44, and thus OI 4.7.4-1 is closed.

To ensure that core plate wedges will be installed to prevent lateral motion of the core plate, the staff will issue a license condition requiring the applicant to install wedges on or before December 20, 2021. The license condition will also require the applicant to submit a report to

NRC staff summarizing the results of the installation of wedges and, if applicable, corrective action.

Based on its audit activities and its subsequent review of the applicant's responses to the staff's RAIs concerning the Columbia BWR Vessel Internals Program, as discussed above, the staff determined the following:

- The Columbia BWR Vessel Internals Program elements are consistent with and bounded by the corresponding program elements described in GALL Report AMP XI.M9.
- The Columbia BWR Vessel Internals Program complies with the quality assurance requirements of 10 CFR Part 50, Appendix B.
- The Columbia BWR Vessel Internals Program complies with the applicable Code requirements and 10 CFR 50.55a.

Therefore, the staff found that the applicant's existing BWR Vessel Internals AMP, as described in LRA Section B.2.10, is acceptable for continued implementation through the end of the period of extended operation.

Operating Experience. LRA Section B.2.10 summarizes operating experience related to the BWR Vessel Internals Program. The applicant stated that its operating experience is consistent with industry experience—a large number of examinations are being performed, and an occasional indication is being found and resolved. Columbia has found cracking of the core shroud, cracking of the steam dryer, gaps on the jet pump set screws, and wear of the jet pump wedges. All conditions have been evaluated and actions taken in accordance with approved BWRVIP documents for the component involved. The applicant also stated that it reviewed the recent industry operating experience for relevance and similar applications and found no indications were reported that required repair or replacement of any component. The applicant further states that BWRs continue to inspect per BWRVIP guidelines and that occasional indications are found and dispositioned. The applicant further stated that future operating experience will be captured through the normal operating experience review process, which will continue through the period of extended operation.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. In LRA Section A.1.2.10, the applicant provided an UFSAR supplement summary description for the BWR Vessel Internals Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.1-2. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's BWR Vessel Internals Program and the closure of open item OI 4.7.4-1, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.7 BWR Water Chemistry

Summary of Technical Information in the Application. LRA Section B.2.11 describes the existing BWR Water Chemistry Program as consistent with GALL Report AMP XI.M2, "Water Chemistry." The applicant stated that this is an existing program that will mitigate damage related to loss of material due to corrosion or erosion, cracking due to SCC, and reduction of heat transfer due to fouling of plant components that are within the scope of license renewal and contain or are exposed to treated water, treated water in the steam phase, reactor coolant, or treated water in a sodium pentaborate solution. The BWR Water Chemistry Program is a mitigation program and is supplemented by separate one-time inspections of representative areas of treated water systems. The one-time inspection provides further confirmation that reduction in heat transfer is effectively mitigated, or to detect and characterize whether, and to what extent, degradation is occurring.

Additionally, the BWR Water Chemistry Program is supplemented by the BWR FW Nozzle Program, BWR SCC Program, BWR Penetration Program, BWR Vessel ID Attachment Welds Program, BWR Vessel Internals Program, ISI Program, and Small Bore Class 1 Piping Inspection to provide verification of the program's effectiveness in managing the effects of aging for reactor pressure vessel (RPV), RVI, and RCPB components.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine if it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M2. As discussed in the audit report, the staff confirmed that these elements are consistent with the corresponding element of GALL Report AMP XI.M2. Based on its audit and review of the applicant's BWR Water Chemistry Program, the staff finds that Elements one through six of the applicant's BWR Water Chemistry Program, are consistent with the corresponding program elements of GALL Report AMP XI.M2 and, therefore, are acceptable.

UFSAR Supplement. LRA Section A.1.2.11 provides the UFSAR supplement for the BWR Water Chemistry Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Tables 3.1-2, 3.2-2, 3.3-2, and 3.4-2. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's BWR Water Chemistry Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.8 Chemistry Program Effectiveness Inspection

Summary of Technical Information in the Application. LRA Section B.2.12 describes the new Chemistry Program Effectiveness Inspection as consistent with GALL Report AMP XI.M32, "One-Time Inspections." The applicant stated that this is a new one-time inspection that detects and characterizes material conditions in representative low-flow and stagnant areas of plant systems managed by the applicant's BWR Water Chemistry Program, Fuel Oil Chemistry Program, and Closed Cooling Water Chemistry Program, all of which are mitigation programs. The applicant also stated that the inspection detects loss of material due to crevice, general, galvanic, or pitting corrosion (in treated water or fuel oil environments), microbiologically-influenced corrosion (MIC) (in a fuel oil environment has occurred), and cracking due to SCC of susceptible materials in susceptible locations.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine if it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M32. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.M32, with the exception of "the parameters monitored/inspected" and "detection of aging effects" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

The staff compared the LRA "Parameters Monitored or Inspected," program element, to the GALL Report AMP XI.M32, "One-Time Inspection" Program, "parameters monitored/inspected" program element. The staff noted the applicant did not elaborate on the inspecting personnel's qualifications, nor if these were in accordance with ASME Code and 10 CFR 50, Appendix B, as the GALL Report AMP XI.M32 recommends. The staff also noted that the One-Time Inspection Program's basis document failed to detail the inspecting personnel's qualifications or describe the site-specific procedure outlining the training requirements for individuals assigned to perform these inspections. By letter dated July 15, 2010, the staff issued RAI B.2.A-1 asking the applicant to provide details on the qualifications and training requirements for its personnel assigned to perform the inspections and its conformance to the applicable ASME Codes.

In its response dated September 13, 2010, the applicant stated that personnel performing the visual examinations, UT, or other NDE techniques, outlined in ASME Sections V and XI, are trained in accordance to ASME Code requirements. The applicant further stated that training requirements for all inspections will be consistent to 10 CFR Part 50, Appendix B. The staff reviewed the applicant's response and finds it acceptable because the one-time inspection will be performed by qualified personnel following procedures consistent to ASME Code and 10 CFR 50, Appendix B, using a variety of NDE methods, including visual and volumetric techniques. The staff's concern described in RAI B.2.A-1 is resolved.

When the staff compared the LRA "detection of aging effects" program element, to the GALL Report AMP XI.M32, "One-Time Inspection," "detection of aging effects" program element, it was not clear how the applicant defined its inspection "representative sample." The staff noted that the LRA characterized the sample population based on an engineering evaluation and a "sound statistical sampling methodology," while the GALL Report AMP XI.M32, recommends the "representative sample" to focus, where practical, on the bounding or lead components of a system population, most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin. The staff also noted that the applicant's sampling plan provides no details on its composition and assurances that a representative population of sufficient size and scope will be inspected. By letter dated July 15, 2010, the staff issued RAI B.2.A-2 asking the applicant to provide details on the proposed sampling methodology indicating, for example, if it follows a RI-ISI methodology, a sequential sampling, or some other statistically based sampling plan.

In its response dated September 13, 2010, the applicant stated that within the scope of the One-Time Inspection Program for each material and environment combination, a sample population will be identified through engineering evaluations. The applicant also stated that the selected components will be those most susceptible to aging effects defined by time in service, severity of operating conditions, and design margins. The applicant further stated that the selected sample population will be capped at 5 percent, for up to 200 components within the same system, with a minimum sample size of one for component populations of less than 20. Finally, the applicant stated that the inspection will include piping segments upstream and downstream of the selected components, and that the supplemental inspections sample size would be determined as part of the Corrective Action Program. However, the staff noted that large sample sizes may be required to adequately confirm an aging effect is not occurring because of the uncertainty in determining the most susceptible locations and the potential for aging to occur in other locations. By letter dated December 3, 2010, the staff issued RAI B.2.A-3 requesting that the applicant provide technical justification for ensuring, based on the sample size chosen, that the components not inspected are not experiencing degradation.

In its response dated January 20, 2011, the applicant stated that the selected set of components to be sampled will be determine based on the material, environment, and aging effect combinations such that each combination represents a sample population. The applicant also stated that it will inspect 20 percent of each population, up to a maximum of 25 inspections per population. The staff finds the applicant's response acceptable because the applicant's sampling methodology ensures that a representative sample of material and environment combinations is considered, ensures sample locations will focus on the most susceptible components based on time in service, severity of operating conditions, and design margins, and includes an appropriate sample size. The staff's concerns described in RAIs B.2.A-2 and B.2.A-3 are resolved.

Based on its audit and review of the applicant's responses to RAIs B.2.A-1, B.2.A-2, and B.2.A-3, the staff finds that Elements one through six of the applicant's Chemistry Program Effectiveness Inspection Program are consistent with the corresponding program elements of GALL Report AMP XI.M32 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.12 summarizes operating experience related to the Chemistry Program Effectiveness Inspection. The applicant stated that its operating experience included instances of MIC in the fuel oil system associated with the fire protection diesel. Corrective actions included more stringent chemical control of new fuel and biocide addition, in addition to cleaning of the tank. The applicant also stated that it reviewed the recent industry operating experience for relevance and similar applications, but none were found. The applicant further stated that future operating experience will be captured through the normal operating experience review process, which will continue through the period of extended operation.

The staff reviewed operating experience information in the application and during the audit to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation. In addition, the staff confirmed that the applicant addressed operating experience identified after issuance of the GALL Report. The applicant's review of this recent operating experience did not reveal any applicable occurrences or detrimental environments that could exacerbate a slow aging effect or accelerate an otherwise long incubation period, nor were any identified in the staff's independent review of the applicant's recent operating experience. The staff, therefore, confirms the applicant's statement that the Chemistry Program Effectiveness Inspection Program is appropriate to verify the effectiveness of the chemistry programs in managing the effects of aging and to identify corrective actions, possibly including programmatic enhancement, to be taken to ensure that the component intended functions will remain consistent with the CLB during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.12 provides the UFSAR supplement for the Chemistry Program Effectiveness Inspection Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Tables 3.1-2, 3.2-2, 3.3-2, and 3.4-2. The staff also notes that the applicant committed (Commitment No. 12) to implement the new Chemistry Program Effectiveness Inspection Program within 10 years prior to the period of extended operation for managing aging of applicable components. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Chemistry Program Effectiveness Inspection Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.9 Cooling Units Inspection

LRA Section B.2.14 originally described the new Cooling Units Inspection Program as consistent with GALL Report AMP XI.M32, "One-Time Inspection." During its review, the staff identified inconsistencies in the use of a One-Time Inspection Program to manage aging for components for which the GALL Report recommends an aging effect. As a result, by letter dated January 28, 2011, the applicant revised its Cooling Units Inspection Program to become a new, plant-specific AMP. The staff's evaluation of the RAIs submitted regarding the original Cooling Units Inspection Program are documented below. The resolutions to these RAIs have been incorporated into the new plant-specific program. The staff's evaluation of the new plant-specific Cooling Units Inspection Program is documented in SER Section 3.0.3.3.3.

Staff Evaluation of RAIs. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine if it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M32, and identified inconsistencies with the "parameters monitored or inspected" and "detection of aging effects" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs, discussed below. The staff also identified inconsistencies in the use of a One-Time Inspection Program to manage aging for components for which the GALL Report recommends an aging effect, which resulted in the issuance of an RAI, discussed below.

GALL Report AMP XI.M32 recommends that inspections are to be performed by qualified personnel under the "parameters monitored or inspected" program element description; however, the staff noted that the applicant did not describe the inspecting personnel's qualifications. By letter dated July 15, 2010, the staff issued RAI B.2.A-1 requesting that the applicant provide details on the qualifications and training requirements for its personnel assigned to perform the inspections and its conformance to the applicable ASME Codes.

In its response dated September 13, 2010, the applicant stated that personnel performing the visual examinations, UT, or other NDE techniques in accordance with ASME Code Section V and ASME Code Section XI, will be trained in accordance with ASME Code requirements. The applicant further stated that training requirements for all inspections will be consistent with 10 CFR Part 50, Appendix B. The staff finds the applicant's response acceptable because the one-time inspection will be performed by qualified personnel following procedures consistent with the ASME Code and 10 CFR 50, Appendix B. The staff's concern described in RAI B.2.A-1 is resolved.

GALL Report AMP XI.M32 recommends that "the inspection includes a representative sample of the system population, and where practical, focuses on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin." However, under the "detection of aging effects" program element description, the applicant stated that the sample population will be determined by engineering evaluation based on sound statistical sampling methodology. By letter dated July 15, 2010, the staff issued RAI B.2.A-2 requesting that the applicant provide details on the proposed sampling methodology.

In its response dated September 13, 2010, the applicant stated that the selected components will be those most susceptible to aging effects defined by time in service, severity of operating conditions, and design margins. The applicant provided a flow chart that described how the sample size would be selected based on the discrete number of components in the population, for example, in a population size of 21–200 components, 5 percent of the components would be inspected. The applicant also stated that supplemental inspection sample size would be determined as part of the corrective action process. However, the staff noted that larger sample sizes may be required to adequately confirm an aging effect is not occurring because of the uncertainty in determining the most susceptible locations and the potential for aging to occur in other locations. By letter dated December 3, 2010, the staff issued RAI B.2.A-3 requesting that the applicant provide technical justification for ensuring, based on the sample size chosen, that the components not inspected are not experiencing degradation.

In its response dated January 20, 2011, the applicant stated that the Cooling Units Inspection Program will be revised to become a plant-specific program and will no longer be a One-Time Inspection Program. By letter dated January 28, 2011, the applicant revised its Cooling Units Inspection Program to become a new plant-specific AMP. The applicant stated that the new plant-specific program will include baseline inspections of 20 percent of the population of each material, environment, and aging effect group, with up to a maximum of 25 inspections per group. The applicant also stated that the inspections will be focused on the components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margins. The staff finds the applicant's response acceptable because the applicant's sampling methodology ensures that a representative sample of material and environment combinations is considered, ensures sample locations will focus on the most susceptible components, and includes an appropriate sample size. The staff's concerns described in RAIs B.2.A-2 and B.2.A-3 are resolved.

GALL Report AMP XI.M32 states that use of a one-time inspection is appropriate at the following times:

- when an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence
- when an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than that generally expected
- when the characteristics of the aging effect include a long incubation period

GALL Report AMP XI.M32 also states that for these cases, the one-time inspection should provide confirmation that either the aging effect is indeed not occurring, or the aging effect is occurring very slowly so as not to affect the component or structure's intended function during the period of extended operation.

In LRA Section B.2.14, the applicant stated that its Cooling Units Inspection Program will detect and identify loss of material due to crevice, galvanic, general, pitting, or microbiologically-influenced corrosion, reduction in heat transfer due to fouling of heat exchanger tubes and fins, and cracking of aluminum components for aluminum. The applicant also stated that the program detects and characterizes the material condition of aluminum, steel, copper alloy, and stainless steel materials used in cooling unit components that are exposed to an internal or external condensation environment. The applicant further stated that the program will ensure the pressure boundary integrity and heat transfer capability of susceptible components and provide assurance (and confirmation) that the structural integrity of susceptible nonsafety-related components will be maintained and not result in the loss of any safety-related component-intended functions.

It is not clear to the staff how a One-Time Inspection Program is appropriate to manage loss of material and cracking for aluminum exposed to condensation (external) and loss of material for steel exposed to condensation (internal) given the following:

- Industry experience has shown that aging is expected for these material and environment combinations.
- The GALL Report recommends periodic inspection programs to manage aging for these material and environment combinations.
- A One-Time Inspection Program is only to be used when an aging effect is not expected or is expected to progress very slowly.

By letter dated November 5, 2010, the staff issued RAI B.2.14-1 requesting that the applicant justify how the one-time inspections proposed by the Cooling Units Inspection Program is adequate by explaining how, for each component managed by the program, one of the following criteria for use of a one-time inspection is satisfied:

- The aging effect is not expected to occur, but the data is insufficient to rule it out with reasonable confidence.
- The aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than that generally expected.
- The characteristics of the aging effect include a long incubation period.

In its response dated January 28, 2011, the applicant revised its Cooling Units Inspection Program to become a new plant-specific AMP, which includes baseline inspections performed within the 10-year period prior to the period of extended operation of a sample population to determine whether, and to what extent, degradation is occurring and to provide a baseline for future inspections. This will be followed by opportunistic inspections when components are opened for maintenance, repair, or surveillances. The new plant-specific program also includes review of inspection findings to ensure that each material exposed to condensation has been examined by opportunistic inspections within an initial 5-year period or appropriate actions will be taken to ensure an inspection is performed if opportunistic inspections have not occurred. The staff's evaluation of the applicant's new plant-specific Cooling Units Inspection Program is documented in SER Section 3.0.3.3.3. The staff finds the applicant's response acceptable because the revised program includes baseline and opportunistic inspections of the subject components to manage loss of material, cracking, and reduction of heat transfer. The staff's concern described in RAI B.2.14-1 is resolved.

Conclusion. On the basis of its review, the staff concludes that the applicant is no longer claiming its program is consistent with GALL Report AMP XI.M32. The staff's evaluation, acceptance, and conclusion on the adequacy of the applicant's new plant-specific Cooling Units Inspection Program is documented in SER Section 3.0.3.3.3.

3.0.3.1.10 Control Rod Drive Return Line Nozzle Program

Summary of Technical Information in the Application. LRA Section B.2.15 describes the existing CRDRL Nozzle Program as consistent with GALL Report AMP XI.M6, "BWR Control Rod Drive Return Line Nozzle." The CRDRL Nozzle Program manages cracking due to flaw growth of the CRDRL nozzle, safe end, cap, and connecting welds. This program was developed in response to industry events involving the CRDRL nozzle. The program includes modifications, mitigation, and inspection and credits portions of the BWR Water Chemistry Program and the ISI Program.

Columbia has modified the CRDRL by the second option discussed in GALL Report AMP XI.M6, by cutting and capping the CRDRL with no alternate return line flow established. The modifications were performed prior to initial startup of Columbia. Modifications were completed by the vessel Original Equipment Manufacturer (OEM). Since the modifications were performed prior to initial startup of Columbia, CRD system functionality was demonstrated by the initial system testing, as described in UFSAR Section 14.2. This startup testing and subsequent system operation have demonstrated CRD return flow capacity.

Columbia mitigates CRDRL nozzle cracking by maintaining water chemistry in accordance with the current BWRVIP guidelines using the BWR Water Chemistry Program.

The CRDRL Nozzle Program performs ultrasonic inspection of the nozzle in accordance with ASME Section XI, Subsection IWB. The nozzle to safe end and safe end to cap are Category B-J welds and are covered by the risk-informed ISI Program. In part because of the all low alloy steel construction that is not susceptible to stress corrosion cracking, these are low risk welds and are not scheduled for inspection in the third 10-year interval.

Enhanced ISI and Maintenance Programs are not required as Columbia did not install an alternate return line. The GALL Report states that the effects of cracking will also be monitored in accordance with NUREG-0619. For licensees who have cut and capped the CRD return line nozzle with rerouting of the CRD return line, NUREG-0619 requires that during each RFO the licensee inspect the welded connection joining the rerouted CRD return line to the system which then returns flow to the RV.

Columbia has used the second option, of not establishing an alternate return line flow, so there is no alternate connection to inspect. This NUREG-0619 requirement is not applicable to Columbia.

Cracking found during ISI is evaluated and dispositioned in accordance with ASME Section XI, Subsection IWB. Removing cracks by mechanical means is acceptable per ASME Section XI. However, recent industry practice has been to repair such cracks by weld overlay, in accordance with Code Cases N504-2 and N638. Columbia does not anticipate any indications in its low alloy steel CRDRL nozzle welds; however, should indications be found and repair be required, all available repair techniques would be evaluated. If Columbia opts for a repair technique different from ASME Section XI, a relief request will be submitted for NRC review and approval.

Staff Evaluation. During the audit, the staff reviewed the applicant's onsite basis documentation for the CRDRL Nozzle Program in order to determine if the AMP elements are consistent with the 10 elements in GALL Report AMP XI.M6. The staff also interviewed the applicant's technical staff and reviewed other onsite documentation for determining whether the CRDRL Nozzle Program, as described in LRA Section B.2.15, is consistent with GALL Report AMP XI.M6 and complies with regulatory requirements.

The applicant stated that the Columbia CRDRL Nozzle Program performs inspection of Columbia's CRDRL nozzle, safe end, CRDRL cap, and connecting welds in accordance with ASME Code, Section XI, Subsection IWB requirements, as required by 10 CFR 50.55a and specified in GALL Report AMP XI.M6. The implementation of the enhanced inspection requirements of NUREG-0619 are not required for Columbia because the CRDRL has been modified using the second option specified in Element 2 of GALL Report AMP XI.M6. Specifically, the CRDRL has been cut and capped with no alternate return line flow established. Therefore, the applicant states that the implementation of the Code requirements for inspection and evaluation of the CRDRL nozzle provides sufficient examination coverage for the subject components and is consistent with GALL Report AMP XI.M6.

The applicant stated that the control of RCS water chemistry for mitigating SCC in the CRDRL nozzle, safe end, cap, and connecting weld components at Columbia is implemented in accordance with the guidelines of applicable BWRVIP documents, as described in the BWR Water Chemistry Program.

During the audit, staff reviewed the ISI Program plan for the current (third) 10-year interval ISI Program to verify that the CRDRL Nozzle Program complies with ASME Code, Section XI requirements. The staff also reviewed operating experience reports, including a sample of CRs prepared by the applicant, and interviewed the applicant’s technical staff to verify that plant-specific operating experience did not reveal any service-induced degradation not bounded by industry experience. The staff also verified that the relevant operating experience described in the applicant’s basis documents and CRs is consistent with the plant-specific operating experience documented for this AMP, as discussed in LRA Section B.2.15. The staff noted that Columbia plant-specific operating experience has shown no indications of cracking or other aging degradation in the CRDRL nozzle, based on inservice examinations conducted for Columbia's second 10-year interval ISI Program.

Based on its site audit activities, the staff was able to initially confirm that the AMP elements, as discussed in LRA Section B.2.15 and the supporting basis documentation, are consistent with the GALL Report AMP XI.M6 program elements. However, the staff determined that consistency with the subject GALL program elements should be fully verified through written correspondence from the applicant concerning several issues related to the scope of materials covered by the AMP and ultrasonic ISI techniques.

The staff noted that the applicant is currently operating with an NRC-approved alternative to ASME Code, Section XI requirements for Examination Category B-J components authorizing the implementation of a risk-informed ISI Program. The subject Code alternative, as noted in LRA Section B.2.15, covers the CRDRL nozzle-to-safe end and CRDRL safe end-to-cap welds, which, according to the applicant, are low-alloy steel welds. As such, these welds are exempted from inspection under the applicant's third 10-year interval ISI Program.

By letter dated July 13, 2010, the staff issued RAI B.2.15-1, requesting that the applicant list the material specifications for CRDRL nozzle, CRDRL safe end, CRDRL cap, and connecting welds.

In its response dated September 3, 2010, the applicant provided the ASME Code, Section II material specifications for the following subject components:

- CRDRL Nozzle Forging: SA-508, Class 2
- Nozzle-to-Safe End Weld: Carbon Steel Filler Metal
- CRDRL Safe End Forging: SA-508, Class 1
- CRDRL Cap Forging: SA-508, Class 1
- Cap-to-Safe End Weld: Carbon Steel Filler Metal

The staff determined that the applicant provided an acceptable response to RAI B.2.15-1 because the applicant provided the requested material specifications for the subject CRDRL components. The staff agreed that the applicant's implementation of an NRC-approved risk-informed ISI Program provides sufficient basis for relief from Code examination requirements for the Examination Category B-J CRDRL nozzle-to-safe end and CRDRL safe end-to-cap welds because the subject welds are carbon steel, which is not prone to service-induced SCC.

The staff noted that the CRDRL nozzle RV penetration is inspected in accordance with ASME Code, Section XI, Examination Category B-D requirements for Columbia's third 10-year interval ISI Program. Furthermore, the CRDRL nozzle RV penetration is exempt from any NRC-authorized Code alternative that implements the examination criteria of ASME Code Case N-702 for Examination Category B-D nozzle penetrations. The staff's concern described in RAI B.2.15-1 is resolved.

By letter dated July 13, 2010, the staff issued RAI B.2.15-2, requesting that the applicant state whether ultrasonic examinations of the CRDRL nozzles are performed using UT systems, personnel, and procedures that are qualified in accordance with ASME Code, Section XI, Appendix VIII PDI requirements.

In its response dated September 3, 2010, the applicant stated that ultrasonic examinations of the CRDRL nozzles are performed using systems, personnel, and procedures that are qualified per the ASME Code, Section XI, Appendix VIII PDI criteria. The staff found the applicant's response to RAI B.2.15-2 acceptable because the applicant's RAI response confirmed that ultrasonic examination systems are appropriately qualified in accordance with the Code PDI requirements. The staff's concern described in RAI B.2.15-2 is resolved.

Based on its audit activities and its subsequent review of the applicant's responses to the staff's RAIs concerning the Columbia CRDRL Nozzle Program, as discussed above, the staff determined that the Columbia CRDRL Nozzle Program elements are consistent with and bounded by the corresponding program elements described in GALL Report AMP XI.M6, and the Columbia CRDRL Nozzle Program complies with the applicable Code requirements and 10 CFR 50.55a. Therefore, the staff found that the applicant's existing BWR Vessel Internals AMP, as described in LRA Section B.2.15, is acceptable for continued implementation through the end of the period of extended operation.

Operating Experience. LRA Section B.2.15 summarizes operating experience related to the CRDRL Nozzle Program. The applicant stated that its operating experience is consistent with industry experience and confirms that the CRDRL Nozzle Program is effective in managing cracking of the CRDRL nozzle. The applicant further states that periodic inspections of the CRDRL nozzle, during the second 10-year ISI interval found no cracking. The applicant also stated that it reviewed the recent industry operating experience for relevance and similar applications but none were found. The applicant further stated that future operating experience will be captured through the normal operating experience review process, which will continue through the period of extended operation.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. In LRA Section A.1.2.15, the applicant provided an UFSAR supplement summary description for the CRDRL Nozzle Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.1-2. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's CRDRL Nozzle Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.11 Diesel Starting Air

Summary of Technical Information in the Application. LRA Section B.2.16 describes the new Diesel Starting Air Inspection Program as consistent with GALL Report AMP XI.M32, "One-Time Inspection." The applicant stated that this program verifies the effectiveness of the Air Quality Sampling Program, assuring that the diesel starting air system dewpoint is within specified limits and the implemented controls on moisture content of the air are adequate to prevent loss of material due to corrosion in the air dryer materials, downstream stainless steel, and steel piping and components.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine if it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M32. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.M32, with the exception of the "parameters monitored/inspected" and "detection of aging effects" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

GALL Report AMP XI.M32 recommends that inspections are to be performed by qualified personnel under the "parameters monitored or inspected," program element description; however the staff noted that the applicant did not describe the inspecting personnel's qualifications. By letter dated July 15, 2010, the staff issued RAI B.2.A-1 requesting that the applicant provide details on the qualifications and training requirements for its personnel assigned to perform the inspections and its conformance to the applicable ASME Codes.

In its response dated September 13, 2010, the applicant stated that personnel performing the visual examinations, UT, or other NDE techniques in accordance with ASME Code Section V and ASME Code Section XI will be trained in accordance with ASME Code requirements. The applicant further stated that training requirements for all inspections will be consistent with 10 CFR Part 50, Appendix B.

The staff finds the applicant’s response acceptable because the one-time inspection will be performed by qualified personnel following procedures consistent with the ASME Code and 10 CFR Part 50, Appendix B. The staff’s concern described in RAI B.2.A-1 is resolved.

GALL Report AMP XI.M32 recommends that “the inspection includes a representative sample of the system population, and where practical, focuses on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin.” However, under the “detection of aging effects” program element description, the applicant stated that the sample population will be determined by engineering evaluation based on sound statistical sampling methodology. By letter dated July 15, 2010, the staff issued RAI B.2.A-2 requesting that the applicant provide details on the proposed sampling methodology.

In its response dated September 13, 2010, the applicant stated that the selected components will be those most susceptible to aging effects defined by time in service, severity of operating conditions, and design margins. The applicant provided a flow chart that described how the sample size would be selected based on the discrete number of components in the population, for example, in a population size of 21–200 components, 5 percent of the components would be inspected. The applicant also stated that the supplemental inspection sample size would be determined as part of the corrective action process. However, the staff noted that large sample sizes may be required to adequately confirm an aging effect is not occurring because of the uncertainty in determining the most susceptible locations and the potential for aging to occur in other locations. By letter dated December 3, 2010, the staff issued RAI B.2.A-3 requesting that the applicant provide technical justification for ensuring, based on the sample size chosen, that the components not inspected are not experiencing degradation.

In its response dated January 20, 2011, the applicant stated that the selected set of components to be sampled will be determine based on the material, environment, and aging effect combinations such that each combination represents a sample population. The applicant also stated that it will inspect 20 percent of each population, up to a maximum of 25 inspections per population. The staff finds the applicant’s response acceptable because the applicant’s sampling methodology ensures that a representative sample of material and environment combinations is considered, ensures sample locations will focus on the most susceptible components based on time in service, severity of operating conditions, and design margins, and includes an appropriate sample size. The staff’s concerns described in RAIs B.2.A-2 and B.2.A-3 are resolved.

Based on its audit and review of the applicant’s responses to RAIs B.2.A-1, B.2.A-2, and B.2.A-3 the staff finds that Elements one through six of the applicant’s Diesel Starting Air Inspection Program are consistent with the corresponding program elements of GALL Report AMP XI.M32 and, therefore, are acceptable.

<u>Operating Experience</u>. LRA Section B.2.16 summarizes operating experience related to the Diesel Starting Air Inspection Program. The applicant stated that a review of plant-specific operating experience for the air receiver tanks indicated no loss of material. The applicant also stated that it will use the air receivers operating experience (aging effects for the air receivers

are managed by the Air Quality Sampling Program) to identify relevant age-related degradation for the air dryers, downstream piping and its components, and the need for additional controls. The applicant further stated that with the exception of the diesel starting air system, there have been no failures or significant degradation of components in compressed air systems, such as the control air system and the service air system. Recurring dewpoint problems have been experienced with the diesel starting air system. Dewpoint, or moisture content, in the diesel starting air system is a concern for the long-term effects of corrosion and corrosion products on diesel starting air system components. The most critical point in the diesel starting air system for moisture control is at the air receivers and the high-pressure portion of the system upstream of the pressure control valves. Degradation has been identified in the diesel starting air system, where the dewpoint has been shown to average +5^{o}C. The applicant took additional actions to reduce degradation from moisture, including increased replenishment of desiccant and increased blow down of the air receivers. These actions were intended to ensure a dry air environment and to effectively maintain the diesel starting air system air quality. The applicant also stated that it will use its Corrective Action Program and ongoing operating experience industry reviews to ensure this program remains the appropriate method to manage the aging effects of components within the scope of this activity.

The staff reviewed operating experience information in the application and during the audit to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

<u>UFSAR Supplement</u>. LRA Section A.1.2.16 provides the UFSAR supplement for the Diesel Starting Air Inspection Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Tables 3.2-2, 3.3-2, and 3.4-2. The staff also notes that the applicant committed (Commitment No. 16) to implement the new Diesel Starting Air Inspection Program within 10 years prior to entering the period of extended operation for managing aging of applicable components. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

<u>Conclusion</u>. On the basis of its review of the applicant's Diesel Starting Air Inspection Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.12 Diesel Systems Inspection

LRA Section B.2.17 originally described the new Diesel Systems Inspection Program as consistent with GALL Report AMP XI.M32, "One-Time Inspection." During its review, the staff identified inconsistencies in the use of a One-Time Inspection Program to manage aging for components for which the GALL Report recommends an aging effect. As a result, by letter dated January 28, 2011, the applicant revised its Diesel Systems Inspection Program to become a new, plant-specific AMP. The staff's evaluations of the RAIs submitted regarding the original Diesel Systems Inspection Program are documented below. The resolutions to these RAIs have been incorporated into the new plant-specific program. The staff's evaluation of the new plant-specific Diesel Systems Inspection Program is documented in SER Section 3.0.3.3.5.

Staff Evaluation of RAIs. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine if it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M32 and identified inconsistencies with the "scope of the program," "parameters monitored or inspected," and "detection of aging effects" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of the RAIs discussed below. The staff also identified inconsistencies in the use of a One-Time Inspection Program to manage aging for components for which the GALL Report recommends an aging effect, which resulted in the issuance of an RAI, as discussed below.

The "parameters monitored or inspected" program element of GALL Report AMP XI.M32 recommends that inspections are performed by qualified personnel in accordance with ASME Code and 10 CFR Part 50, Appendix B. However, the staff noted that the applicant did not describe the inspecting personnel's training and qualifications in the LRA or program basis document. By letter dated July 15, 2010, the staff issued RAI B.2.A-1 requesting that the applicant provide details on the qualifications and training requirements for its personnel assigned to perform the inspections and its conformance to the applicable ASME Codes.

In its response dated September 13, 2010, the applicant stated that personnel performing the visual examinations, UT, or other NDE techniques, in accordance with ASME Code Section V and ASME Code Section XI, will be trained and qualified in accordance to ASME Code requirements. The applicant further stated that training requirements for all inspections will be consistent with 10 CFR Part 50, Appendix B. The staff finds the applicant's response acceptable because, once updated, the One-Time Inspection Program will require inspecting personnel to be trained and qualified consistent with applicable ASME Code requirements and with 10 CFR 50, Appendix B. The staff's concern described in RAI B.2.A-1 is resolved.

GALL Report AMP XI.M32 recommends that "the inspection includes a representative sample of the system population, and where practical, focuses on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin." However, under the "detection of aging effects" program element description, the applicant stated that the sample population will be determined by engineering evaluation based on sound statistical sampling methodology. By letter dated July 15, 2010, the staff issued RAI B.2.A-2 requesting the applicant to provide details on the proposed sampling methodology.

In its response dated September 13, 2010, the applicant stated that the selected components will be those most susceptible to aging effects defined by time in service, severity of operating conditions, and design margins. The applicant provided a flow chart that described how the sample size would be selected based on the discrete number of components in the population, for example, in a population size of 1–20 components, 1 of the components would be inspected. The applicant also stated that for a population size of 21–200 components, 5 percent of the components would be inspected. The applicant also stated that supplemental inspection sample size would be determined as part of the corrective action process. However, the staff noted that large sample sizes may be required to adequately confirm an aging effect is not occurring because of the uncertainty in determining the most susceptible locations and the potential for aging to occur in other locations. By letter dated December 3, 2010, the staff issued RAI B.2.A-3 requesting that the applicant provide technical justification for ensuring, based on the sample size chosen, that the components not inspected are not experiencing degradation.

In its response dated January 20, 2011, the applicant stated that the Diesel Systems Inspection Program will be revised to become a plant-specific program and will no longer be a One-Time Inspection Program. By letter dated January 28, 2011, the applicant revised its Diesel Systems Inspection Program to become a new plant-specific AMP. The applicant stated that the new plant-specific program will include baseline inspections of 20 percent of the population of each material, environment, and aging effect group, with up to a maximum of 25 inspections per group. The applicant also stated that the inspections will be focused on the components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margins. The staff finds the applicant’s response acceptable because the applicant’s sampling methodology ensures that a representative sample of material and environment combinations is considered, ensures sample locations will focus on the most susceptible components, and includes an appropriate sample size. The staff’s concerns described in RAIs B.2.A-2 and B.2.A-3 are resolved.

GALL Report AMP XI.M32 states that use of a one-time inspection is appropriate at the following times:

- when an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence
- when an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than that generally expected
- when the characteristics of the aging effect include a long incubation period

GALL Report AMP XI.M32 also states that for these cases, the one-time inspection should provide confirmation that either the aging effect is indeed not occurring or the aging effect is occurring very slowly so as not to affect the component or structure’s intended function during the period of extended operation.

In LRA Section B.2.17, the applicant stated that its Diesel Systems Inspection Program will be used to manage loss of material in the interior of the exhaust piping for the diesel engine exhaust system exposed internally to outdoor air.

It is not clear to the staff how a one-time inspection is appropriate to manage loss of material for this material and environment combination given that loss of material is expected to occur for steel piping exposed to outdoor air; the GALL Report recommends periodic inspection programs to manage aging for these material and environment combinations; and a One-Time Inspection Program is only to be used when an aging effect is not expected or is expected to progress very slowly. By letter dated November 1, 2010, the staff issued RAI B.2.17-1 requesting that the applicant justify how the one-time inspections proposed by the Diesel Systems Inspection Program are adequate to manage loss of material for steel components exposed internally to outdoor air by explaining how, for each component managed by the program, one of the following criteria for use of a one-time inspection is satisfied:

- The aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence.
- The aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than that generally expected.
- The characteristics of the aging effect include a long incubation period.

In its response dated January 28, 2011, the applicant revised its Diesel Systems Inspection Program to become a new plant-specific AMP, which includes baseline inspections performed within the 10-year period prior to the period of extended operation of a sample population to characterize the material condition of the components, followed by opportunistic inspections when components are opened for maintenance, repair, or surveillances. The new plant-specific program also includes review of inspection findings to ensure that each material exposed to either outdoor air or raw water has been examined by opportunistic inspection in each 5-year period or appropriate actions will be taken to ensure an inspection is performed if opportunistic inspections have not occurred. The staff's evaluation of the applicant's new plant-specific Diesel Systems Inspection Program is documented in SER Section 3.0.3.3.5. The staff finds the applicant's response acceptable because the revised program includes baseline and opportunistic inspections of the subject components which will effectively manage loss of material. The staff's concern described in RAI B.2.17-1 is resolved.

Conclusion. On the basis of its review, the staff concludes that the applicant is no longer claiming its program is consistent with GALL Report AMP XI.M32. The staff's evaluation, acceptance, and conclusion on the adequacy of the applicant's new plant-specific Diesel Systems Inspection Program is documented in SER Section 3.0.3.3.5.

3.0.3.1.13 Diesel-Driven Fire Pumps Inspection

LRA Section B.2.18 originally described the new Diesel-Driven Fire Pumps Inspection Program as consistent with GALL Report AMP XI.M32, "One-Time Inspection." During its review, the staff identified inconsistencies in the use of a One-Time Inspection Program to manage aging for components for which the GALL Report recommends an aging effect. As a result, by letter dated January 28, 2011, the applicant revised its Diesel-Driven Fire Pumps Inspection Program to become a new, plant-specific AMP. The staff's evaluations of the RAIs submitted regarding the original Diesel-Driven Fire Pumps Inspection Program are documented below. The resolutions to these RAIs have been incorporated into the new plant-specific program. The staff's evaluation of the new plant-specific Diesel-Driven Fire Pumps Inspection Program is documented in SER Section 3.0.3.3.4.

Staff Evaluation of RAIs. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine if it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M32 and identified inconsistencies with the "parameters monitored or inspected" and "detection of aging effects" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs, discussed below. The staff also identified inconsistencies in the use of a One-Time Inspection Program to manage aging for components for which the GALL Report recommends an aging effect, which resulted in the issuance of an RAI, as discussed below.

The "parameters monitored or inspected" program element of GALL Report AMP XI.M32 recommends that inspections be performed by personnel qualified in accordance with ASME Code and 10 CFR 50, Appendix B. The staff noted the applicant did not elaborate on the inspecting personnel's qualifications in the LRA or program basis document. By letter dated July 15, 2010, the staff issued RAI B.2.A-1 requesting that the applicant provide details on the qualifications and training requirements for its personnel assigned to perform the inspections and its conformance to the applicable ASME Codes.

In its response dated September 13, 2010, the applicant stated that personnel performing the visual examinations, UT, or other NDE techniques, as outlined in ASME Sections V and XI, are trained in accordance to ASME Code requirements. The applicant further stated that training requirements for all inspections will be consistent with 10 CFR Part 50, Appendix B. The staff finds the applicant's response acceptable because the one-time inspection will be performed by qualified personnel following procedures consistent with the ASME Code and 10 CFR 50, Appendix B. The staff's concern described in RAI B.2.A-1 is resolved.

GALL Report AMP XI.M32 recommends that "the inspection includes a representative sample of the system population, and where practical, focuses on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin." However, under the "detection of aging effects" program element description, the applicant stated that the sample population will be determined by engineering evaluation based on sound statistical sampling methodology. By letter dated July 15, 2010, the staff issued RAI B.2.A-2 requesting that the applicant provide details on the proposed sampling methodology.

In its response dated September 13, 2010, the applicant stated that the selected components will be those most susceptible to aging effects defined by time in service, severity of operating conditions, and design margins. The applicant provided a flow chart that described how the sample size would be selected based on the discrete number of components in the population. The applicant also stated that for a population size of 21–200 components, 5 percent of the components would be inspected, and a minimum sample size of one component would be inspected for populations of less than 20. The applicant further stated that supplemental inspection sample sizes would be determined as part of the corrective action process. However, the staff noted that larger sample sizes may be required to adequately confirm an aging effect is not occurring because of the uncertainty in determining the most susceptible locations and the potential for aging to occur in other locations. By letter dated December 3, 2010, the staff issued RAI B.2.A-3 requesting that the applicant provide technical justification for ensuring, based on the sample size chosen, that the components not inspected are not experiencing degradation.

In its response dated January 20, 2011, the applicant stated that the Diesel-Driven Fire Pumps Inspection Program will be revised to become a plant-specific program, and it will no longer be a One-Time Inspection Program. By letter dated January 28, 2011, the applicant revised its Diesel-Driven Fire Pumps Inspection Program to become a new plant-specific AMP. The applicant stated that the new plant-specific program will include baseline inspections of

20 percent of the population of each material, environment, and aging effect group, with up to a maximum of 25 inspections per group. The applicant also stated that the inspections will be focused on the components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margins. The staff finds the applicant's response acceptable because the applicant's sampling methodology ensures that a representative sample of material and environment combinations is considered, ensures sample locations will focus on the most susceptible components, and includes an appropriate sample size. The staff's concerns described in RAIs B.2.A-2 and B.2.A-3 are resolved.

GALL Report AMP XI.M32 states that use of a one-time inspection is appropriate at the following times:

- When an aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence
- When an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than that generally expected
- When the characteristics of the aging effect include a long incubation period

GALL Report AMP XI.M32 also states that for these cases, the one-time inspection should provide confirmation that either the aging effect is indeed not occurring or the aging effect is occurring very slowly so as not to affect the component or structure's intended function during the period of extended operation.

In LRA Section B.2.18, the applicant stated that its Diesel-Driven Fire Pump Inspection Program will be used to identify loss of material in the interior of the fire protection system diesel engine steel exhaust piping exposed to outdoor air and the copper alloy, gray cast iron (steel), and stainless steel heat exchangers exposed to raw water (antifreeze). The applicant also stated that the inspection checks for reduction in heat transfer and cracking due to SCC of susceptible materials.

It is not clear to the staff how a One-Time Inspection Program is appropriate to manage loss of material and reduction of heat transfer for these material and environment combinations given that the following is true:

- Loss of material is expected to occur for steel piping exposed to outdoor air.
- Loss of material and reduction in heat transfer is expected to occur for copper alloy, steel, and stainless steel heat exchanger components exposed to raw water.
- The GALL Report recommends periodic inspection programs to manage aging for these material and environment combinations.
- A One-Time Inspection Program is only to be used when an aging effect is not expected or is expected to progress very slowly.

By letter dated November 1, 2010, the staff issued RAI B.2.18-1 requesting that the applicant justify how the one-time inspections proposed by the Diesel-Driven Fire Pump Inspection Program are adequate to manage loss of material and reduction of heat transfer for copper alloy, steel, and stainless steel components exposed internally to outdoor air or raw water by explaining how, for each component managed by the program, one of the following criteria for use of a one-time inspection is satisfied:

- The aging effect is not expected to occur but the data is insufficient to rule it out with reasonable confidence.
- The aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than that generally expected.
- The characteristics of the aging effect include a long incubation period.

In its response dated January 28, 2011, the applicant revised its Diesel-Driven Fire Pumps Inspection Program to become a new plant-specific AMP, which includes baseline inspections performed within the 10-year period prior to the period of extended operation of a sample population to characterize the material condition of the components, followed by periodic opportunistic inspections when components are opened for maintenance, repair, or surveillances. The new plant-specific program also includes review of inspection findings to ensure that each material exposed to either outdoor air or raw water has been examined by opportunistic inspection in each 5-year period or appropriate actions will be taken to ensure an inspection is performed if opportunistic inspections have not occurred. The staff's evaluation of the applicant's new plant-specific Diesel-Driven Fire Pumps Inspection Program is documented in SER Section 3.0.3.3.4. The staff finds the applicant's response acceptable because the revised program includes baseline and periodic opportunistic inspections of the subject components to manage loss of material, cracking, and reduction of heat transfer. The staff's concern described in RAI B.2.18-1 is resolved.

Conclusion. On the basis of its review, the staff concludes that the applicant is no longer claiming its program is consistent with GALL Report AMP XI.M32. The staff's evaluation, acceptance, and conclusion on the adequacy of the applicant's new plant-specific Diesel-Driven Fire Pumps Inspection Program is documented in SER Section 3.0.3.3.4.

3.0.3.1.14 Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements

Summary of Technical Information in the Application. LRA Section B.2.19 describes the new Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Program as consistent with GALL Report AMP XI.E1 "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements." The applicant stated that the program provides for the periodic visual inspection of accessible, non-environmentally qualified electrical cables and connections, to determine if age-related degradation is occurring, particularly in plant areas with adverse localized environments caused by high temperatures or high radiation levels.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine if it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.E1. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.E1, with the exception of "scope of program," and "parameters monitored or inspected" program elements. For these elements, the staff determined that the need for additional clarification, which resulted in the issuance of RAIs.

GALL Report AMP XI.E1 under "scope of program" element states that this inspection program applies to accessible electrical cables and connections within the scope of license renewal that are installed in an adverse localized environment. In the applicant's basis document, under the same element, the applicant stated that the program includes all cables and connections that are not subject to the EQ requirements of 10 CFR 50.49 and that are within the scope of license renewal. The applicant also stated that this program is credited with detecting non-EQ cable and connection aging effects caused by adverse localized environments. But the applicant had not described the methodology to be used to identify an adverse localized environment.

By letter dated July 7, 2010, the staff issued RAI B.2.19-1 requesting that the applicant explain how an adverse localized environment will be identified including EQ records, environment surveys, plant walkdowns, and operating experiences.

In its response dated August 31, 2010, the applicant provided the information for identifying adverse localized environments. The applicant stated that the inspection program will define adverse localized environments through a review of plant engineering data (EQ records, environment surveys, cable and connection material specifications), plant operating experience, and plant walkdowns. The cable and connection insulation materials' 60-year design limits, as taken from industry guidance documents, will also be used in identifying plant adverse localized environments. The staff finds the applicant's response acceptable because the applicant provided information on how it will identify cables and connections installed in an adverse localized environment. Based on the review of its response to RAI B.2.19-1, the staff's concern is resolved.

GALL Report AMP XI.E1 under "parameters monitored and inspected" element states that a representative sample of accessible electrical cables and connections installed in adverse localized environments are visually inspected for cable and connection jacket surface anomalies. The technical basis for selection of the sample is to be provided. In the applicant's basis document, under the same element, the applicant states that the program will provide for the visual inspection of accessible cables and connections located in adverse localized environments. The implementing document for the program will provide the technical basis for the sample selection, with respect to both sample size and inspection location. The staff issued RAI B.2.19-2 requesting the applicant to provide the technical basis for the sample selection with respect to both sample size and inspection location. In its response dated August 31, 2010, the applicant stated that it will perform inspections of all accessible cables, connections, and terminal blocks that are identified within adverse localized environments. The staff accepts the applicant's response to inspect all accessible cables, connections, and terminal blocks located in adverse localized environments because it is a more conservative inspection than recommended in the GALL Report AMP XI.E1. The staff's concern in RAI B.2.19-2 is resolved.

Based on its audit and review of the applicant's responses to RAIs B.2.19-1 and B.2.19-2, the staff finds that Elements one through six of the applicant's Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements AMP are consistent with the corresponding program elements of GALL Report AMP XI.E1 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.19 summarizes operating experience related to the Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Program. The applicant stated the Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Program is a new program for which there is no direct site-specific operating experience. The applicant also stated that, based on review of plant-specific and industry operating experience, the identified aging effects require management for the period of extended operation. The applicant further stated that plant operating experience has shown that the Corrective Action Program has addressed issues of cable degradation in recent years. Cables have been identified with degraded insulation, primarily as a result of exposure to excessive localized overheating. For example, wiring on an insulated cable associated with the B phase of a motor connection was found to be degraded from overheating, due to the hot connection. Also, wiring to level switches located in the turbine building was found to be embrittled as a result of close proximity to hot piping. Cables have also been identified with mechanical damage, such as crimping or pinching (although these are not aging issues). Finally, the applicant stated that industry operating experience will be included in the development of this program.

The staff reviewed the operating experience, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant had adequately incorporated and evaluated operating experience related to this program.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective to adequately manage aging effects during the period of extended operation.

Based on its audit and review of the application, and review of the applicant's responses to RAIs B.2.19-1 and B.2.19-2, the staff finds that operating experience related to the applicant's program demonstrates that the program can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

<u>UFSAR Supplement</u>. LRA Section A.1.2.19 provides the UFSAR supplement for the Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Program. The program provides for periodic visual inspection of accessible, non-environmentally qualified cables and connections to determine if age-related degradation is occurring, particularly in plant areas with adverse localized environments. An adverse localized environment is a condition in a limited plant area that is significantly more severe than the specified design or bounding plant environment for the general area. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.6-2.

The staff also notes that the applicant committed (Commitment No. 19) to implement the new Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Program prior to entering the period of extended operation for managing aging of applicable components.

The staff determines that the information in the UFSAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

<u>Conclusion</u>. On the basis of its review of the applicant's Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Program and the applicant's responses to RAIs B.2.19-1 and B.2.19-2, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR

supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.15 Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Used in Instrumentation Circuits

Summary of Technical Information in the Application. LRA Section B.2.20 describes the new Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Used In Instrumentation Circuits Program as consistent with GALL Report AMP XI.E2, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits." The applicant stated that this program will provide the technical input necessary to manage the aging of the non-environmentally qualified low-current instrumentation cables and connections within the license renewal scope. The applicant also stated that the program relies upon a review of calibration records for surveillance tests routinely performed on the circuits to determine if any degradation to the cable system is occurring. Reduced insulation resistance is the parameter of interest.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.E2. As discussed in the audit report, the staff confirmed that these elements are consistent with the corresponding element of GALL Report AMP XI.E2. Based on its audit, the staff finds that Elements one through six of the applicant's Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Used in Instrumentation Circuits Program are consistent with the corresponding program elements of GALL Report AMP XI.E2 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.20 summarizes operating experience related to the Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Used in Instrumentation Circuits Program. The applicant stated that the Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Used in Instrumentation Circuits Program is a new program for which there is no direct site-specific operating experience. The applicant also stated that, based on review of plant-specific and industry operating experience, the identified aging effects require management for the period of extended operation. The applicant further stated that plant operating experience has shown that the Corrective Action Program has addressed issues of cable degradation in recent years. Cables have been identified with degraded insulation, primarily as a result of exposure to excessive localized overheating. Low-current instrument cable issues have also been identified during loop testing, such as a failed source range monitor cable. An intermediate range monitor cable was found smashed against a ladder (although this is not an insulation aging issue). Finally, the applicant stated that industry operating experience will be considered in the development of this program.

The staff reviewed the operating experience in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant had adequately incorporated and evaluated operating experience related to this program.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that the program can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.20 provides the UFSAR supplement for the Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Used In Instrumentation Circuits Program. This program is a monitoring program that detects degradation of electrical cables and connections that are not environmentally qualified and used in circuits with sensitive, low-current applications. The program provides a review of calibration records for the low-current instruments to detect and identify degradation of cable system insulation resistance. The program retains the option to perform direct cable testing. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.6-2.

The staff also notes that the applicant committed (Commitment No. 20) to implement the new Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Used In Instrumentation Circuits Program once every 10 years, with the initial review to be performed prior to entering the period of extended operation for managing aging of applicable components.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Used in Instrumentation Circuits Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.16 Environmental Qualification

Summary of Technical Information in the Application. LRA, Section B.2.22 describes the existing EQ Program as consistent with GALL Report AMP X.E1, "Environmental Qualification (EQ) of Electric Components." The applicant stated that the EQ Program manages component thermal, radiation, and cyclic aging through the use of aging evaluations based on the methods identified in 10 CFR 50.49(f) and NRC RG 1.89 Revision 1. The applicant also stated that, as required by 10 CFR 50.49, components subject to EQ but not qualified for the entire current license term are to be refurbished, replaced, or have its qualification extended prior to reaching the aging limits established in the evaluation. The applicant further stated that aging evaluations for environmentally qualified components that specify a qualification of at least 40 years are identified as time-limited aging analyses (TLAAs) for license renewal.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP X.E1. As discussed in the audit report, the staff confirmed that these elements are consistent with the corresponding element of GALL Report AMP X.E1. Based on its audit, the staff finds that Elements one through six of the applicant's EQ Program are consistent with the corresponding program elements of GALL Report AMP X.E1 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.22 summarizes operating experience related to the EQ Program. The applicant stated that a formal process for review of industry operating experience is used to identify and transfer lessons learned from industry experience into Columbia processes and programs, including the EQ Program. The applicant also stated that plant-specific operating experience is identified and evaluated primarily through the Corrective Action Program. Evaluation of both industry and plant-specific operating experience includes consideration of the need to modify qualification bases and conclusions, including qualified life. The applicant further stated that selected operating experience that affects the qualified lives of environmentally qualified equipment at Columbia is as follows:

- Lead wires on certain normally energized solenoid valves are required to be replaced periodically (from the Institute of Nuclear Power Operations (INPO)).
- Normally energized relays have been assigned an operating life based on plant-specific operating experience.
- The orientation of ASCO and Marotta solenoid valves is controlled to prevent excessive heat rise to the electrical components (INPO).
- Replacement of Namco switches on the main steam isolation valves (MSIVs) is now based on plant-specific operating experience.
- A Columbia EQ procedure was modified to consider the effect of high float voltages on DC coils (industry EQ group operating experience).

The staff reviewed the operating experience information in the application and during the audit to determine whether the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10 and, therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.22 provides the UFSAR supplement for the EQ Program. The staff reviewed this UFSAR supplement description of the program against the recommended description for this type of program, as described in SRP-LR Tables 4.4-1 and 4.4-2. In SRP-LR Table 4.4-2, Examples of UFSAR supplement for EQ of Electrical Equipment TLAA evaluation, it states that reanalysis addresses attributes of analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, corrective actions if acceptance criteria are not met, and the period of time prior to the end of qualified life when the reanalysis will be completed.

In LRA Appendix A, UFSAR Supplement A.1.2.22, the applicant did not address the reanalysis attributes. The LRA Appendix A, UFSAR Supplement A.1.2.22 description is not consistent with SRP-LR Table 4.4-2. The reanalysis attributes are important attributes to extend the qualified life of EQ electrical components and must be included in the summary description in LRA Appendix A. In a letter dated July 7, 2010 (RAI B.2.22-1), the staff asked the applicant to explain why reanalysis attributes are not included in the UFSAR supplement to be consistent with SRP-LR Table 4.4-2.

In a letter dated August 31, 2010, the applicant stated that the revision to include the EQ component reanalysis attributes in the program description in LRA Section A.1.2.22 is shown in Amendment 5, provided in the enclosure to this letter. The staff reviewed the LRA amendment and finds it acceptable because the UFSAR supplement now includes the required reanalysis attributes to extend the qualified life of EQ electrical components. The staff's concern in RAI B.2.22-1 is resolved.

The staff also notes that the applicant committed (Commitment No. 22) to ongoing implementation of the existing EQ Program for managing aging of applicable components during the period of extended operation.

The staff determines that the information in the UFSAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's EQ Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.17 Heat Exchangers Inspection

Summary of Technical Information in the Application. LRA Section B.2.30 describes the new Heat Exchangers Inspection Program as consistent with GALL Report AMP XI.M32, "One-Time Inspection." The applicant stated that this is a new one-time inspection that detects and characterizes the surface conditions with respect to fouling of heat exchangers and coolers that are in the scope of the inspection and exposed to indoor air or to water with the chemistry controlled by the BWR Water Chemistry Program or the Closed Cooling Water Chemistry Program. The applicant also stated that the inspection provides direct evidence as to whether, and to what extent, a reduction of heat transfer due to fouling has occurred or is likely to occur on the heat transfer surfaces of heat exchangers and coolers.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M32. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.M32, with the exception of the parameters monitored and inspected and detection of aging effects program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

The staff compared the LRA "parameters monitored or inspected," program element, to the GALL Report AMP XI.M32, "One-Time Inspection" Program, "parameters monitored/inspected" program element. The staff noted the applicant did not elaborate on the inspecting personnel's qualifications or if these complied with ASME Code and 10 CFR Part 50, Appendix B, as the GALL Report AMP XI.M32 recommends. The staff also noted that the One-Time Inspection Program's basis document failed to detail the inspecting personnel's qualifications or describe the site-specific procedure outlining the training requirements for individuals assigned to perform these inspections. By letter dated July 15, 2010, the staff issued RAI B.2.A-1 asking the applicant to provide details on the qualifications and training requirements for its personnel assigned to perform the inspections and its conformance to the applicable ASME Codes.

In its response dated September 13, 2010, the applicant stated that personnel performing the visual examinations, UT, or other NDE techniques, outlined in ASME Sections V and XI, are trained in accordance with ASME Code requirements. The applicant further stated that training requirements for all inspections will be consistent with 10 CFR Part 50, Appendix B. The staff reviewed the applicant's response and finds it acceptable because the one-time inspection will be performed by qualified personnel following procedures consistent to ASME Code and 10 CFR Part 50, Appendix B, using a variety of NDE methods, including visual and volumetric techniques. The staff's concern described in RAI B.2.A-1 is resolved.

When the staff compared the LRA "detection of aging effects" program element, to the GALL Report AMP XI.M32, "One-Time Inspection," Program "detection of aging effects" program element, it was not clear how the applicant defined its inspection "representative sample." The staff noted that the LRA characterized the sample population based on an engineering evaluation and a "sound statistical sampling methodology," while the GALL Report AMP XI.M32, recommends the "representative sample" to focus, where practical, on the bounding or lead components of a system population most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin. The staff also noted that the applicant's sampling plan provides no details on its composition and assurances that a representative population of sufficient size and scope will be inspected. By letter dated July 15, 2010, the staff issued RAI B.2.A-2 asking the applicant to provide details on the proposed sampling methodology indicating, for example, if it follows an RI-ISI methodology, a sequential sampling, or some other statistically based sampling plan.

In its response dated September 13, 2010, the applicant stated that within the scope of the One-Time Inspection Program for each material and environment combination, a sample population will be identified through engineering evaluations. The applicant also stated that the selected components will be those most susceptible to aging effects defined by time in service, severity of operating conditions, and design margins. The applicant further stated that the selected sample population will be capped at 5 percent, for up to 200 components within the same system, with a minimum sample size of one for component populations of less than 20. Finally, the applicant stated that the inspection will include piping segments upstream and downstream of the selected components, and the supplemental inspections sample size would be determined as part of the Corrective Action Program. However, the staff noted that large sample sizes may be required to adequately confirm an aging effect is not occurring because of the uncertainty in determining the most susceptible locations and the potential for aging to occur in other locations. By letter dated December 3, 2010, the staff issued RAI B.2.A-3 requesting that the applicant provide technical justification for ensuring, based on the sample size chosen, that the components not inspected are not experiencing degradation.

In its response dated January 20, 2011, the applicant stated that the selected set of components to be sampled will be determined based on the material, environment, and aging effect combinations such that each combination represents a sample population. The applicant also stated that it will inspect 20 percent of each population, up to a maximum of 25 inspections per population. The staff finds the applicant's response acceptable because the applicant's sampling methodology ensures that a representative sample of material and environment combinations is considered and ensures that sample locations will focus on the most susceptible components based on time in service, severity of operating conditions, and design margins. It also includes an appropriate sample size. The staff's concerns described in RAIs B.2.A-2 and B.2.A-3 are resolved.

Based on its audit and review of the applicant's responses to RAIs B.2.A-1, B.2.A-2, and B.2.A-3, the staff finds that Elements one through six of the applicant's Heat Exchangers Inspection Program are consistent with the corresponding program elements of GALL Report AMP XI.M32 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.30 summarizes operating experience related to the Heat Exchangers Inspection Program. The applicant stated that a review of Columbia operating experience identified no examples of aging-related degradation in components subject to this AMP.

The staff reviewed operating experience information in the application and during the audit to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation. In addition, the staff confirmed that the applicant addressed operating experience identified after issuance of the GALL Report. The applicant's review of this recent operating experience did not reveal any applicable occurrences or detrimental environments that could exacerbate a slow aging effect or accelerate an otherwise long incubation period. Additionally, neither of these were identified in the staff's independent review of the applicant's recent operating experience. The staff, therefore, confirms that the Heat Exchangers Inspection Program is appropriate to verify whether the aging mechanisms exist and to what extent it may be occurring. In addition, the site's use of a Corrective Action Program and ongoing reviews of industry operating experience will assist the management of aging effects for the extended period of operation. The applicant also stated that it will use its Corrective Action Program and ongoing industry operating experience to ensure this program is effective in managing the identified aging effects.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.30 provides the UFSAR supplement for the Heat Exchangers Inspection Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.2-2 and 3.3-2. The staff also notes that the applicant committed (Commitment No. 30) to implement the new Heat Exchangers Inspection Program within the 10 years prior to the period of extended operation for managing aging of applicable components. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Heat Exchangers Inspection Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.18 Inaccessible Power Cables Not Subject to 10 CFR 50.49 EQ Requirements

Summary of Technical Information in the Application. LRA Section B.2.32 describes the new Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program as consistent with GALL Report AMP XI.E3, "Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements." The applicant stated that this program will manage the aging of inaccessible medium-voltage electrical cables that are not environmentally qualified and are subject to wetting within the scope of license renewal. The applicant also stated that the program provides for periodic testing to determine if age-related degradation is occurring and includes a provision for the inspection of associated manholes to identify any collection of water. The applicant further stated that the Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program will be implemented prior to the period of extended operation. The applicant stated that the cable testing will be performed every 10 years thereafter, and manhole inspections will be performed at least every 2 years thereafter.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.E3. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.E3, with the exception of the "detection of aging effects" program element. For this element, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

Element 4 of the applicant's Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program states that cable testing will be performed at least once every 10 years, with the first cable test and manhole inspection for water collection to occur during the 10-year period prior to the end of the current operating license. LRA Appendix A, Section A.1.2.32, states that the first test and inspection are to be performed prior to the period of extended operation. GALL Report AMP XI.E3 states that the first test and inspections for license renewal are to be completed before the period of extended operation.

The staff was concerned that the inaccessible medium-voltage cable test and inspection may exceed the interval guidance specified by GALL Report AMP XI.E3. Additionally, if the cable inspection or tests are performed up to 10 years prior to the period of extended operation and credited as the initial test or inspection, without additional inspections or tests performed per the guidance of GALL Report AMP XI.E3, the tests or inspection results may not be representative of inaccessible medium-voltage cable conditions upon entering the period of extended operation.

By letter dated July 7, 2010, the staff issued RAI B.2.32-2 asking the applicant to explain why LRA AMP B.2.32, "Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program," is consistent with GALL Report XI.E3 and SRP-LR Table 3.6-2 with respect to performing the test and inspection prior to the period of extended operation such that the inspection and test frequency would not exceed the test and inspection frequency guidance of GALL Report AMP XI.E3. The applicant responded by letter dated August 31, 2010, and stated in part that, for LRA AMP B.2.32, the attribute "detection of aging effects" was intended to specify that the first test or inspection would not be conducted more than 10 years prior to the period of extended operation, and there would never be a period greater than 10 years between tests or 2 years between inspections. The applicant also stated that the LRA AMP B.2.32 element "detection of aging effects" is revised to state that the first test and inspection will occur prior to the end of the current operating license. The applicant further stated that this change would allow the first test and inspection to be completed any number of years before the period of extended operation as long as subsequent tests are performed at least once every 10 years and subsequent inspections are performed at least every 2 years.

With the information provided by the applicant's RAI response, the staff finds the Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program acceptable with respect to test and inspection frequencies because the applicant revised the Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program, "detection of aging effects" program element to be consistent with the associated program description. Also, LRA Section A.1.2.32, Commitment No. 32, which is consistent with GALL Report AMP XI.E3, ensures that inaccessible medium voltage cables exposured to significant moisture will be adequately managed during the period of extended operation. The staff's concern described in RAI B.2.32-2 is resolved.

GALL Report AMP XI.E3 provides definitions for significant voltage and significant moisture. In addition, GALL Report AMP XI.E3 states that the specific type of test performed will be a proven test for detecting deterioration of the insulation system due to wetting. GALL Report AMP XI.E3 also states that inspection for water collection is performed based on actual plant experience with a minimum inspection frequency of at least once every 2 years.

The staff noted that the applicant's associated basis document specify that inspections for water collection will be based on actual plant operating experience with a minimum frequency of at least once every 2 years. The LRA and basis documents provide no discussion on whether event-drive water collection (heavy rain, flood) is addressed. The staff is concerned that periodic inspection may not mitigate severe, event-driven water collection and may allow inaccessible medium-voltage cables to be exposed to significant moisture.

By letter dated July 7, 2010, the staff issued RAI B.2.32-3 requesting that the applicant explain why event-driven inspection is not included in LRA AMP B.2.32 to limit inaccessible medium voltage cable exposure to significant moisture. The applicant responded by letter dated August 31, 2010, and stated that LRA Section B.2.32 under "detection of aging effects" states that inspections for water collection will be performed based on actual plant operating experience with water accumulation in the manholes. The applicant also stated that this is consistent with the wording in the SRP-LR Table 3.6-2. The applicant also stated that GALL Report AMP XI.E3 defines significant moisture as periodic exposure to moisture that lasts more than a few days. The applicant further stated that event-driven water collection is not discussed specifically in the LRA because any event-driven water collection is based on plant experience that would be evaluated as operating experience. Finally, the applicant stated that an event-driven water accumulation would be based on plant operating experience, and is therefore covered implicitly under the term "actual plant operating experience."

With the information provided by the applicant's RAI response, the staff finds that the Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program did not address whether plant-specific or industry operating experience with event-driven water collection has been evaluated or is applicable to Columbia. The applicant's Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program does not specifically address or evaluate event-driven occurrences that may cause cables within the scope of the program to be subjected to significant moisture. Industry experience shows that event-driven water collection can occur and may not be addressed by a periodic inspection program. The applicant's program, therefore, had not addressed plant-specific or industry operating experience to ensure that inaccessible medium voltage cable exposure to significant moisture will be adequately managed during the period of extended operation.

In a letter dated December 7, 2010, the applicant's response to RAI B.2.32-4 also included its response to RAI B.2.32-3. The applicant stated that LRA Section B.2.32 and A.1.32 are revised to include an in-scope manhole inspection frequency of at least once per year and an inspection after events that could cause water to accumulate to the level of the installed cables or conduits. The staff finds the applicant's response acceptable because it includes a manhole inspection frequency of at least once per year and an inspection after events that could cause water to accumulate to the level of the installed cables or conduits consistent with industry and plant-specific operating experience which has shown that flooding or heavy rain could subject cables within the scope of program to submergence. The staff's concern in RAI B.2.32-3 is resolved.

Based on its audit and review of the applicant's response to RAI B.2.32-2 and RAI B.2.32-4, the staff finds that Elements one through six of the applicant's Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program are consistent with the corresponding program elements of GALL Report AMP XI.E3 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.32 summarizes operating experience related to the Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program. The applicant stated this is a new program for which there is no site-specific operating experience. The applicant stated, based on a review of plant-specific and industry operating experience, that Columbia has experienced no failures of cables directly attributed to water treeing and no degradation failures of medium voltage cables. The applicant did note two failures of 480 volt (V) power cables attributed to damage incurred during installation with subsequent moisture intrusion and one medium voltage cable (4,160 VAC) failure due to ampacity overheating. These failures are also noted in the applicant's response to GL 2007-01, "Inaccessible or Underground Power Cable Failures That Disable Accident Mitigation Systems or Cause Plant Transients." No other cable failures are indentified in the GL 2007-01 response. The applicant further stated that recent inspections identified two manholes (E7 and E8) adjacent to the cooling towers with standing water. The applicant stated that the Corrective Action Program will be used to determine the source, correct or mitigate the problem, and determine the inspection frequency needed. The applicant initiated CRs and work orders for manhole inspection, repair, and cable testing to address water collection in these manholes. During a subsequent walkdown of the manholes during the audit, the staff observed only minor water accumulation with no cable submergence noted.

The staff reviewed the operating experience, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. Further, the staff performed a search of regulatory operating experience for at least the past 10-year period through March 2010. Databases were searched using various key word searches and then reviewed by technical auditor staff.

During its review, the staff identified operating experience that could indicate that the applicant's program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of an RAI.

The application of GALL Report AMP XI.E3 to medium voltage cables was based on the operating experience available at the time Revision 1 of the GALL Report was developed. However, recently identified industry operating experience indicates that the presence of water or moisture can be a contributing factor in inaccessible power cables failures at lower service voltages (480 V to 2 kilovolts (kV)). Applicable operating experience was identified in licensee responses to GL 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," which included failures of power cables operating at service voltages of less than 2 kV where water was considered a contributing factor. The staff has concluded, based on recently identified industry operating experience concerning the failure of inaccessible low voltage power cables (400 V to 2 kV) in the presence of significant moisture, that these cables should be addressed in an AMP. The staff notes that the applicant's AMP does not address these inaccessible low voltage power cables.

By letter dated September 21, 2010, the staff issued RAI B.2.32-4 requesting the following:

(1) The applicant should provide a summary of its evaluation of recently identified industry operating experience and any plant-specific operating experience concerning inaccessible low voltage power cable failures within the scope of license renewal (not subject to 10 CFR 50.49 EQ requirements) and explain how this operating experience applies to the need for additional aging management activities at your plant for such cables.

(2) The applicant should explain how it will manage the effects of aging on inaccessible low voltage power cables within the scope of license renewal and subject to AMR; with consideration of recently identified industry operating experience and any plant-specific operating experience to ensure that the intended functions of inaccessible low voltage power cables subject to adverse localized environments will remain consistent with the CLB throughout the period of extended operation. The discussion should include assessment of its AMP description, program elements (i.e., scope of program, parameters monitored/inspected, detection of aging effects, and corrective actions), and UFSAR summary description.

(3) The applicant should provide an evaluation showing that the Inaccessible Medium Voltage Program test and inspection frequencies, including event-drive inspections, incorporate recent industry and plant-specific operating experience for both inaccessible low and medium voltage cable. It should discuss how the Inaccessible Medium Voltage Program will ensure that future industry and plant-specific operating experience will be incorporated into the program such that inspection and test frequencies may be increased based on test and inspection results.

The applicant responded by letter dated December 7, 2010, and stated that, based on industry cable operating experience and plant-specific manhole inspection operating experience, Energy Northwest determined that the addition of inaccessible power cables operated at or above 400 V is prudent. The applicant also stated that testing of in-scope inaccessible power cables every 6 years is reasonable and allows for trending of test data. In addition, the applicant stated that inspection for water in the in-scope manholes at least every year and after events that could cause water to accumulate to the level of the installed cables or conduit is also warranted.

The applicant stated that the Energy Northwest's response to GL 2007-01 detailed three cable failures at the plant, none of which were within the scope of license renewal. The failures involved two 480 VAC fan motor power cables (for the circulating water system) and one 4,160 VAC power cable (for circulating water pump motor 1C). The 480 VAC fan motor power cables were concluded to have most likely failed due to cable damage during installation and subsequent water intrusion (the cables were gouged on the outside, which enabled the water intrusion). The 4,160 VAC power cable failed due to ampacity overheating effects, which were attributed to improper de-rating (design issue). The applicant also stated that recent industry and plant-specific operating experience with respect to lower service voltage cables summarized above indicates that monitoring of inaccessible underground lower service voltage power cables (400 VAC to 2kV) is desirable during the period of extended operation.

As such, the applicant amended the LRA to include inaccessible lower service voltage power cables in the Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program. Although the applicant noted there have been no in-scope medium-voltage and lower service voltage cable failures at Columbia attributed to moisture intrusion, the frequency of cable testing within the revised Inaccessible Power Cables Not Subject to 10 CFR 50.49 EQ Requirements Program is also changed to 6 years based on industry operating experience.

The applicant stated that the program detailed in Section B.2.32 of the LRA is revised to address power cables at lower service voltages (400 VAC to 2 kV) in inaccessible underground locations. In addition, the AMP is re-named as the Inaccessible Power Cables Not Subject to 10 CFR 50.49 EQ Requirements Program.

Based on the information provided by the applicant's RAI response, the staff finds that the following is true:

- The applicant appropriately expanded the program scope to include inaccessible low voltage power cables (480 V to 2 kV) and eliminated the criterion of “exposure to significant voltage,” consistent with industry operating experience.
- For Columbia, the proposed 6-year frequency for power (low and medium voltage) cable insulation testing is appropriate for the following reasons:
  - It considers plant-specific and industry operating experience.
  - Research of plant-specific operating experience has not revealed any instance of inaccessible low voltage (480 V to 2 kV) and medium voltage cable failures due to aging related effects within the scope of the Non-EQ Inaccessible Medium Voltage Cable Program.
  - Columbia Corrective Action and Operating Experience Programs will continue to evaluate industry and plant-specific operating experience during the period of extended operation.
- The applicant’s proposed approach for inspecting manholes containing inaccessible in-scope power cables annually is acceptable because it includes a manhole water inspection frequency of at least every year and after events that could cause water to accumulate to the level of the installed cables or conduits. Recently identified industry operating experience has shown that flooding or heavy rain could subject cables within the scope of program to submergence. The staff determined that event-driven inspections, in addition to a one year periodic inspection frequency, is a conservative approach.

With the information provided by the applicant’s RAI response, the staff finds the Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program acceptable with respect to inaccessible low voltage power cable because the applicant included inaccessible low voltage power cables into its Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program which is consistent with industry and plant-specific operating experience to ensure that inaccessible low voltage power cable subject to significant moisture will be adequately managed during the period of extended operation. The staff’s concern described in RAI B.2.32-4 is resolved.

Subsequent to the applicant's RAI response, by letter dated November 16, 2011, the applicant submitted a supplement to the LRA that identified an additional manhole (identified as B105) subject to the applicant's Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program. The applicant stated that manhole B105 does not contain medium voltage cables and was therefore not subject to the program until the program was modified to include cables operating at greater than or equal to 400 volts. The applicant stated that manhole B105 is located in the circulation water pumphouse and is subject to water intrusion from the circulating water pump basins when basin levels are abnormally high. Manhole B105 is equiped with a sump pump. The applicant also stated that the sump pump was installed before 1991 to manage water intrusion and that operating procedures are also in place to limit water intrusion into manhole B105. Based on the above, the applicant revised LRA Section B.2.32 to state the following.

> The inspection will include direct observation that the cables are not wetted or submerged; that cable/splices and cable support structures are intact; and sump

> pump systems and associated alarms operate properly. In addition, sump pumps will be inspected and operation verified prior to any known or predicted heavy rain or flooding events which could require the sump pump to operate.

Based on its audit and review of the application, and review of the applicant's response to RAIs B.2.32-2, B.2.32-3, B.2.32-4, and the LRA supplement dated November 16, 2011, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.32 provides the UFSAR supplement for the Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program. The staff reviewed this UFSAR supplement description of the program against the recommended description for this type of program, as described in SRP-LR Table 3.6-2.

The staff reviewed the applicant's UFSAR supplement and found that LRA UFSAR supplement Section A.1.2.32 does not include definitions of significant moisture or significant voltage consistent with SRP-LR Table 3.6-2 or GALL Report AMP XI.E3. In addition, LRA UFSAR supplement Section A.1.2.32 does not include a discussion of tests to be performed or specify that inspection for water collection will be based on plant-specific experience, as described in SRP-LR Table 3.6-2.

By letter dated July 7, 2010, the staff issued RAI B.2.32-1 requesting that the applicant explain why LRA UFSAR Supplement A.1.2.32 does not include the definition of significant moisture, significant voltage, or a discussion of testing and inspection for water collection based on operating experience consistent with GALL Report AMP XI.E3 and SRP-LR Table 3.6-2. In its response dated August 31, 2010, the applicant revised LRA UFSAR Supplement A.1.2.32 to include definitions of significant moisture, significant voltage, and testing and inspection frequencies.

Subsequent to the applicant's RAI response, by letter dated November 16. 2011, the applicant submitted a supplement to the LRA that identified an additional manhole (identified as B105) subject to the applicant's Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements Program. The applicant revised LRA Section A.1.2.31 as follows.

> The inspection will include direct observation that the cables are not wetted or submerged; that cable/splices and cable support structures are intact; and sump pump systems and associated alarms operate properly. In addition, sump pumps will be inspected and operation verified prior to any known or predicted heavy rain or flooding events which could require the sump pump to operate.

With the applicant's amendment, including the LRA supplement dated November 16, 2011, the staff finds the UFSAR supplement for the Inaccessible Medium-Voltage Cables Not Subject to 10 CFR EQ Requirements Program acceptable because it is now consistent with the corresponding program description in SRP-LR Table 3.6-2. The staff's concern described in RAI B.2.32-1 is resolved.

The staff also notes that the applicant committed (Commitment No.32) to implement the new Inaccessible Medium Voltage-Cables Not Subject to 10 CFR EQ Requirements Program prior to entering the period of extended operation for managing aging of applicable components.

As a result of the applicant response to staff RAI B.2.32-4, and LRA supplement, the applicant revised LRA Appendix A, Section A.1.2.32 to include additional manhole B105, and inaccessible low-voltage power cables in-scope. The applicant also (1) removed the significant voltage criterion, (2) included a testing interval of at least once every 6 years for cable insulation, (3) included an inspection interval of at least once annually for manholes that contain in-scope cables, and (4) included an inspection, based on event-driven occurrences.

The staff determines that the information in the UFSAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Inaccessible Medium-Voltage Cables Not Subject to 10 CFR EQ Requirements Program and the applicant's responses to RAIs B.2.32-2, B.2.32-3 and B.2.32-4, the staff finds that all program elements are consistent with the GALL Report, and the program enhancements are consistent with plant-specific and industry operating experience. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.19 Inservice Inspection

Summary of Technical Information in the Application. LRA Section B.2.33 describes the existing ISI Program as consistent with GALL Report AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD." The applicant stated that the inspections under this program manage cracking due to SCC/IGA and flaw growth of RCS pressure boundary components made of nickel alloy, stainless steel (including CASS), and steel (including steel with stainless steel cladding), and a limited number of RVI components. The applicant also stated that the program manages loss of material due to corrosion for RVI components and reduction of fracture toughness due to thermal embrittlement of CASS pump casings and valve bodies. The applicant noted that the ISI Program complies with ASME Code requirements with regard to examinations, testing, repair, and replacement of components specified in Code Section XI for Class 1, 2, or 3 components.

The applicant further stated that the program scope has been augmented to include additional requirements and components beyond the ASME requirements, such as the examinations per GL 88-01 dealing with the IGSCC of piping components. In addition, the applicant noted that its ISI Program uses an RI-ISI Program, for a subset of Class 1 piping welds, based on EPRI topical report as an alternative to the ASME Code Section XI requirements (for Class 1, non-socket Category B-J welds). The applicant also noted that flaws reported during the ISI are evaluated in accordance with established site procedures based on the ASME Code Section XI, IWB-300 and BWRVIP requirements, which may result in re-inspection or sample expansion.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M1. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL

Report AMP XI.M1, with the exception of the “scope of program,” “parameters monitored/inspected,” “detection of aging effects,” “monitoring and trending,” “acceptance criteria” program elements, and the AMP “program description.” For items related to these, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

The applicant’s “program description” of the ISI Program in LRA Section B.2.33 did not explicitly specify the applicable ASME Code edition(s) in current use. The staff noted that the applicant’s program basis document and “program description” did not specify or confirm which Code edition will be incorporated for inspection intervals during the period of extended operation. By letter dated June 24, 2010, the staff issued RAI B.2.33-1 requesting that the applicant clarify the ASME Code edition currently incorporated in the existing ISI Program and confirm if the ASME Code edition, to be incorporated for future inspection intervals during the period of extended operation, would be the ASME Section XI Code editions and addenda, as modified and limited in 10 CFR 50.55a.

In its response dated August 19, 2010, the applicant stated that the ASME Section XI Code incorporated in the current ISI Program is the 2001 Edition including the 2002 and 2003 Addenda. The applicant’s response also stated that ASME Code edition, to be incorporated for the future inspection intervals during the period of extended operation, will be the ASME Section XI Code editions and addenda, as modified and limited in the 10 CFR 50.55a rule, that are considered acceptable by the staff in the *Federal Register* Notice for future 10 CFR 50.55a amendments.

Based on its review, the staff finds the applicant’s response to RAI B.2.33-1 acceptable because it clarifies the proper referencing of the applicable Code editions consistent with the GALL Report AMP XI.M1 and confirms the applicant will use ASME Section XI Code editions and addenda, as modified and limited by 10 CFR 50.55a for future inspection intervals. The staff's concern described in RAI B.2.33-1 is resolved.

LRA Section B.2.33 and Section A.1.2.33 indicate that the applicant manages the reduction of fracture toughness due to thermal embrittlement of CASS pump casings and valve bodies. The staff noted that the inspections under the ASME Section XI, Subsections IWB, IWC, and IWD and the GALL Report AMP XI.M1 provide for the detection of aging effects to reveal cracking, loss of material due to corrosion, leakage of coolant and degradation from wear or stress relaxation, and do not address the reduction of fracture toughness. The staff also noted that GALL Report AMP XI.M1 does not include management of the thermal embrittlement or the resulting loss of fracture toughness. By letter dated June 24, 2010, the staff issued RAI B.2.33-2 requesting that the applicant cover this additional aging management issue as an enhancement to its existing ISI Program and provide the basis and justification for the enhancement.

In its response dated August 19, 2010, the applicant stated that its ISI Program does not directly monitor for loss of fracture toughness induced by thermal aging; instead, the impact of loss of fracture toughness on component integrity is indirectly managed by using visual or volumetric examination techniques to monitor for cracking in the components. The applicant further stated that the ISI Program continues to perform ASME Code required inspections, and the GALL Report states in multiple locations that this is acceptable for managing reduction of fracture toughness. The applicant stated that it does not consider this an enhancement to the ISI Program. The applicant justifies this in its response with reference to the Grimes letter dated May 19, 2000.

Although GALL Report AMP XI.M1 does not include management of thermal embrittlement, the staff finds applicant's justification for not identifying this as an enhancement to be acceptable for the following reasons:

- The referenced Grimes letter represents the previously accepted position by the staff, that Class 1 pump casings and valves are adequately managed for loss of fracture toughness by inspections performed as part of ASME Section XI.
- GALL Report AMP XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Steel (CASS)," refers to and confirms, on the basis of the Grimes letter, that for pump casings and valve bodies greater than NPS 4 in., the existing ASME Section XI inspection requirements, including the alternative requirements of ASME Code Case N-481 for pump casings, are adequate, and ASME Section XI, Subsection IWB, requires only surface examination of valve bodies less than NPS 4 in.

The staff's concern described in RAI B.2.33-2 is resolved.

The applicant incorporated in its augmentation of the ISI Program, for the ASME Code Section XI examinations, the IGSCC of BWR piping components, discussed in NRC GL 88-01. The nature and scope of this augmentation and its consistency with the GALL Report AMP XI.M1 were not apparent to the staff. In particular, it was not clear to the staff if the applicant was crediting any mitigation measures under GL 88-01 and if there is any impact on the scope of related inspections as required by the ASME Section XI. By letter dated June 24, 2010, the staff issued RAI B.2.33-3 requesting that the applicant clarify the extent of the augmented ISI Program to manage the GL 88-01 impacted components and justify the adequacy of augmentation to manage the IGSCC issue over the extended period of operation.

In its response dated August 19, 2010, the applicant stated that the requirements of GL 88-01 are dealt with more explicitly in its LRA Section B.2.8, "BWR Stress Corrosion Cracking Program," which is consistent with GALL Report AMP XI.M7, "BWR Stress Corrosion Cracking." Accordingly, the applicant noted that the GL 88-01 related inspections comply with the requirements of the ASME Code, Section XI, supplemented by guidelines of approved BWRVIP documents. The applicant's response further clarified that the current scope of inspections is in accordance with NRC approved BWRVIP-75, and it has implemented HWC and NMCA to mitigate IGSCC but, to date, has not requested any scope reduction based on chemistry. The applicant further stated that any future reduction of GL 88-01 examination scope based on HWC/NMCA will be submitted, as required, to the NRC for approval prior to implementation.

Based on its review, the staff finds the applicant response to RAI B.2.33-3 acceptable because it clarifies the scope of inspections as augmented by the applicant's BWR SCC Program to address the GL 88-01, which is consistent with the recommendations of GALL Report AMP XI.M7. Additionally, the applicant will seek prior NRC approval for any scope reduction in its future implementation in managing the IGSCC issue during the period of extended operation. The staff's concern described in RAI B.2.33-3 is resolved.

The applicant's response stated that the actual ISI Program is described in UFSAR Section 5.2.4; however, this section includes the ISI Program only by reference in a plant-specific document. The staff noted from UFSAR page 5.2-22 states that about 16 percent of the applicant's vessel weld volume is inaccessible. GALL Report AMP XI.M1, "scope of program" and "detection of aging effects" program elements recommend program adequacy and timely detection of aging effects for maintaining the structural integrity. The staff noted that meeting this recommendation with the 16 percent inaccessible weld volume will depend on the location and distribution of weld regions in the RV. It was not clear to the staff if or how the applicant made this determination to ensure the adequacy of existing ISI Program over the period of extended operation. By letter dated June 24, 2010, the staff issued RAI B.2.33-4 asking the applicant to address the large inaccessible weld regions of the vessel and provide the basis for the adequacy of the existing ISI Program coverage to manage the aging related degradation of these regions so that its intended function will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

In its response dated August 19, 2010, the applicant stated that BWRVIP-74-A (which is an NRC-approved inspection and complies with the AMP requirements of ASME Section XI) determined that the existing programs are adequate to ensure RPV integrity for an additional 20-year period of extended operation. The applicant’s response also indicated that the distribution of weld regions consists of the 84 percent accessible volume for inspections.

Based on its review, the staff finds the applicant’s response to RAI B.2.33-4 acceptable because the applicant follows the NRC-approved applicable BWRVIP guidelines, and the total weld volume that is examined represents a large and representative sample of the RPV so that the RPV weld integrity can be verified by examination of this sample. The staff's concern described in RAI B.2.33-4 is resolved.

The applicant’s ISI Program contains an RI-ISI Program based on EPRI TR-112657, Revision B-A, which has been approved by the NRC staff. The RI-ISI provides alternate inspection requirements for a subset of Class 1 piping welds. The staff noted that the application of RI-ISI is plant-specific requiring a set of plant information in the LRA. The staff confirmed this documentation during the onsite audit, and the applicant’s ISI Program plan calls for a review of the RI-ISI for future inspection intervals.

The staff noted that LRA Table 3.1.2-2 states that the shroud support access hole covers are fabricated from nickel alloy and reference LRA Table 3.1.1 Item 3.1.1-49. LRA Table 3.1.1 Item 3.1.1-49 states that access hole covers are of the retrofit (welded with crevices) design, but were modified during RPV construction to eliminate the crevice, by back welding the crevices and installing a modified cover configuration. During its audit, the staff noted that one of the plates is welded only from the top and the plate is fabricated from austenitic stainless steel. The staff noted that since this plate is only welded from the top, there is the potential for IGSCC to occur on the bottom of the plate where crevice conditions exist. By letter dated September 16, 2010, the staff issued RAI 3.1.1.x-1 requesting that the applicant (a) clarify and reconcile the actual plant conditions for the access hole welded cover plates and LRA Table 3.1.1, Item 3.1.1-49, (b) justify the absence of any augmented inspection plan for the creviced locations, and (c) provide the method and basis for monitoring and inspecting for potential IGSCC of these locations such that these components are adequately managed so that their intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In its response dated December 21, 2010 the applicant reconciled the actual plant conditions for the access hole covers by clarifying that one of the access hole covers has a modified top-hat design where the cover is raised with a ring separating the top cover from the shroud support plate. Furthermore, this raised top-hat cover plate is made of austenitic stainless steel and has a potential crevice condition from the bottom side. The applicant amended its LRA in Amendment 15, dated December 21, 2010, to reflect these conditions of the access hole covers. The applicant further stated that it performs inspections of all welds associated with the access hole covers in accordance with the Inservice Inspection Program, augmented per

BWRVIP guidelines, even though the only creviced weld is the stainless steel weld. The applicant noted that the access hole covers are inspected by EVT-1 in accordance with BWRVIP guidelines on a six year frequency that coincides with the ASME Code Section XI inspections for access hole covers and that a baseline inspection to BWRVIP guidelines was performed during Refueling Outage R18 (2007). The applicant also committed (Commitment No. 63) to perform ultrasonic Testing (UT) examination of creviced shroud support plate access hole cover weld, top hat configuration, once a demonstrated acceptable UT technique becomes available.

The staff noted that the applicant includes its augmented inspection activities for the access hole covers within the scope of its BWR Vessel Internals Program, which is provided in LRA Section B.2.10. The staff evaluation of the applicant's augmented inspection of the access hole covers during the period of extended operation is documented in SER Section 3.0.3.1.6. The staff's evaluation also includes the review of the applicant's commitment on the augmented inspection methods that will be used for the augmented inspection.

Based on its review, the staff finds the applicant's response to RAI 3.1.1.x-1 acceptable because (a) the applicant clarified the actual plant configuration for both the access hole covers and amended its LRA to describe this configuration, (b) the access hole covers are inspected by EVT-1 in accordance with BWRVIP guidelines on a six year frequency that coincides with the ASME Code Section XI inspections and is consistent with the recommendations of GALL Report AMP XI.M7, and (c) the applicant commited (Commitment No. 63), to perform UT examination of creviced shroud support plate access hole cover weld , top hat configuration, once a demonstrated acceptable UT technique becomes available.

Based on its audit and review of the applicant's responses to RAI B.2.33-1, RAI B.2.33-2, RAI B.2.33-3, RAI B.2.33-4, and RAI 3.1.1.x-1, the staff finds that elements one thru six of the applicant's ISI Program are consistent with the corresponding program elements of GALL Report AMP XI.M1, and, therefore acceptable.

Operating Experience. The staff reviewed the operating experience summarized in LRA Section B.2.33 related to the ASME Section XI ISI, Subsections IWB, IWC, and IWD Program.

The applicant provided its review of the industry experience and its plant-specific operating experience related to the findings from ISIs, as documented in its ISI outage summary reports, with specific examples of ISI findings also documented in CRs. The applicant noted that its operating experience is consistent with industry experience, a large number of examinations are being performed, and indications are found and resolved. Additionally, an occasional repair has been identified and performed prior to loss of intended function. The applicant further indicated that it will use its site-specific Corrective Actions Program and an ongoing review of industry operating experience to ensure that the ISI Program remains effective in managing the identified aging effects.

The staff reviewed operating experience information, in the application and during the audit, to determine whether the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine whether the applicant adequately incorporated and evaluated operating experience related to this program. The staff reviewed a sample of CRs and interviewed the applicant's technical staff to confirm that the plant-specific operating experience did not reveal any degradation not bounded by industry experience. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, and review of the applicant's response to RAIs B.2.33-1, B.2.33-2, B.2.33-3, and B.2.33-4, the staff finds that operating experience related to the applicant's program for this AMP demonstrates that the applicant can adequately manage the effects of aging on SSCs within the scope of this AMP program and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in the GALL Report and SRP-LR Section A.1.2.3.10; therefore, the staff finds this program element acceptable.

UFSAR Supplement. LRA Section A.1.2.33 provides the UFSAR supplement for the ISI Program. The staff reviewed this UFSAR supplement description of the program against the recommended description for this type of program, as described in SRP-LR Table 3.1-2.

The staff noted this description to be consistent with the description provided in the SRP-LR, with the exceptions of its reference to the use of future editions of the ASME Code, the management of fracture toughness, and the augmentation of ISI concerning GL 88-01. The staff noted that these exceptions are discussed in the above RAIs and its resolution addressed in the applicant's response and staff's evaluation of the response. Based on its review and applicant's responses, the staff finds that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.1-2.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's ISI Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.20 ISI Program—IWE

Summary of Technical Information in the Application. LRA Section B.2.34 describes the existing ISI Program—IWE as consistent with GALL Report AMP XI.S1, "ASME Section XI, Subsection IWE." The applicant's ISI Program—IWE establishes responsibilities and requirements for conducting IWE inspections as required by 10 CFR 50.55a. The ISI Program—IWE includes visual examination of all accessible surface areas of the steel containment and its integral attachments and containment pressure-retaining bolting in accordance with the requirements of the ASME Code, Section XI, 2001 Edition through 2003 Addenda for Subsection IWE. The applicant further stated that the inservice examinations conducted throughout the service life of Columbia will comply with the requirements of the ASME Code Section XI Edition and Addenda incorporated by reference in 10 CFR 50.55a(b), 12 months prior to the start of the inspection interval, subject to prior approval of the edition and addenda by the NRC. The applicant stated that this is consistent with NRC statements of consideration associated with the adoption of new editions and addenda of the ASME Code in 10 CFR 50.55a.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine if it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.S1. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.S1, with the exception of the "scope of program" program element. For this element, the staff determined the need for additional clarification, which resulted in the issuance of an RAI.

Containment pressure retaining bolting is included in the GALL Report AMP XI.S1 under the "scope of program" program element description. In addition, the GALL Report AMP XI.M18, "Bolting Integrity" AMP recommends including structural bolting (actual yield strength greater than or equal to 150 thousand pounds per square inch (ksi)) under its "scope of program" program element description. Program Element 1 of the Columbia ISI Program—IWE includes examination of pressure-retaining bolting within its scope; however, this program element description does not specifically state that structural bolting (actual yield strength greater than or equal to 150 ksi) is included within the scope of pressure-retaining bolting.

By letter dated July 7, 2010, the staff issued RAI B.2.34-2 requesting that the applicant describe the methods that Columbia is implementing to examine pressure-retaining bolting including structural bolts with actual yield strength greater than 150 ksi.

In its response to RAI B.2.34-2, dated September 3, 2010, the applicant stated that the scope of its IWE program is visual examination of all accessible surface areas of the steel containment and its integral attachments and containment pressure-retaining bolting regardless of bolt material or properties (yield strength). The applicant assumed that Class I bolting (mechanical) is susceptible to SCC; however, all the parameters required for SSC to occur in high-strength material for bolting (structural) are not present at Columbia. The applicant provided a detailed justification for this assumption in response to the Bolting Integrity RAI B.2.4-5 (see SER Section 3.0.3.2.2).

The staff finds the applicant's response to the RAI B.2.34-2 acceptable because all three parameters are required for SCC to occur—a corrosive environment, a susceptible material, and high sustained tensile stresses. The absence of any one of the three parameters eliminates the material's susceptibility to corrosion. The pressure retaining bolts used at Columbia are not exposed to corrosive environment inside containment. Lubricants containing molybdenum disulphide are prohibited at Columbia. Therefore, environmental conditions necessary for SCC of the bolts to occur do not exist at Columbia. The staff's concern in RAI B.2.34-2 is resolved.

Based on its audit and review of the applicant's response to RAI B.2.34-2, the staff finds that elements one through six of the applicant's ISI Program—IWE are consistent with the corresponding program elements of GALL Report AMP XI.S1 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.34 summarizes operating experience related to the ISI Program—IWE. According to the applicant, Columbia's Mark II containment is inerted with nitrogen, which provides an atmosphere that is not conducive to corrosion of containment interior surfaces. All examinations and tests performed to date satisfied the acceptance standards contained within Article IWE-3000, without exception. Currently, there are no containment surfaces or components requiring designation as augmented examination areas. The applicant further stated that two bolting related defects were found during the IWE inspection and were reported in the RFO 18 ISI summary report. One defect was related to a bolt for the drywell head, and the other defect was for a bolt on the equipment hatch. Both bolt and nut sets were replaced and, subsequently, pressure tested to confirm pressure boundary integrity of the joint. In addition, the suppression pool wetted surfaces of the submerged areas were examined and found acceptable.

The applicant also stated that, due to the possibility of containment shell degradation from corrosion induced by a moist environment in the sand pocket region, Columbia has committed to monitor humidity levels in this region and has implemented a procedure to survey the relative humidity of air drawn from within the containment annulus sand pocket region. Review of past inspection results revealed that inspections performed were satisfactory and surveillances since late 1989 indicate that no water was detected, and there is no evidence of leakage into the sand pocket region. The applicant further stated that measurement of sand pocket area humidity provides assurance that water is not accumulating in the sand pocket area, which could cause corrosion of the outer surface of the containment shell.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program.

During its review, the staff identified operating experience which could indicate that the applicant’s program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of RAIs.

In LRA Section B.2.34, the applicant stated that due to the possibility of containment shell degradation from corrosion induced by a moist environment in the sand pocket region, Columbia has committed to monitor humidity levels in this region. The applicant also stated that a procedure to survey the relative humidity of air drawn from within the containment annulus sand pocket region has been implemented. According to the applicant, this procedure is only used before and after each refueling operation to verify that no water entered the sand pocket area. During the audit, the staff reviewed documentation stating the following:

> From the data reviewed, the worst case (maximum) dew point temperature of the sand pocket air was about 54 degrees Fahrenheit. The temperature of the containment shell in the sand pocket area is essentially the same temperature as the suppression pool water. The suppression pool water temperature is normally maintained above 54 degrees Fahrenheit.

Because these data indicate that the relative humidity in the sand pocket area could be as high as 100 percent under certain operating conditions, the staff was concerned that humidity of this magnitude could cause general corrosion of the outside surface of the metal containment shell in the sand pocket area. Therefore, by a letter dated July 7, 2010, the staff issued RAI B.2.34-1 requesting that the applicant provide details of its Humidity Monitoring Program including the acquisition frequency of humidity measurement data, limits of acceptability for humidity level values, and followup actions that the applicant will take when humidity levels exceed the acceptance criteria. In addition, the applicant was asked to explain how humidity measurements acquired before and after refueling demonstrate that there is no water in the sand pocket area since it will take some time for the water to flow through the flexible urethane foam sheets located between bioshield wall and steel containment and affect the humidity of the sand pocket region. The applicant was also asked to describe potential aging effects including loss of material resulting from exposure of the metal containment shell to humidity levels that are measured during the plant outages.

In its response to the RAI B.2.34-1, dated September 3, 2010, the applicant stated that humidity monitoring of the sand pocket region is performed on a 2-year cycle in accordance with a plant procedure. This procedure does not provide specific humidity level acceptance criteria, but consideration of abnormally high humidity levels is left to the judgment of the system engineer and manager. The applicant recognizes this potential procedure weakness and has initiated a CR under the corrective action process to provide more definitive acceptance criteria. The applicant further stated that the humidity in the sand pocket area is measured prior to reactor cavity flood-up and after reactor cavity drain-down to ensure water has not been introduced into the sand pocket area during refueling activities. According to the applicant, an abnormally high differential in the flood-up and drain-down humidity readings would indicate the presence of moisture in the annulus area between the containment vessel and the biological shield wall. This moisture could originate from a significant leak in the outer refueling bellows seal, drain lines from the reactor pool cavity, or a through-wall leak in the containment shell below the suppression pool water level. In addition, the sand pocket drains are checked monthly (28-day frequency) for the presence of water. To date, no water has been documented as a result of drain line surveillance, but discovery of water would be addressed under the applicant's corrective action process.

The applicant addressed potential material loss resulting from exposure of the metal containment shell to high humidity levels by stating that loss of material extrapolated out to 60 years will be 90 mils based on an assumed maximum corrosion rate of 1.5 mils per year. The 90-mil metal loss includes the 62.5-mil (1/16-in.) corrosion allowance provided by the original design methodology and the 27.5 mils of excess metal thickness associated with the 1.9 percent margin between actual and allowable stress. The applicant concludes that although the humidity checks may not provide immediate evidence of any potential leaks, there is sufficient corrosion allowance inherent in the design of the containment vessel to ensure the containment vessel maintains its integrity under a 100 percent humidity (treated water) environment in the sand pocket region.

The staff reviewed the applicant's response to the RAI B.2.34-1 and arranged a conference with the applicant on September 22, 2010, to understand the applicant's response to corrosion in the sand pocket region and in the annulus region between the containment steel and concrete shield wall above the sand pockets. During the conference call, the applicant stated that the valves for the sand pocket drains are opened every 28 days to check for leakage. Until now, leakage has not been detected from these valves. The applicant also stated that Columbia does not have an alarm system that can identify leakage from the bellows or reactor cavity into the annular space between the steel containment and the concrete shield wall. In addition, due to lack of evidence of leakage from the sand pocket drain, the applicant does not have any plans to perform any NDE such as UT of the drywell and wetwell area to detect corrosion.

The applicant further stated that the assumed corrosion rate of 1.5 mil per year is based on the applicant's site-specific measured data from steel coupons that are inserted in the service water (SW) and removed every 4 months to determine the corrosion rate. New coupons are inserted every 4 months. According to the applicant, the corrosion rate of 1.5 mil per year obtained from the coupons is a conservative estimate of the potential corrosion of the steel containment vessel in contact with the polyurethane foam material located in the annulus between the biological shield wall and the primary containment vessel.

Following the conference call, the staff issued followup RAI B.2.34-1, dated November 19, 2010 (ML103130548), requesting that the applicant provide details regarding the following:

(a) how the sand pocket drains are inspected

(b) the basis for the corrosion rate of 1.5 mil per year

(c) justification for assuming the corrosion rate in the sand bed region is linearly proportional to the drywell thickness

(d) plans for ultrasonic examination of the steel containment and sand pocket region to detect degradation of steel and confirm the corrosion rate is less than 1.5 mil per year.

In its response to followup RAI B.2.34-1 dated January 20, 2011(ML110270135), the applicant addressed each issue separately. Responses to issues (a)–(d) are summarized below.

Issue (a): The sand pocket drains are checked on a 28-day frequency by opening the valve at each of the eight drain lines (one at a time) and checking for the presence of water; however, the drain lines are not evacuated for this task. To date, no water has been found. In addition, the humidity level in the sand pocket drain region is checked on a 2-year frequency prior to and after each RFO. For this evaluation, a vacuum pump is attached to each drain line to draw an air sample. Successful completion of this task has served to confirm and reaffirm that the drain lines are not clogged. In addition, to further confirm the absence of clogged drain lines, the applicant committed (Commitment No. 67) to perform a boroscope inspection of the containment sand drain lines before the end of 2015.

Issue (b): The corrosion rate of 1.5 mil per year is based on plant-specific data from 180-day corrosion coupons exposed to SW system (raw water) environment. The subject 180-day coupons are bare carbon steel which are removed every 180 days and the material loss determined. These coupons are replaced with new coupons (also bare carbon steel), and the process repeated. Data reviewed was for the most recent 3–4 year period.

Issue (c): Based on review of the final stress analysis report provided by the primary containment vessel vendor, the stresses seen by the primary containment vessel can be both membrane and bending stresses based on the load combinations. The resultant stress intensities related to membrane stresses are linearly proportional to the thickness, and the resultant stress intensities related to bending stresses are exponentially proportional to the thickness (thickness squared). However, the allowable stress intensity for stress intensities associated with bending stress is also higher (1.5 times) than that for stress intensity related to purely membrane stresses. Thus, to address this concern the applicant performed an evaluation of the entire primary containment vessel and adjusted the stress intensities identified in the final stress report as appropriate for the anticipated reduction in thickness of 90 mils through the period of extended operation. This evaluation addressed the primary containment vessel from the sand pocket region up to the location of the refueling bellows or the entire height of the primary containment vessel. The results of this evaluation are that the primary containment vessel will maintain its structural integrity for all load cases with the postulated corrosion loss of 90 mils through the period of extended operation.

Issue (d): The applicant has no plans to perform ultrasonic examinations of the primary containment vessel to confirm that the potential corrosion rate is less than the postulated rate of 1.5 mil per year. This rate was based on new (bare) carbon steel in raw water as noted in Issue (b) and, while the exterior side of the primary containment vessel is also bare carbon steel, the applicant feels that exposure of this material to water has been minimal as discussed in Issue (a). However, per response to RAI 3.5.2.2.1.4-1, the applicant committed (Commitment No. 64), in a letter dated January 18, 2011, to remove eight inspection ports equally spaced in the upper region of the primary containment vessel to visually inspect this exterior side of the primary containment vessel. These inspection ports are located just below the refueling bellows, which would be the most likely source of any potential leak into the annulus area between the primary containment vessel and the concrete shield wall. These inspections will be performed during the fourth ISI interval prior to the period of extended operation, and again in the fifth ISI interval after entering period of extended operation, to verify leakage is not occurring.

Based on its review, the staff finds the applicant's response to RAI B.2.34-1 and the clarification provided by the applicant in the conference call on September 23, 2010, and its response to followup RAI B.2.34-1, acceptable because the staff finds that potential corrosion of the steel containment vessel, including the area adjacent to the sand pocket regions are being effectively managed. This conclusion is supported by actions taken by the applicant to periodically monitor the leakage from the sand pocket region drains and its finding that no leakage was detected. The commitments to remove eight inspection ports in the upper region of the primary containment vessel to visually inspect the exterior side of the primary containment vessel and to inspect each of the eight sand pocket drains using a boroscope will provide additional evidence that corrosion is not occurring. In addition, the applicant has used a general corrosion rate for steel exposed to SW of 1.5 mil per year, which is site-specific, based on actual observations, and consistent with published data. The projected loss of thickness of 90 mils in the steel containment in the event that water is trapped behind the steel and not drained for 60 years is equivalent to the sum of the corrosion allowance in the original design plus the excess metal thickness due to the design margin. The staff also finds that the primary containment vessel will maintain its structural integrity for all load cases with the postulated corrosion loss of 90 mils through the period of extended operation based on stress analysis results provided by the applicant in its letter dated January 20, 2011. Therefore, the staff's concerns described in RAI B.2.34-1 are resolved.

In LRA Section B.2.34, the applicant also stated that "suppression pool wetted surfaces of the submerged area were examined and found acceptable." However, the applicant did not indicate whether or not repairs to the drywell shell coating or the moisture barrier were performed to achieve compliance with ASME Section XI, Subsection IWE requirements. During the audit, the staff reviewed documentation stating the following:

> All coated surfaces exhibited a light dusting on all surfaces, which was removed prior to the VT-3 examination. It is recommended that a complete Wet Well de-sludge be performed prior to the next VT-3 examination on the bottom head moisture barrier.
>
> Note 3 for ASME Section XI, Subsection IWE, Table IWE-2500-1 states that examination shall include moisture barrier materials intended to prevent intrusion of moisture against inaccessible areas of the pressure retaining metal containment shell or liner at concrete-to-metal interfaces and at metal-to-metal interfaces which are not seal-welded. Containment moisture barrier materials include caulking, flashing, and other sealants used for this application.

By letter dated July 3, 2010, the staff issued RAI B.2.34-3 requesting that the applicant provide the inspection frequency for the accessible coated wetwell metal shell surface and the moisture barrier inside the wetwell at the concrete-to-metal interface. In addition, the staff asked the applicant to provide the details and number of all coating degradations in the drywell and wetwell and degradation of the wetwell moisture barrier observed during the previous IWE inspections. The applicant was asked to describe how VT-3 examination of the moisture barrier and steel containment is performed without removing the sludge from the inspected surfaces.

In its response to the RAI B.2.34-3, dated September 3, 2010, the applicant stated that the frequency of the inspection periods within the 10-year inspection interval are within 3, 7 and 10 calendar years of plant service and in accordance with ASME Section XI, Article IWE-2000, 2001 Edition, 2003 Addenda, Section IWE-2412, "Inspection Program B," Table IWE-2412-1 requirements. The applicant further stated that accessible metal shell surfaces and the moisture barrier at the concrete-to-metal interface are inspected during each of the three inspection periods within the 10-year inspection interval, and the submerged area is inspected once during the 10-year inspection interval. No degradation of the moisture barrier or submerged wetwell shell was identified during inspections of the submerged area and the moisture barrier conducted during the 2009 RFO (R-19). The drywell shell coating was also examined during R-19. Inspections of the accessible surface area (drywell shell and wetwell above the water line) were performed during the RFO in 2007 (R-18). The inspections revealed a hanger pad weld with corrosion on the drywell shell near the 520 foot (ft) elevation, but there was no evidence of corrosion on the drywell shell. The weld was cleaned and inspected again, before coating. No indications were found on the wetwell shell, above the water line.

The applicant also stated that VT-3 examinations are performed in accordance with plant procedures by certified VT-3 examiners. The VT-3 examiner assesses the target surface at the time of the examination to determine if the VT-3 examination can be performed. If the surface is obstructed so that an adequate examination cannot be performed, the examiner cleans the surface or has it cleaned. After the obstructing material is removed, the examiner performs the examination. Therefore, neither the inspection in question, nor are other inspections, performed on unacceptably obstructed surfaces.

The staff reviewed the applicant's response to the RAI B.2.34-3 and could not determine if the applicant is following 10 CFR 50.55a requirements concerning personal qualifications of VT-1 and VT-3 examiners. Therefore, the staff issued followup RAI B.2.34-3 on November 19, 2010 (ML103130548), requesting that the applicant provide the qualification requirements for the VT-3 examiners and whether or not the VT-3 examiners are qualified in accordance with ASME IWA-2300. In its response to followup RAI B.2.34-3 dated January 20, 2011, the applicant provided the following statement:

> Columbia Generating Station qualifies and certifies VT-3 visual examination personnel to a procedure which complies with 1) ASME Section XI 2001 Edition through the 2003 Addenda, 2) 10 CFR 50.55a, and 3) [American Society for Nondestructive Testing] ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel CP-189, as modified by ASME Section XI 2001 Edition 2003 Addenda. Since the procedure complies with the requirements of ASME Section XI, the personnel are qualified in accordance with IWA-2300 of ASME Section XI 2001 Edition, 2003 Addenda.

Based on its review, the staff finds the applicant's response to followup RAI B.2.34-3 acceptable because the applicant qualifies and certifies VT-3 visual examination personnel in accordance with ASME IWA-2300 requirements. The staff's concern described in followup RAI B.2.34-3 is resolved.

Based on its audit and review of the application, and review of the applicant's responses to RAIs B.2.34-1 and B.2.34-3, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.34 provides the UFSAR supplement for the ISI Program—IWE. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.5-2.

The staff also notes that the applicant committed (Commitment No. 34) to ongoing implementation of the existing ISI Program—IWE for managing aging of applicable components of the steel containment and its integral attachments and containment pressure-retaining bolting in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWE during the period of extended operation. In addition, the applicant committed (Commitments No. 64 and 67) to inspect each of the eight sand pocket drains in 2015 using a boroscope to verify that the drains are not clogged and to remove eight inspection ports equally spaced in the upper region of the primary containment vessel to visually inspect this exterior side of the primary containment vessel for evidence of leakage during the fourth and fifth ISI intervals.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's ISI Program—IWE, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.21 ISI Program—IWF

Summary of Technical Information in the Application. LRA Section B.2.35 describes the existing ISI Program—IWF as consistent with GALL Report AMP XI.S3, "ASME Section XI, Subsection IWF." The applicant stated that this program establishes responsibilities and requirements for conducting IWF Inspections for ASME Class 1, 2, and 3 component supports, as required by 10 CFR 50.55a. The program involves visual examination of supports based on sampling of the total support population depending on the ASME Class. Degradation that potentially compromises support functions or load capacity is identified for evaluation. Supports requiring corrective actions are reexamined during the next inspection period. The applicant further stated that the inservice examinations conducted throughout the service life of Columbia will comply with the requirements of the ASME Section XI Edition and Addenda incorporated by reference in 10 CFR 50.55a(b), 12 months prior to the start of the inspection interval, subject to prior approval of the edition and addenda by the NRC. The applicant stated that this is consistent with NRC statements of consideration for 10 CFR Part 54 associated with the adoption of new editions and addenda of the ASME Code in 10 CFR 50.55a.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.S3. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.S3, with the exception of the "scope of program" program element. For this element, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

In LRA Section B.2.35, the applicant stated that the scope of the IWF Program includes ASME Class 1, 2, and 3 piping supports and supports other than piping supports (Class 1, 2, 3, and MC). In documentation reviewed by the staff during the audit, the applicant stated that "one component in each multiple component group" is selected for examination. However, Note 3 for Table IWF-2500-1 in ASME Section XI, Subsection IWF states that for multiple components other than piping, within a system of similar design, function, and service, the support of only one of the multiple components are required to be examined.

By letter dated July 7, 2010, the staff issued RAI B.2.35-1 requesting that the applicant describe the criteria used to select components for examination under its ISI Program—IWF AMP and to ensure consistency with component selection requirements in ASME Section XI, Subsection IWF, Table IWF-2500-1.

In its response dated September 3, 2010, the applicant stated that it complies with 10 CFR 50.55a, and the supports for examination are selected in accordance with ASME Section XI, Subsection IWF, Table IWF-2500-1, 2001 Edition, 2003 Addenda. The applicant also stated that the requirements and components are grouped by component type, as specified in Note 3 of this Table. Within each component type group, a single component is selected for examination and all supports for that single component are examined. The applicant further stated that this also complies with the extent and frequency of examinations specified in the table. The staff finds this response acceptable because the applicant's support selection methodology and examination is consistent in context, extent, and frequency with the requirements of ASME Section XI, Subsection IWF, Table IWF-2500-1, including Note 3.

Based on its audit and review of the applicant's response to RAI B.2.35-1, the staff finds that elements one through six of the applicant's ISI Program—IWF are consistent with the corresponding program elements of GALL Report AMP XI.S3 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.35 summarizes operating experience related to the ISI Program—IWF. During RFO 18 (R-18) in May 2007, the applicant reported that the ISI Program—IWF inspection did not identify aging related degradation. However, deficiencies such as a spring can setting out of tolerance were found. The spring can setting deficiency was further evaluated and accepted in accordance with the ISI Program. Another deficiency found was one of the 1/2 in. bolts holding the installed shims in place sheared at a RPV stabilizer. An engineering evaluation determined that the condition of the RPV stabilizer is acceptable, and a CR documented the discovery of this sheared bolt. Only one of the two 1/2 in. diameter bolts provided for shim restraint on each side was damaged (i.e., the upper bolt on the right hand side), the associated shims was not dislodged, and the condition does not affect the overall functionality of the RPV stabilizer. The damaged bolt was replaced during RFO 19 (R-19) in May 2009.

The applicant also reported that 100 percent of the locations specified in the program were examined, and there were two Code related successive inspections required to be performed per Subsection IWF during the third interval inspection period. These inspections, one on a snubber and one on a spring support, were performed during the R-19 outage, and the results were acceptable. The applicant further stated that the program health reports for 2007 and 2008 indicated no age-related concerns for systems and components within the scope of the ISI Program—IWF. In addition, review of the three previous RFOs (R-18, R-17, and R-16) ISI summary reports and plant operating experience did not reveal any age related issues with regards to ASME Class 1, 2, 3, and MC supports pertaining to ASME Section XI, Subsection IWF.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program.

During its review, the staff identified operating experience, which could indicate that the applicant's program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of a RAI B.2.35-2, as discussed below.

In LRA Section B.2.35, the applicant states that "The ISI Program–IWF will be capable of detecting and managing loss of material and cracking for ASME Class 1, 2, and 3 component supports." However, during the audit walkdown, the staff observed evidence of loss of material due to corrosion in the above-water portions of structural steel supports for the spray pond ring header.

By letter dated July 7, 2010, the staff issued RAI B.2.35-2 requesting that the applicant describe the inspection frequency and details of the supplemental examinations required in accordance with IWF-3200 for both the above-water and below-water portions of the structural steel supports for the spray pond ring header. The staff also requested that the applicant describe the methods used to protect the steel from corrosion, the process used to verify that the corrosion mitigation measures are effective and the criteria used to initiate the Corrective Actions Program.

In its response dated September 3, 2010, the applicant stated that IWF-3200 specifies no inspection frequency for supplemental examinations. The applicant also stated that when visual examinations detect conditions in the probed supports the examinations may be supplemented with other examination methods to characterize flaws. Supplemental examinations may be either or both surface and volumetric methods. The applicant further stated that these structural steel supports of the spray ring header are protected from corrosion by a coating and a sacrificial anode protective system. The effectiveness of the corrosion protection system is assessed periodically by performing above-water and below-water visual inspections of the structural supports. Additionally, the operation of the anode protective system is verified periodically. The criterion to initiate the corrective action process, in accordance with plant procedures, is to "identify any issue or condition that doesn't look as if it is right using the AR-CR process."

The staff reviewed the applicant's response to RAI B.2.35-2 and determined that there was not adequate information regarding the frequency of the periodic inspection of the SW pond spray ring header steel supports and of the anode protective systems. In addition, the criterion used to initiate the corrective action process was deemed to be subjective. Therefore, by letter dated November 19, 2010, the staff issued a followup RAI B.2.35-2 requesting the applicant to provide the inspection frequencies for the above-water and below-water inspection of SW pond spray header supports, and anode protection system and to quantify the criteria used to initiate the corrective action process.

By letter dated January 20, 2011, the applicant responded and stated that both above-water and below-water inspections are performed. The above-water portion of the SW spray header supports quadrennially with the existing Structures Monitoring Program. The applicant also stated that visual inspection of the supports is done from the access catwalk to the ring header following the guidance of the general plant procedures and relies on the skill of selected qualified engineer(s). Undesired conditions are recorded in the corrective action process. The applicant further stated that RAI Response B.2.50-2 from Letter GO2-10-128 (ML1025200480), Amendment 4, provides a further commitment to quantify, monitor, and trend inspection results, better aligning these to industry codes, standards, and guidelines referenced in the Structures Monitoring Program. The applicant finally stated that this enhancement meets GALL Report AMP XI.S6, “acceptance criteria,” program element. Details of the implementation timeline of the required program enhancement are provided in response to followup RAIs B.2.50-1, B.2.50-2, and B.2.50-3 (see SER Section 3.0.3.2.18).

For the below-water portion of the SW spray header supports and associated sliding surfaces and connected items, the applicant stated that it performs visual inspections decennially or every five RFOs for loss of material due to corrosion and loss of structural integrity with VT-3 qualified divers who implement the ISI Program. Recorded conditions and data are further reviewed by Level II or III inspectors. Plant-specific instructions provide requirements for visual examination of component supports including personnel qualifications, data recording, and data evaluation. Any component supports containing unsatisfactory items are then further evaluated for entry into the site corrective action process.

Inspection of the anode protection system for the SW spray header supports is performed by divers triennially. Divers wire brush clean, inspect, and collect data on the anodes. The system engineer uses the as-found anode condition for trending and monitoring and each anode’s average depth, average gap, and percent volume remaining for quantitative measurement of material left to determine if and when anode(s) require replacement.

Indications or relevant conditions of degradation are reported and submitted for further evaluation as part of the Corrective Action Program. These evaluations are performed by trained, experienced engineers qualified to evaluate evidence of potential aging effects. It ensures the components are maintained within all CLB design conditions and will continue to function as originally designed.

Based on its review, the staff finds the applicant’s response to RAI B.2.35-2 and its followup RAI acceptable because the inspection frequency of the above-water and below-water structural supports meets or exceeds the criteria set by the applicable references of GALL Report AMP XI.S6, “Structures Monitoring Program,” which the applicant has aligned itself with in Commitment No. 50, and ASME Section XI, Rules for ISI of Nuclear Power Plant Components of 5-10 years. Anodes are typically long lasting, and its triennial inspection ensures that it is maintained within all CLB design conditions and replaced when necessary. Moreover, the inspecting personnel are either civil or structural engineers with an engineering degree, capable of performing inspections for the criteria set in structural industry codes as stated in the applicant’s letter response dated September 3, 2010, to RAI B.2.50-3 or qualified and certified

VT-3 examiners satisfying ASME Section XI, 10 CFR 50.55a, and ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel, as reported on January 20, 2011, in response to the followup RAI B.2.34-3.

Based on its audit and review of the application, and review of the applicant's response to RAI B.2.35-2, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.35 provides the UFSAR supplement for the ISI Program—IWF. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.5-2.

The staff also notes that the applicant committed (Commitment No. 35) to ongoing implementation of the existing ISI Program—IWF for managing aging of applicable components during the period of extended operation. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's ISI Program—IWF, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.22 Lubricating Oil Inspection

Summary of Technical Information in the Application. LRA Section B.2.37 describes the new Lubricating Oil Inspection Program as consistent with GALL Report AMP XI.M32, "One-Time Inspection." The applicant stated that this is a new one-time inspection that detects and characterizes the condition of materials in systems and components for which the Lubricating Oil Analysis Program (a mitigation program) is credited with aging management. The applicant also stated that this inspection provides direct evidence as to whether, and to what extent, a loss of material due to crevice, galvanic, general, or pitting corrosion or selective leaching, or reduction in heat transfer due to fouling has occurred on surfaces exposed to lubricating oil.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M32. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.M32, with the exception of the parameters monitored/inspected and detection of aging effects program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

The staff compared the LRA “Parameters Monitored or Inspected,” program element, to the GALL Report AMP XI.M32, “One-Time Inspection” Program, “parameters monitored/inspected” program element. The staff noted the applicant did not elaborate on the inspecting personnel’s qualifications or note if these complied with ASME Code and 10 CFR Part 50, Appendix B, as the GALL Report AMP XI.M32 recommends. The staff also noted that the One-Time Inspection Program’s basis document failed to detail the inspecting personnel’s qualifications or describe the site-specific procedure outlining the training requirements for individuals assigned to perform these inspections. By letter dated July 15, 2010, the staff issued RAI B.2.A-1 asking the applicant to provide details on the qualifications and training requirements for its personnel assigned to perform the inspections and its conformance to the applicable ASME Codes.

In its response dated September 13, 2010, the applicant stated that personnel performing the visual examinations, UT, or other NDE techniques, outlined in ASME Sections V and XI, are trained in accordance to ASME Code requirements. The applicant further stated that training requirements for all inspections will be consistent to 10 CFR Part 50, Appendix B. The staff reviewed the applicant’s response and finds it acceptable because the one-time inspection will be performed by qualified personnel following procedures consistent to ASME Code and 10 CFR Part 50, Appendix B, using a variety of NDE methods, including visual and volumetric techniques. The staff’s concern described in RAI B.2.A-1 is resolved.

When the staff compared the LRA “Detection of Aging Effects” program element, to the GALL Report AMP XI.M32, “One-Time Inspection,” Program “detection of aging effects” program element, it was not clear how the applicant defined its inspection “representative sample.” The staff noted that the LRA characterized the sample population based on an engineering evaluation and a “sound statistical sampling methodology,” while the GALL Report AMP XI.M32, recommends the “representative sample” to focus, where practical, on the bounding or lead components of a system population, most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin. The staff also noted that the applicant’s sampling plan provides no details on its composition and assurances that a representative population of sufficient size and scope will be inspected. By letter dated July 15, 2010, the staff issued RAI B.2.A-2 asking the applicant to provide details on the proposed sampling methodology indicating, for example, if it follows an RI-ISI methodology, a sequential sampling, or some other statistically-based sampling plan.

In its response dated September 13, 2010, the applicant stated that within the scope of the One-Time Inspection Program for each material and environment combination, a sample population will be identified through engineering evaluations. The applicant also stated that the selected components will be those most susceptible to aging effects defined by time in service, severity of operating conditions, and design margins. The applicant further stated that the selected sample population will be capped at 5 percent, for up to 200 components within the same system, with a minimum sample size of one for component populations of less than 20. Finally, the applicant stated that the inspection will include piping segments upstream and downstream of the selected components, and supplemental inspections sample size would be determined as part of the Corrective Action Program. However, the staff noted that large sample sizes may be required to adequately confirm an aging effect is not occurring because of the uncertainty in determining the most susceptible locations and the potential for aging to occur in other locations. By letter dated December 3, 2010, the staff issued RAI B.2.A-3 requesting that the applicant provide technical justification for ensuring, based on the sample size chosen, that the components not inspected are not experiencing degradation.

In its response dated January 20, 2011, the applicant stated that the selected set of components to be sampled will be determined based on the material, environment, and aging effect combinations such that each combination represents a sample population. The applicant also stated that it will inspect 20 percent of each population, up to a maximum of 25 inspections per population. The staff finds the applicant's response acceptable because the applicant's sampling methodology ensures that a representative sample of material and environment combinations is considered; ensures sample locations will focus on the most susceptible components based on time in service, severity of operating conditions, and design margins; and includes an appropriate sample size. The staff's concerns described in RAIs B.2.A-2 and B.2.A-3 are resolved.

Based on its audit and review of the applicant's responses to RAIs B.2.A-1, B.2.A-2, and B.2.A-3, the staff finds that Elements one through six of the applicant's Lubricating Oil Inspection Program are consistent with the corresponding program elements of GALL Report AMP XI.M32 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.37 summarizes operating experience related to the Lubricating Inspection Program. The applicant stated that a review of Columbia operating experience identified no examples of aging-related degradation in components managed by this AMP.

The staff reviewed operating experience information, in the application and during the audit, to determine whether the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine whether the applicant had adequately incorporated and evaluated operating experience related to this program. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation. In addition, the staff confirmed that the applicant addressed operating experience identified after issuance of the GALL Report. The applicant's review of this recent operating experience did not reveal any applicable occurrences or detrimental environments that could exacerbate a slow aging effect or accelerate an otherwise long incubation period, and none of these were identified in the staff's independent review of the applicant's recent operating experience. The staff, therefore, confirms that the Lubricating Oil Inspection Program is appropriate to verify whether the aging mechanisms exist and to what extent it may be occurring. In addition, the site's use of a Corrective Action Program and ongoing reviews of industry operating experience will assist the management of aging effects for the extended period of operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.37 provides the UFSAR supplement for the Lubricating Oil Inspection Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Tables 3.2-2 and 3.3-2. The staff also notes that the applicant committed (Commitment No. 37) to implement the new Lubricating Oil Program within 10 years prior to the period of extended operation for managing aging of applicable components. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Lubricating Oil Inspection Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.23 Monitoring and Collection Systems Inspection

LRA Section B.2.41 originally described the new Monitoring and Collection Systems Inspection program as consistent with GALL Report AMP XI.M32, "One-Time Inspection." During its review, the staff identified inconsistencies in the use of a One-Time Inspection Program to manage aging for components for which the GALL Report recommends an aging effect. As a result, by letter dated January 28, 2011, the applicant revised its Monitoring and Collection Systems Inspection Program to become a new, plant-specific AMP. The staff's evaluations of the RAIs submitted regarding the original Monitoring and Collection Systems Inspection Program are documented below. The resolutions to these RAIs have been incorporated into the new plant-specific program. The staff's evaluation of the new plant-specific Monitoring and Collection Systems Inspection Program is documented in SER Section 3.0.3.3.8.

Staff Evaluation of RAIs. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M32 and identified inconsistencies with the "parameters monitored or inspected" and "detection of aging effects" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs, discussed below.

The "parameters monitored or inspected" program element of GALL Report AMP XI.M32 recommends that inspections be performed by personnel qualified in accordance with ASME Code and 10 CFR Part 50, Appendix B. The staff noted the applicant did not elaborate on the inspecting personnel's qualifications in the LRA or program basis document. By letter dated July 15, 2010, the staff issued RAI B.2.A-1 requesting the applicant to provide details on the qualifications and training requirements for its personnel assigned to perform the inspections and its conformance to the applicable ASME Codes.

In its response, dated September 13, 2010, the applicant stated that personnel performing the visual examinations, UT, or other NDE techniques, as outlined in ASME Sections V and XI, will be trained in accordance with ASME Code requirements. The applicant further stated that training requirements for all inspections will be consistent to 10 CFR Part 50, Appendix B. The staff finds the applicant's response acceptable because, once updated, the One-Time Inspection Program will require inspecting personnel to be trained and qualified consistent with applicable ASME Code requirements and with 10 CFR Part 50, Appendix B. The staff's concern described in RAI B.2.A-1 is resolved.

GALL Report AMP XI.M32 recommends that “the inspection includes a representative sample of the system population, and where practical, focuses on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin.” However, under the “detection of aging effects” program element description, the applicant stated that the sample population will be determined by engineering evaluation based on sound statistical sampling methodology. By letter dated July 15, 2010, the staff issued RAI B.2.A-2 requesting that the applicant provide details on the proposed sampling methodology.

In its response dated September 13, 2010, the applicant stated that the selected components will be those most susceptible to aging effects defined by time in service, severity of operating conditions, and design margins. The applicant provided a flow chart that described how the sample size would be selected based on the discrete number of components in the population. The applicant also stated that for a population size of 21–200 components, 5 percent of the components would be inspected, and a minimum sample size of one component would be inspected for populations of less than 20. The applicant further stated that supplemental inspection sample sizes would be determined as part of the corrective action process. However, the staff noted that large sample sizes may be required to adequately confirm an aging effect is not occurring because of the uncertainty in determining the most susceptible locations and the potential for aging to occur in other locations. By letter dated December 3, 2010, the staff issued RAI B.2.A-3 requesting that the applicant provide technical justification for ensuring, based on the sample size chosen, that the components not inspected are not experiencing degradation.

In its response dated January 20, 2011, the applicant stated that the Monitoring and Collection Systems Inspection Program will be revised to become a plant-specific program and will no longer be a One-Time Inspection Program. By letter dated January 28, 2011, the applicant revised its Monitoring and Collection Systems Inspection Program to become a new plant-specific AMP. The applicant stated that the new plant-specific program will include baseline inspections of 20 percent of the population of each material, environment, and aging effect group, with up to a maximum of 25 inspections per group. The applicant also stated that the inspections will be focused on the components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margins. The staff finds the applicant’s response acceptable because the applicant’s sampling methodology ensures that a representative sample of material and environment combinations is considered, ensures sample locations will focus on the most susceptible components, and includes an appropriate sample size. The staff’s concerns described in RAIs B.2.A-2 and B.2.A-3 are resolved.

The staff issued RAIs 3.3.2.1-Y4, 3.3.2.2.7.2-1, 3.3.2.2.10.2-1, and 3.3.1.68-1 as a result of reviewing AMR items that credit this program. These RAIs requested that the applicant justify the use of a One-Time Inspection Program when the aging effect of loss of material could not necessarily be ruled out with reasonable confidence.

In its response, dated January 28, 2011, the applicant revised its Monitoring and Collection Systems Inspection Program to become a new plant-specific AMP, which includes baseline inspections performed within the 10-year period prior to the period of extended operation of a sample population to characterize the material condition of the components, followed by opportunistic inspections when components are opened for maintenance, repair, or surveillances. The new plant-specific program also includes review of inspection findings to ensure that each material exposed to either outdoor air or raw water has been examined by opportunistic inspection in a 5-year period or appropriate actions will be taken to ensure an inspection is performed if opportunistic inspections have not occurred. The staff's evaluation of the applicant's new plant-specific Monitoring and Collection Systems Inspection Program is documented in SER Section 3.0.3.3.8. The staff's concerns described in RAI 3.3.2.1-Y4, RAI 3.3.2.2.7.2-1,and RAI 3.3.2.2.10.2-1 and its resolutions are documented in SER Sections 3.3.2.1.2, 3.3.2.2.7, and 3.3.2.2.10, respectively.

Conclusion. On the basis of its review, the staff concludes that the applicant is no longer claiming its program is consistent with GALL Report AMP XI.M32. The staff's evaluation, acceptance, and conclusion on the adequacy of the applicant's new plant-specific Monitoring and Collection Systems Inspection Program is documented in SER Section 3.0.3.3.8.

3.0.3.1.24 Reactor Head Closure Studs

Summary of Technical Information in the Application. LRA Section B.2.45 describes the existing Reactor Head Closure Studs Program as consistent with GALL Report AMP XI.M3, "Reactor Head Closure Studs." The applicant stated that the program manages cracking due to SCC and loss of material due to corrosion for the reactor head closure stud assemblies (studs, nuts, washers, and bushings). The applicant also stated that the inspection of RV stud assemblies is performed in accordance with ASME Code, Section XI, Subsection IWB, Table IWB 2500-1 (2003 addenda), which includes volumetric examinations rather than the surface examinations called out in paragraph NB-2545 or NB-2546 of Section III of the ASME Code. The applicant further stated that ultimate tensile stress for the studs and nuts (SA-540 Grade B23 or B24) is less than the 1,172 MPa (170 ksi) limitation in RG 1.65. The applicant further stated that there are no metal platings applied to the applicant's closure studs, nuts, or washers, and a phosphate coating is applied to threaded and bearing areas of studs and nuts to act as a rust inhibitor and to assist in retaining lubricant on these surfaces.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M3. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.M3, with the exception of the "scope of program" and "detection of aging effects" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

The staff also noted that the GALL Report states that the GALL Report AMP XI.M3 includes ISI to detect cracking due to SCC or IGSCC, loss of material due to wear, and coolant leakage from RV closure stud bolting for both BWRs and pressurized-water reactors (PWRs). In addition, the "detection of aging effects" program element of the GALL Report AMP XI.M3 states that inspection can reveal cracking, loss of materials due to corrosion or wear, and leakage of coolant. The staff further noted that, in the program description of LRA Section B.2.45, the applicant stated that its program manages cracking due to SCC and loss of material due to corrosion for the reactor head closure stud assemblies (studs, nuts, washers, and bushings). The applicant further stated that this is an existing program that is consistent with GALL Report AMP XI.M3 "Reactor Head Closure Studs." It was not clear to the staff that the loss of material due to wear was addressed either in the LRA program description or in relation to "detection of aging effects" program element.

By letter dated June 24, 2010, the staff issued RAI B.2.45-1 requesting that the applicant verify that its program also manages the loss of material due to wear or justify why wear is not considered as a significant degradation mechanism.

In its response dated August 19, 2010, the applicant stated that the its Reactor Head Closure Studs Program manages the loss of material due to wear by performing the ASME Code-required examinations.

Based on its review, the staff finds the applicant's response to RAI B.2.45-1 acceptable because the applicant confirmed its Reactor Head Closure Studs Program is consistent with the recommendations in the GALL Report by managing loss of material due to wear. The staff's concern described in RAI B.2.45-1 is resolved.

In its review related to the "detection of aging effects" program element, the staff noted that LRA Section B.2.45 states that the Reactor Head Closure Studs Program examines RV stud assemblies in accordance with the examination and inspection requirements specified in Table IWB-2500-1. The applicant further stated that inspections include VT-1 visual examination of the nuts, washers, and bushing and volumetric examination of studs and threads, and VT-2 inspections for leak detection are performed during system pressure tests. The applicant further stated that the inspection of the RV closure stud assemblies is performed in accordance with ASME Code, Section XI, Subsection IWB, Table IWB 2500-1 (2003 addenda), which includes volumetric examinations rather than the surface examinations.

The staff noted that, in its current plan, the applicant has a RFO every 2 years. The staff also noted that the "detection of aging effects" program element of GALL Report AMP XI.M3 recommends Examination Category B-G-1 for pressure-retaining bolting greater than 2 in. in diameter in RVs, which is based on the 1995 edition of the ASME Code. The staff further noted that the 1995 edition of the ASME Code specifies volumetric examination of studs in place or surface and volumetric examination of studs when removed.

The staff noted that the ASME Code inspection requirements for RPV head closure studs have evolved between the 1995 Edition and the 2001 Edition of ASME Section XI so that the inspection requirements were made less prescriptive with regard to the conditions of inspections and more flexible with respect to the type of examinations. The staff also noted that the use of the 2001 edition of ASME Code Section XI, inclusive of 2002 and 2003 addenda, is consistent with the program description in GALL Report AMP XI.M3. The staff further noted that although the applicants ISI Program performs volumetric examination of the closure studs and does not include surface examination, the applicant's procedures for ultrasonic examination specify that, as a supplemental examination, a magnetic particle or liquid penetrant examination should be performed in the localized area of the indication for further confirmation, if possible. In addition, the staff noted that because cracking would initiate on the outside diameter of the closure studs, ASME Code Case N-652-1 provides an alternative to examination Category B-G-1 by indicating that either a surface or volumetric examination is acceptable when the closure bolts are removed for examination. The staff also noted that RG 1.147, Revision 15 has approved the use of Code Case N-652-1 unconditionally.

However, in its review of LRA Appendix C, Table C-11, the staff noted that the table addresses license renewal Applicant Action Item 1 associated with the NRC SER for BWRVIP-74 "BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines." In LRA Table C-11, the applicant's plant-specific response to the action item states the following:

> The BWR Vessel Internals Program requires the inspection and evaluation guidelines of this BWRVIP report to be implemented at Columbia. Site procedures require a technical justification to be documented for any deviation from the guidelines. Columbia has not identified any deviation from the BWRVIP-74-A guidelines. Therefore, Columbia is bounded by the BWRVIP-74-A report.
>
> Columbia commits to programs described as necessary in the BWRVIP report to manage the effects of aging during the period of extended operation. Commitments are administratively controlled in accordance with the requirements of 10 CFR 50 Appendix B.

The staff noted that Section 4.1.2 of the BWRVIP-74-A report states that vessel closure head studs (Category B-G-1, greater than 2 in. in diameter) require ultrasonic examination when the examination is done in place and both a surface and an ultrasonic examination if vessel closure studs are removed for examination. Therefore, the staff found the need to confirm that the applicant's program performs volumetric examination of the studs in place since the applicant indicated that its program includes only volumetric examination. By letter dated June 24, 2010, the staff issued RAI B.2.45-2 requesting the applicant to clarify that the existing Reactor Head Closure Studs Program includes volumetric examination of the studs in place.

In its response dated August 19, 2010, the applicant stated that the current Reactor Head Closure Studs Program includes inspection, in accordance with ASME Section XI 2001 Edition, 2003 Addenda. The applicant also stated that Table IWB-2500-1 of this addendum requires only a volumetric examination of the RPV closure studs, which can be performed with the studs in place under tension, when the joint is disassembled, or when the stud is removed. The applicant further added that future examinations of the RV stud assemblies will comply with the examination and inspection requirements specified in ASME, Section XI, Table IWB-2500-1, as modified and limited in the 10 CFR 50.55a rule, that are considered acceptable by the staff in the *Federal Register* Notice for future 10 CFR 50.55a amendments.

The applicant also stated that the objective of BWRVIP-74-A is to demonstrate that NRC-approved inspection and AMPs for the current term are also adequate for a 20-year license renewal term. The applicant also stated that since it has not reached the period of extended operation, the requirements are not applicable for the CLB. The applicant further stated that if at the period of extended operation both volumetric and surface examinations of the removed studs are determined to be a BWRVIP-74-A mandatory or needed requirement, the applicant will either comply with the requirement or complete any applicable deviation dispositions. In addition, the applicant stated that Section 4.1.2 of BWRVIP-74-A describes the examination requirements of ASME, Section XI for the individual items identified by examination category. The applicant also indicated that the discussion in Section 4.1.2 applies to the BWRVIP program requirements as it appears in the 1989 Edition of ASME, Section XI, except where noted.

Based on its review, the staff finds the applicant's response to RAI B.2.45-2 acceptable because the applicant clarified the following:

- The current Reactor Head Closure Studs Program includes inspections, in accordance with ASME Code Section XI, 2001 Edition, 2002 and 2003 Addenda, consistent with GALL Report AMP XI.M3.

- If, at the period of extended operation, both volumetric and surface examinations of the removed studs are determined to be a BWRVIP-74-A mandatory or needed requirement, the applicant will either comply with the requirement of performing both volumetric and surface examinations or complete any applicable deviation dispositions.

The staff's concern described in RAI B.2.45-2 is resolved.

Based on its audit and review of the applicant's responses to RAIs B.2.45-1 and B.2.45-2, the staff finds that Elements one through six of the applicant's Reactor Head Closure Studs Program are consistent with the corresponding program elements of GALL Report AMP XI.M3 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.45 summarizes operating experience related to the Reactor Head Closure Studs Program. The applicant stated that a review of Columbia operating experience (i.e., CRs, work orders, etc.) has not revealed any reactor head closure stud cracking or loss of material. The applicant further stated that the existing program is adequately managing the aging of the reactor head closure studs to maintain the intended function, and it will continue to do so for the period of extended operation.

The applicant further stated that a review of industry operating experience since January 2005 for ASME, Section XI, ISI of reactor head closure stud assemblies, indicates the following:

- no recordable indication at Duane Arnold Energy Center
- no aging effects attributed to wear, loss of material, or SCC at Crystal River
- no cracking due to SCC or IGSCC at Palo Verde
- two non-recordable indications for studs, one non-recordable indication for washers, and one recordable indication for studs that was evaluated as satisfactory at Cooper

The applicant also stated that operating experience assures that implementation of the Reactor Head Closure Studs Program will manage the effects of aging such that applicable components will continue to perform its intended functions consistent with the CLB for the period of extended operation.

The staff reviewed operating experience information, in the application and during the audit, to determine whether the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant had adequately incorporated and evaluated operating experience related to this program. In addition, the staff confirmed that the applicant addressed operating experience identified after issuance of the GALL Report. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.45 provides the UFSAR supplement for the Reactor Head Closure Studs Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.1-2. The staff also notes that the applicant committed (Commitment No. 45) to ongoing implementation of the existing Reactor Head Closure Studs Program for managing aging of applicable components during the period of extended operation.

As described in the aforementioned evaluation, the staff also noted that LRA Appendix C, Table C-11 contained the applicant's response to license renewal Applicant Action Item 1 associated with NRC SER for BWRVIP-74 "BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines." As evaluated above, the staff's concern described in RAI B.2.45-2 is resolved because the applicant clarified the following:

- The current Reactor Head Closure Studs Program includes inspections, in accordance with ASME Code Section XI, 2001 Edition, 2002 and 2003 Addenda, consistent with the program description of GALL Report AMP XI.M3.
- If, at the time of the period of extended operation, both volumetric and surface examinations of the removed studs are determined to be a BWRVIP-74-A mandatory or needed requirement, the applicant will either comply with the requirement or complete any applicable deviation dispositions.
- The inspection requirements in Section 4.1.2 of BWRVIP-74-A are mainly based on 1989 Edition of ASME Section XI.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Reactor Head Closure Studs Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.25 RV Surveillance

Summary of Technical Information in the Application. LRA Section B.2.46 describes the existing RV Surveillance Program as consistent with GALL Report AMP XI.M31, "Reactor Vessel Surveillance." The RV Surveillance Program manages the effects of aging due to radiation embrittlement on the fracture toughness properties for low allow steels in the RV. The RV Surveillance Program is part of the BWRVIP Integrated Surveillance Program (ISP), which includes multiple BWRs. The applicant stated that testing of surveillance capsules and reporting of surveillance data by the BWRVIP ISP is performed in accordance with 10 CFR Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements," and American Society for Testing and Materials (ASTM) Standard Practice E 185-82, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels," which is incorporated by reference into 10 CFR Part 50, Appendix H, for the period of extended operation. The NRC approved the use of the BWRVIP ISP in place of a unique plant-specific program for Columbia. The BWRVIP ISP has been revised for license renewal, as documented in BWRVIP-116, "BWR Vessel and Internals Project, Integrated Surveillance

Program (ISP) Implementation for License Renewal, (BWRVIP-116)," July 29, 2003, to ensure representative capsules are irradiated to fluence levels corresponding to the end of the period of extended operation.

The BWRVIP ISP conducts tests on material surveillance capsules in BWR plants, as well as supplemental capsules irradiated in host plants, to provide data that bounds all operating BWR plants. According to the applicant, no surveillance capsules from Columbia are included in the BWRVIP ISP; however, the Columbia surveillance capsules will continue to be maintained in the RV in standby (deferred) status, as required by the BWRVIP ISP. Capsules from host plants will be removed and tested, in accordance with the ISP implementation plan defined in BWRVIP-86-A, "BWR Vessel and Internals Project, Updated BWR Integrated Surveillance Program (ISP) Implementation Plan," September 2008. Results from these tests that are applicable to Columbia will provide the necessary data to monitor embrittlement for the Columbia RV. Columbia will apply the applicable results of the ISP capsule testing to Columbia.

The applicant stated the RV Surveillance Program manages the reduction in fracture toughness due to neutron embrittlement for the low alloy steel RV beltline shell and weld materials. The neutron fluence values used for the projections of neutron embrittlement effects are determined using an NRC-approved methodology, as described in LRA Section 4.2.1. The exposure conditions of the RV are monitored to ensure that it continues to be consistent with those used to project the effects of embrittlement to the end of the extended license term. If the RV exposure conditions (neutron flux, spectrum, irradiation temperature, etc.) are altered, then the basis for the projection to 60 years is reviewed. If deemed appropriate, a revised fluence projection is prepared, and the effects of the revised fluence analysis on neutron embrittlement calculations will be evaluated.

The AMP monitors changes in these RV materials' Charpy upper-shelf energy (USE) values and nil-ductility transition temperature (RT_{NDT}) values, due to the effects of neutron irradiation embrittlement, in accordance with 10 CFR Part 50, Appendix H. The applicant stated that the determination of neutron embrittlement effects (Adjusted RT_{NDT} (ART) and USE) for Columbia fully complies with NRC RG 1.99, Revision 2 "Radiation Embrittlement of Reactor Vessel Materials," May 1988. The extent of RV embrittlement, with respect to USE and ART, is projected for 60 years in accordance with RG 1.99, Revision 2, as described in LRA Sections 4.2.2 and 4.2.3. These projections will be updated throughout the remaining operating life if new information (e.g., material data from the ISP capsules applicable to Columbia or revised fluence values) becomes available.

Pressure-Temperature (P-T) limits will be managed as a TLAA under this AMP for the period of extended operation, as described in LRA Section 4.2.4. This AMP will also monitor the effective full power years (EFPY) accumulated by the reactor and ensure that the P-T limit curves contained in plant TSs are updated periodically such that it is always valid beyond the EFPY that the plant has accumulated. Participation in the BWRVIP ISP will ensure that changes to radiation embrittlement information will be factored into the determination of P-T limits in a timely fashion. ART values are used for developing P-T limit curves and are calculated using the procedures of RG 1.99, Revision 2. The calculation methodologies in RG 1.99, Revision 2 for the ART prescribe the use of either chemistry factor data from the RG in accordance with Regulatory Position (RP) 1.1, or the use of credible surveillance capsule data from the BWRVIP ISP in accordance with RP 2.1 from the RG. All surveillance data for the Columbia RV is obtained through the testing of applicable of BWRVIP ISP RV surveillance capsules and the analysis of applicable BWRVIP ISP surveillance data.

The Columbia RV Surveillance Program requires that untested capsules either be returned to the RV or maintained in storage for possible future reinsertion. As no Columbia capsules are scheduled for testing, the disposition of tested capsules is not applicable to Columbia.

Staff Evaluation. The staff reviewed the applicant's description of the Columbia RV Surveillance AMP provided in LRA Section B.2.46 to determine the following:

- whether the AMP is adequate for managing the effects of aging due to radiation embrittlement of low allow steel components in the Columbia RV for the period of extended operation (54 EFPY)
- whether the Columbia RV Surveillance AMP will remain in compliance with the requirements of 10 CFR Part 50, Appendix H for the period of extended operation
- whether the elements of this AMP are consistent with 10 elements of an effective RV Surveillance Program, as described in GALL Report AMP XI.31

Per the requirements of 10 CFR Part 50, Appendix H, the design of RV Surveillance Programs must meet the requirements of the edition of the ASTM E 185. Additionally, 10 CFR Part 50, Appendix H specifies that later editions of ASTM E 185 may be used but including only those editions through 1982 (ASTM E 185-82). For each surveillance capsule withdrawal, 10 CFR Part 50, Appendix H states that the testing and reporting criteria must meet the requirements of ASTM E 185-82, to the extent practical for the configuration of the specimens in the capsule.

The applicant stated in LRA Section B.2.46 that the Columbia RV Surveillance AMP is part of the BWRVIP ISP. The BWRVIP ISP is an NRC-approved program that implements the requirements of 10 CFR Part 50, Appendix H. The NRC approved the applicant's implementation of the BWRVIP ISP in place of a unique RV Surveillance Program at Columbia. Testing of surveillance capsules and reporting of surveillance data by the BWRVIP ISP is performed in accordance with the requirements of ASTM E 185-82. Therefore, the applicant's implementation of the ASTM E 185-82 standard through its participation in the BWRVIP ISP meets these 10 CFR Part 50, Appendix H requirements.

The BWRVIP ISP was revised to address extended license terms for BWR plants to support operation of RVs at participating plants through the completion of each facility's extended period of operation (60-year operating license). The technical bases for the development and implementation of the ISP for the period of extended operation (ISP(E)) are documented in the July 29, 2003 BWRVIP-116 report, as supplemented by BWRVIP letter dated January 11, 2005, which included the BWRVIP's responses to the NRC staff's RAI concerning BWRVIP-116. The staff reviewed the BWRVIP-116 report, as supplemented by the BWRVIP's RAI responses, and concluded that the BWRVIP ISP(E) meets the requirements of 10 CFR Part 50, Appendix H, for the period of extended operation, as discussed in the NRC staff's final safety evaluation for BWRVIP-116, dated March 1, 2006. The BWRVIP-116 ISP(E) guidelines ensure that representative capsules are irradiated to fluence levels corresponding to the end of the period of extended operation, as required by 10 CFR Part 50, Appendix H.

The staff reviewed LRA Section B.2.46 to determine if the Columbia RV Surveillance Program elements are consistent with the eight elements of an acceptable RV Surveillance Program specified in GALL Report AMP XI.31. The staff's review of these program elements is discussed below.

Element 1. GALL Report AMP XI.31, Element 1 states that the extent of RV neutron embrittlement, with respect to USE and P-T limits, is projected for 60 years in accordance with the RG 1.99, Revision 2. When using RG 1.99, Revision 2, an applicant may use Tables 1 and 2 in RG 1.99, Revision 2 to project the extent of RV neutron embrittlement for the period of extended operation based on materials' copper and nickel content, as described RP 1 in RG 1.99, Revision 2. Otherwise, the applicant may project RV neutron embrittlement using credible surveillance data based on a best fit to the surveillance data, as described in RP 2 in RG 1.99, Revision 2. It is understood that this specific program element applies to all ferritic RV beltline materials, specifically those ferritic RV pressure boundary materials projected to undergo exposure to high energy neutron fluence greater than $1x10^{17}$ n/cm^2 (E > 1.0 MeV) through the end of the period of extended operation.

The Columbia RV Surveillance AMP requires that the effects of RV neutron embrittlement, with respect to USE and ART, be projected in accordance with RG 1.99, Revision 2. The Columbia P-T limits are a TLAA that will be managed for the period of extended operation, pursuant to 10 CFR 54.21(c)(1)(iii), as described in LRA Section 4.2.4 and evaluated by the staff in SER Section 4.2.4. As the Columbia P-T limit curves are calculated based, in part, on the ART value for the limiting RV beltline material, the staff determined that the statement in LRA Section B.2.46 that the ART values are projected for 60 years, in accordance with RG 1.99, Revision 2, is consistent with the statement in GALL Element 1 that the extent of RV neutron embrittlement, with respect to P-T limits, is projected for 60 years in accordance with the RG 1.99, Revision 2.

The staff's review of the applicants TLAAs for USE and ART are discussed in SER Sections 4.2.2 and 4.2.3, respectively. Based on its review of these TLAAs, the staff determined that the applicant's USE and ART projections are acceptable for all RV beltline components. Therefore, the staff determined that the Columbia RV Surveillance AMP is consistent with Element 1 from GALL Report AMP XI.M31.

Element 2. GALL Report AMP XI.31, Element 2 states that determinations of neutron embrittlement for RV beltline materials based on RP 1 in RG 1.99, Revision 2 are subject to the applicable limitations in RP 1.3 of the RG. The limitations are based on material properties, temperature, material chemistry, and neutron fluence. The staff reviewed the applicant's RV Surveillance Program description in LRA Section B.2.46, as well as the TLAAs related to neutron embrittlement projections for RV beltline materials, and determined that the applicant's neutron embrittlement projections based on RP 1 in RG 1.99, Revision 2 are bounded by the subject limitations in RP 1.3 of RG 1.99, Revision 2. Therefore, the staff determined that the applicant's RV surveillance AMP is consistent with GALL Report AMP XI.M31, Element 2.

Element 3. GALL Report AMP XI.31, Element 3 states that determinations of neutron embrittlement for RV beltline materials using surveillance data are subject to the applicable bounds of the surveillance data, such as neutron fluence and irradiation temperature. The staff determined that the applicant's participation in the BWRVIP ISP, including the ISP(E), as discussed in LRA Section B.2.46, will ensure that any embrittlement calculations for Columbia's RV using ISP(E) surveillance capsules are appropriately bounded by the applicable exposure parameters of the surveillance data. Only ISP capsule materials that are applicable to Columbia RV beltline materials will be used to monitor embrittlement for the Columbia RV. The exposure conditions of the RV are monitored to ensure that it continues to be consistent with those used to project the effects of embrittlement to the end of the extended license term, including the exposure conditions of the applicable ISP surveillance capsules, as discussed in LRA

Section B.2.46. Therefore, the staff determined that the applicant's RV Surveillance AMP is consistent with GALL Report AMP XI.M31, Element 3.

Element 4. GALL Report AMP XI.31, Element 4 states that all pulled and tested surveillance capsules, unless discarded before August 31, 2000, shall be placed in storage to be saved for possible reconstitution and use. LRA Section B.2.46 states that no Columbia surveillance capsules are scheduled for testing; therefore, "the disposition of tested capsules is not applicable to Columbia." The staff noted that although Columbia currently has no surveillance capsules scheduled for testing under the ISP, there are two standby surveillance capsules in the Columbia RV. The staff noted that the criteria of this program element are still applicable to all surveillance capsules, both tested and untested, because future changes to the ISP(E) may require that standby surveillance capsules be made available for testing even if the standby capsules are not currently scheduled for testing. As stated in LRA Section B.2.46, this AMP specifically requires that untested standby capsules that are pulled from the RV either be returned to the RV or maintained in storage for possible future reinsertion. It is understood that proper maintenance of pulled and untested standby capsules is required so that the capsules can be made available for possible future testing under the BWRVIP ISP(E). Therefore, if Columbia's standby capsules are eventually pulled and tested, the requirements of this program element would apply.

By letter dated August 3, 2010, the staff issued RAI B.2.46 requesting that the applicant clarify the statement in LRA Section B.2.46 that "the disposition of tested capsules is not applicable to Columbia."

In its response dated September 26, 2010, the applicant stated that the only Columbia RV surveillance capsules are those standby capsules that are currently in place in the RV. The Columbia RV Surveillance Program required these capsules to remain in place as deferred/standby capsules for possible future use by the BWRVIP ISP. The applicant further stated that Energy Northwest acknowledges that if standby surveillance capsules are eventually scheduled for testing, then the tested capsules will be stored by the ISP for possible re-constitution in the future. The staff found the applicant's response to RAI B.2.46 acceptable because the applicant acknowledged that the criteria of this program element are applicable to the Columbia standby surveillance capsules if these capsules are eventually tested under the ISP and ISP(E). Therefore, based on the information provided in LRA Section B.2.46 and the applicant's response to RAI B.2.46, the staff determined that the applicant's RV Surveillance AMP is consistent with GALL Report AMP XI.M31, Element 4.

Element 5. GALL Report AMP XI.31, Element 5 states that if an applicant has a surveillance program that consists of capsules with a projected fluence of less than the 60-year RV fluence at the end of 40 years, at least one capsule is to remain in the RV and is tested during the period of extended operation. The applicant may either delay withdrawal of the last capsule or withdraw a standby capsule during the period of extended operation to monitor the effects of long-term exposure to neutron irradiation.

The staff reviewed the applicant's description of the Columbia RV Surveillance AMP in LRA Section B.2.46 and determined that the applicant's participation in the staff-approved BWRVIP ISP including the ISP(E) ensures that the Columbia RV Surveillance AMP is consistent with this program element because the ISP's capsule withdrawal schedule is bounded by the above criteria. Therefore, based on the information provided in LRA Section B.2.46, the staff determined that the applicant's RV Surveillance AMP is consistent with GALL Report AMP XI.M31, Element 5.

Element 6. GALL Report AMP XI.31, Element 6 states that if an applicant has a surveillance program that consists of capsules with a projected fluence exceeding the 60-year RV fluence at the end of 40 years, the applicant withdraws one capsule at an outage in which the capsule receives a neutron fluence equivalent to the 60-year RV fluence and tests the capsule in accordance with the requirements of ASTM E 185. Any capsules that are left in the RV shall provide meaningful metallurgical data (i.e., the capsule fluence does not significantly exceed the RV fluence at an equivalent of 60 years). Other standby capsules are removed and placed in storage. These standby capsules (and archived test specimens available for reconstitution) would be available for reinsertion into the reactor if additional license renewals are sought (e.g., 80 years of operation). If all surveillance capsules have been removed, operating restrictions are to be established to ensure that the plant is operated under conditions to which the surveillance capsules were exposed. The exposure conditions of the RV are monitored to ensure that it continues to be consistent with those used to project the effects of embrittlement to the end of the period of extended operation. If the RV exposure conditions (neutron flux, spectrum, irradiation temperature, etc.) are altered, then the basis for the projection to 60 years is reviewed; and, if deemed appropriate, an active surveillance program is reinstituted. Any changes to the RV exposure conditions and the potential need to reinstitute a Vessel Surveillance Program is discussed with the NRC staff prior to changing the plant's licensing basis.

The staff reviewed the applicant's description of the Columbia RV Surveillance AMP in LRA Section B.2.46 and determined the following:

- The applicant's participation in the staff-approved BWRVIP ISP including the ISP(E) ensures that the Columbia RV Surveillance AMP is consistent with this program element because the ISP's capsule withdrawal schedule is bounded by the above criteria.
- The AMP appropriately requires that standby capsules removed from the Columbia RV be maintained in storage for possible future reinsertion into the RV.
- The AMP requires the monitoring of RV exposure conditions to ensure that it continues to be consistent with those used to project the effects of embrittlement to the end of the period of extended operation.

If the RV exposure conditions (neutron flux, spectrum, irradiation temperature, etc.) are altered, then the basis for the projection to 60 years is reviewed; and, if deemed appropriate, a revised fluence projection is prepared and the effects of the revised fluence analysis on neutron embrittlement calculations will be evaluated, as stated in LRA Section B.2.46. Therefore, based on the information provided in LRA Section B.2.46, the staff determined that the applicant's RV Surveillance AMP is consistent with GALL Report AMP XI.M31, Element 6.

Element 7. GALL Report AMP XI.31, Element 7 states that applicants without in-vessel capsules use alternative dosimetry to monitor neutron fluence during the period of extended operation, as part of the AMP for RV neutron embrittlement. The staff determined that there are two standby surveillance capsules in the Columbia RV. The applicant stated that the exposure conditions of the RV are monitored to ensure that it continues to be consistent with those used to project the effects of embrittlement to the end of the license term. Therefore, based on the information provided in LRA Section B.2.46, the staff determined that the applicant's RV Surveillance AMP is consistent with GALL Report AMP XI.M31, Element 7.

Element 8. GALL Report AMP XI.31, Element 8 states that the applicant may choose to demonstrate that the materials in the RV inlet, outlet, and safety injection nozzles are not controlling, so that such materials need not be added to the Material Surveillance Program for the license renewal term. Based on its review of the TLAAs provided in LRA Section 4.2, as amended, the staff determined that none of the RV beltline nozzle or nozzle weld materials are controlling with respect to either the projected 54 EFPY ART or USE values. Therefore, based on the information provided in LRA Section B.2.46, the staff determined that the applicant's RV Surveillance AMP is consistent with GALL Report AMP XI.M31, Element 8.

The staff determined that all aspects of the applicant's RV Surveillance AMP, as described in LRA Section B.2.46 are consistent with the eight elements of an acceptable RV surveillance AMP specified in GALL Report AMP XI.31.

Operating Experience. LRA Section B.2.46 summarizes operating experience related to the RV Surveillance Program. The applicant stated that it participates in the BWRVIP ISP, as described in reports BWRVIP-86-A and BWRVIP-116. Participation in the ISP ensures that future operating experience from all participating BWRs will be factored into the RV Surveillance Program. The applicant also identified no issues related to RV embrittlement based on its operating experience. The applicant further stated that future operating experience will be captured through the normal operating experience review process, which will continue through the period of extended operation.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. In LRA Section A.1.2.46, the applicant provided an UFSAR supplement summary description for the RV Surveillance Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.1-2. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's RV Surveillance Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.26 Selective Leaching Inspection

Summary of Technical Information in the Application. LRA Section B.2.47 describes the new Selective Leaching Inspection Program as consistent with GALL Report AMP XI.M33, “Selective Leaching of Materials.” In the LRA, the applicant describes the Selective Leaching Inspection Program as a One-Time Inspection Program, which will detect and characterize the conditions on internal and external surfaces exposed to raw water, treated water, fuel oil, soil, and moist air environments. The one-time inspection will use visual inspection and hardness testing to identify the occurrence and extent of selective leaching. In addition, the applicant states that it will implement the Selective Leaching Inspection Program prior to the period of extended operation.

Staff Evaluation. During its audit, the staff reviewed the applicant’s claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant’s program to the corresponding elements of GALL Report AMP XI.M33. As discussed in the audit report, the staff confirmed that these elements are consistent with the corresponding elements of GALL Report AMP XI.M33. Based on its audit, the staff finds that Elements one through six of the applicant’s Selective Leaching Inspection Program are consistent with the corresponding program elements of GALL Report AMP XI.M33 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.47 summarizes operating experience related to the Selective Leaching Inspection Program. The applicant stated that selective leaching is a new one-time inspection activity for which plant operating experience has shown no occurrence of selective leaching. Further, the applicant stated that it follows industry initiatives with respect to inspections for selective leaching.

The staff performed an independent search for leaching in the site operational experience (for the past 10 years) and found no selective leaching of materials documented. In addition, the staff reviewed the applicant’s internal response to NRC IN 94-59. The staff identified that the applicant responded to the IN by identifying conditions that had led to selective leaching and confirming that it was not applicable or were being actively managed at Columbia. Further, the staff reviewed Columbia operating procedures for evaluating industrial experience. The staff confirmed that Columbia reviews industrial experience for applicability to site-specific components and materials and is aware of industrial experience applicable to selective leaching.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant had adequately incorporated and evaluated operating experience related to this program.

During its review, the staff found no operating experience to indicate that the applicant’s program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant’s program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.47 provides the UFSAR supplement for the Selective Leaching Inspection Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.1-2, 3.2-2, and 3.3-2. The staff also notes that the applicant committed (Commitment No. 47) to implement the new Selective Leaching Inspection Program prior to entering the period of extended operation for managing aging of applicable components.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Selective Leaching Inspection Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.27 Service Air System Inspection

LRA Section B.2.48 originally described the new Service Air System Inspection Program as consistent with GALL Report AMP XI.M32, "One-Time Inspection." During its review, the staff identified inconsistencies in the use of a One-Time Inspection Program to manage aging for components for which the GALL Report recommends an aging effect. As a result, by letter dated January 28, 2011, the applicant revised its Service Air System Inspection Program to become a new, plant-specific AMP. The staff's evaluations of the RAIs submitted regarding the original Service Air System Inspection Program are documented below. The resolutions to these RAIs have been incorporated into the new plant-specific program. The staff's evaluation of the new plant-specific Service Air System Inspection Program is documented in SER Section 3.0.3.3.11.

Staff Evaluation of RAIs. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M32 and identified inconsistencies with the "parameters monitored or inspected" and "detection of aging effects" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs, discussed below.

The "parameters monitored or inspected" program element of GALL Report AMP XI.M32 recommends that inspections be performed by personnel qualified in accordance with ASME Code and 10 CFR Part 50, Appendix B. The staff noted that the applicant did not elaborate on the inspecting personnel's qualifications in the LRA or program basis document. By letter dated July 15, 2010, the staff issued RAI B.2.A-1 asking the applicant to provide details on the qualifications and training requirements for its personnel assigned to perform the inspections and its conformance to the applicable ASME Codes.

In its response dated September 13, 2010, the applicant stated that personnel performing the visual examinations, UT, or other NDE techniques, as outlined in ASME Sections V and XI are trained in accordance to ASME Code requirements. The applicant further stated that training requirements for all inspections will be consistent with 10 CFR Part 50, Appendix B.

The staff finds the applicant's response acceptable because, once implemented, the One-Time Inspection Program ensures inspections are performed by qualified personnel following procedures consistent with the ASME Code and 10 CFR Part 50, Appendix B. The staff's concern described in RAI B.2.A-1 is resolved.

GALL Report AMP XI.M32 recommends that "the inspection includes a representative sample of the system population, and where practical, focuses on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin." However, under the "detection of aging effects" program element description, the applicant stated that the sample population will be determined by engineering evaluation based on sound statistical sampling methodology. By letter dated July 15, 2010, the staff issued RAI B.2.A-2 requesting that the applicant provide details on the proposed sampling methodology.

In its response dated September 13, 2010, the applicant stated that the selected components will be those most susceptible to aging effects defined by time in service, severity of operating conditions, and design margins. The applicant provided a flow chart that described how the sample size would be selected based on the discrete number of components in the population. The applicant also stated that for a population size of 21–200 components, 5 percent of the components would be inspected, and a minimum sample size of one component would be inspected for populations of less than 20. The applicant further stated that supplemental inspection sample sizes would be determined as part of the corrective action process. However, the staff noted that large sample sizes may be required to adequately confirm an aging effect is not occurring because of the uncertainty in determining the most susceptible locations and the potential for aging to occur in other locations. By letter dated December 3, 2010, the staff issued RAI B.2.A-3 requesting that the applicant provide technical justification for ensuring, based on the sample size chosen, that the components not inspected are not experiencing degradation.

In its response dated January 20, 2011, the applicant stated that the Service Air System Inspection Program will be revised to become a plant-specific program and will no longer be a One-Time Inspection Program. By letter dated January 28, 2011, the applicant revised its Service Air System Inspection Program to become a new plant-specific AMP. The applicant stated that the new plant-specific program will include baseline inspections of 20 percent of the population of each material, environment, and aging effect group, with up to a maximum of 25 inspections per group. The applicant also stated that the inspections will be focused on the components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margins. The staff finds the applicant's response acceptable because the applicant's sampling methodology ensures that a representative sample of material and environment combinations is considered, ensures sample locations will focus on the most susceptible components, and includes an appropriate sample size. The staff's concerns described in RAIs B.2.A-2 and B.2.A-3 are resolved.

GALL Report AMP XI.M32 states that use of a one-time inspection is appropriate at the following times:

- when an aging effect is not expected to occur, but the data is insufficient to rule it out with reasonable confidence
- when an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than that generally expected
- when the characteristics of the aging effect include a long incubation period

GALL Report AMP XI.M32 also states that for these cases, the one-time inspection should provide confirmation that either the aging effect is indeed not occurring or the aging effect is occurring very slowly so as not to affect the component or structure's intended function during the period of extended operation.

In LRA Section B.2.48, the applicant stated that its Service Air System Inspection Program will be used to identify loss of material due to general corrosion of steel piping and valves in the Service Air System exposed internally to air. It is not clear to the staff how a One-Time Inspection Program is appropriate to manage loss of material for these material and environment combinations given the following:

- Loss of material is expected to occur for steel piping exposed to outdoor air.
- The GALL Report recommends periodic inspection programs to manage aging for these material and environment combinations.
- A One-Time Inspection Program is only to be used when an aging effect is not expected or is expected to progress very slowly.

By letter dated November 1, 2010, the staff issued RAI B.2.48-1 requesting that the applicant justify how the one-time inspections proposed by the Service Air System Inspection Program are adequate to manage loss of material in the steel piping and valves exposed internally to air by explaining how, for each component managed by the program, one of the following criteria for use of a one-time inspection is satisfied:

- The aging effect is not expected to occur, but the data is insufficient to rule it out with reasonable confidence.
- The aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than that generally expected.
- The characteristics of the aging effect include a long incubation period.

In its response dated January 28, 2011, the applicant revised its Service Air System Inspection Program to become a new plant-specific AMP, which includes baseline inspections performed within the 10-year period prior to the period of extended operation of a sample population to characterize the material condition of the components followed by opportunistic inspections when components are opened for maintenance, repair, or surveillances. The new plant-specific program also includes review of inspection findings to ensure that each material has been examined by opportunistic inspection in each 5-year period or appropriate actions will be taken to ensure an inspection is performed if opportunistic inspections have not occurred. The staff's evaluation of the applicant's new plant-specific Service Air System Inspection Program is documented in SER Section 3.0.3.3.11. The staff finds the applicant's response acceptable because the revised program includes baseline and opportunistic inspections of the subject components to manage loss of material. The staff's concern described in RAI B.2.48-1 is resolved.

Conclusion. On the basis of its review, the staff concludes that the applicant is no longer claiming its program is consistent with GALL Report AMP XI.M32. The staff's evaluation, acceptance, and conclusion on the adequacy of the applicant's new plant-specific Service Air System Inspection Program is documented in SER Section 3.0.3.3.11.

3.0.3.1.28 Small Bore Class 1 Piping Inspection

Summary of Technical Information in the Application. LRA Section B.2.49 describes the new Small Bore Class 1 Piping Inspection Program as consistent with GALL Report AMP XI.M32, "One-Time Inspection." The applicant stated that this is a new one-time inspection that will detect and characterize the conditions on the internal surfaces of small bore Class 1 piping components that are exposed to reactor coolant. The applicant also stated that this one-time inspection will provide physical evidence as to whether, and to what extent, cracking due to SCC or to thermal or mechanical loading has occurred in small bore Class 1 piping components.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M35. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.M35, with the exception of the "detection of aging effects" program element. For this element, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

Under the program element "detection of aging effects," the applicant states that "Columbia has not experienced cracking of small bore Class 1 piping solely due to stress corrosion or thermal and mechanical loading, and therefore this one-time inspection is appropriate." However, the staff noted that a review of the applicant's operating experience indicates that multiple failures of small-bore socket welds have occurred due to cracking from a combination of factors such as fatigue and stress corrosion cracking. The staff also notes that GALL Report AMP XI.M35 recommends the use of the One-Time Inspection of ASME Code Class 1 Small Bore Piping only for those plants that have not experienced cracking of ASME Code Class 1 small-bore piping resulting from stress corrosion or thermal and mechanical loading. For those plants that have experienced cracking, the GALL Report AMP XI.M35 recommends periodic inspection of the subject piping to be managed by a plant-specific AMP. The staff also noted that the applicant stated in the "parameters monitored or inspected" program element that volumetric examinations (destructive or nondestructive) will be performed. The staff further noted that in the "monitoring and trending" program element, the applicant stated that guidelines of EPRI Report 1000701, "Interim Thermal Fatigue Management Guideline (MRP-24)" will be considered in selecting the sample size and locations. The staff noted that EPRI-issued Report 1011955, "Materials Reliability Program Management of Thermal Fatigue in Normally Stagnant Non-Isolable Reactor Coolant System Branch Lines (MRP-146)," in 2005, which is a more recent revision to MRP-24 regarding thermal fatigue issues. Finally, the staff noted that, regarding sample selection, the GALL Report states that, "this number, or sample size, is based on susceptibility, inspectability, dose considerations, operating experience, and limiting locations of the total population of ASME Code Class 1 small-bore piping locations."

By letter dated July 15, 2010, the staff issued RAI B.2.49-1 requesting that the applicant either provide a plant-specific AMP that includes periodic inspections to manage cracking or provide justification why a plant-specific AMP that includes periodic inspections is not necessary for ASME Code Class 1 small-bore piping. The staff also requested that the applicant provide specifics of the volumetric examinations of socket welds for both destructive and NDEs. Furthermore, the staff requested that the applicant explain why an older version of the MRP guidance is used. Finally, the staff requested that the applicant provide specifics regarding methodology of sample selections for both full penetration welds and socket welds for each inspection. In particular, the applicant was asked to state how many Code Class 1 socket welds are in the plant and how many samples will be selected for each inspection.

In its response dated September 13, 2010, the applicant replaced the "Small Bore Class 1 Piping Inspection" Program with a new, plant-specific, "Small Bore Class 1 Piping" Program to address the staff's concern. The staff's review of the plant-specific "Small Bore Class 1 Piping" Program is documented in SER Section 3.0.3.3.13 of this document. The staff's concern described in RAI B.2.49-1 is resolved.

Conclusion. On the basis of its review, the staff concludes that the applicant is no longer claiming its program is consistent with GALL Report AMP XI.M35, and the applicant's aging management of ASME Class 1 small-bore piping and the staff's evaluation is documented in SER Section 3.0.3.3.13. The staff's conclusion on the adequacy of the applicant's Small Bore Class 1 Piping Program is also documented in SER Section 3.0.3.3.13.

3.0.3.1.29 Supplemental Piping and Tank Inspection

Summary of Technical Information in the Application. LRA Section B.2.51 describes the new Supplemental Piping/Tank Inspection Program as consistent with GALL Report AMP XI.M32, "One-Time Inspection." The applicant stated that this program includes inspection of steel, gray cast iron, and stainless steel piping/tanks and related components that are exposed to moist air environments, being managed for loss of material due to general, crevice, galvanic, and pitting corrosion, or MIC. The applicant also stated that the moist air environment included the aggressive alternate wet and dry environment that exists at air-water interfaces or air spaces of susceptible piping and tanks that could result in loss of its intended function(s).

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M32. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.M32, with the exception of the "parameters monitored/inspected" and "detection of aging effects" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

GALL Report AMP XI.M32 recommends that inspections are to be performed by qualified personnel under the "parameters monitored or inspected," program element description; however the staff noted that the applicant did not describe the inspecting personnel's qualifications. By letter dated July 15, 2010, the staff issued RAI B.2.A-1 requesting that the applicant provide details on the qualifications and training requirements for its personnel assigned to perform the inspections and its conformance to the applicable ASME Codes.

In its response dated September 13, 2010, the applicant stated that personnel performing the visual examinations, UT, or other NDE techniques in accordance with ASME Code Section V and ASME Code Section XI will be trained in accordance with ASME Code requirements. The applicant further stated that training requirements for all inspections will be consistent with 10 CFR Part 50, Appendix B.

The staff finds the applicant's response acceptable because the one-time inspection will be performed by qualified personnel following procedures consistent with the ASME Code and 10 CFR Part 50, Appendix B. The staff's concern described in RAI B.2.A-1 is resolved.

GALL Report AMP XI.M32 recommends that "the inspection includes a representative sample of the system population, and where practical, focuses on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin." However, under the "detection of aging effects" program element description, the applicant stated that the sample population will be determined by engineering evaluation based on sound statistical sampling methodology. By letter dated July 15, 2010, the staff issued RAI B.2.A-2 requesting that the applicant provide details on the proposed sampling methodology.

In its response dated September 13, 2010, the applicant stated that the selected components will be those most susceptible to aging effects defined by time in service, severity of operating conditions, and design margins. The applicant provided a flow chart that described how the sample size would be selected based on the discrete number of components in the population, for example, in a population size of 21–200 components, 5 percent of the components would be inspected. The applicant also stated that the supplemental inspection sample size would be determined as part of the corrective action process. However, the staff noted that large sample sizes may be required to adequately confirm an aging effect is not occurring because of the uncertainty in determining the most susceptible locations and the potential for aging to occur in other locations. By letter dated December 3, 2010, the staff issued RAI B.2.A-3 requesting that the applicant provide technical justification for ensuring, based on the sample size chosen, that the components not inspected are not experiencing degradation.

In its response dated January 20, 2011, the applicant stated that the selected set of components to be sampled will be determined based on the material, environment, and aging effect combinations such that each combination represents a sample population. The applicant also stated that it will inspect 20 percent of each population, up to a maximum of 25 inspections per population. The staff finds the applicant's response acceptable because the applicant's sampling methodology ensures that a representative sample of material and environment combinations is considered; ensures sample locations will focus on the most susceptible components based on time in service, severity of operating conditions, and design margins; and includes an appropriate sample size. The staff's concerns described in RAIs B.2.A-2 and B.2.A-3 are resolved.

Based on its audit and review of the applicant's responses to RAIs B.2.A-1, B.2.A-2, and B.2.A-3, the staff finds that Elements one through six of the applicant's Supplemental Piping/Tank Inspection Program are consistent with the corresponding program elements of GALL Report AMP XI.M32 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.51 summarizes operating experience related to the Supplemental Piping/Tank Inspection Program. The applicant stated that a review of plant-specific operating experience subject to this AMP identified no examples of aging-related degradation in air-water interfaces and other susceptible locations. The applicant also stated that it reviewed recent industry operating experience for applicability, and none were found. The applicant further stated that it will use its Corrective Action Program and ongoing industry operating experience to ensure this program is effective in managing the identified aging effects.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.51 provides the UFSAR supplement for the Supplemental Piping/Tank Inspection Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.2-2, 3.3-2, and 3.4-2. The staff also notes that the applicant committed (Commitment No. 51) to implement the new Supplemental Piping/Tank Inspection Program within 10 years prior to entering the period of extended operation for managing aging of applicable components. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Supplemental Piping/Tank Inspection Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.1.30 Thermal Aging and Neutron Embrittlement of CASS

Summary of Technical Information in the Application. LRA Section B.2.52 describes the new Thermal Aging and Neutron Embrittlement of CASS Program as consistent with GALL Report AMP XI.M13, "Thermal Aging and Neutron Embrittlement of Cast Austenitic Stainless Steel (CASS)." The applicant stated that this is a new program that will manage reduction of fracture toughness due to thermal aging and neutron irradiation embrittlement of CASS RVI. This program augments the visual inspection of the RVI done in accordance with the ASME Code, Section XI, Subsection IWB and in accordance with the BWRVIP program documents. This program will consist of identification of susceptible components followed by aging management accomplished through either a component-specific evaluation or a supplemental examination. The Thermal Aging and Neutron Embrittlement of CASS Program is a Condition Monitoring Program with no actions to prevent or mitigate aging effects. The program will be implemented by analyses and augmenting of the ISI Program completed prior to the period of extended operation. The program credits portions of the ISI and the BWR Vessel Internals Program.

The Thermal Aging and Neutron Embrittlement of CASS Program will screen RVI components to determine which components are susceptible to reduction of fracture toughness due to the combination of thermal aging and neutron embrittlement on the basis of casting method, molybdenum content, and ferrite content.

Columbia has no CASS RCPB components that are exposed to high levels of neutron irradiation; therefore, there are no pressure boundary components in this program.

Components identified as susceptible by the screening will be individually evaluated for susceptibility based on neutron fluence and component material properties following the guidelines in NUREG/Contractor Report (CR)-4513. Component-specific evaluations may include a mechanical loading assessment. If no component-specific evaluation is performed, or if the evaluation does not eliminate the need for inspection, the components will be inspected

Examination techniques will be developed considering the recommendations of GALL Report AMP XI.M13. As determined necessary, NDEs (including visual, ultrasonic, and surface techniques) will be performed by qualified personnel following procedures consistent with ASME Section XI and 10 CFR Part 50, Appendix B. Supplemental examination of screened components will be performed as augmented inspections in the 10-year ISI Program.

Staff Evaluation. During its audit, the staff reviewed the applicant’s claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine if it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant’s program to the corresponding elements of GALL Report AMP XI.M13. As discussed in the audit report, the staff confirmed that each element of the applicant’s program is consistent with the corresponding element of GALL Report AMP XI.M13, with the exception of the “acceptance criteria” program element. For this element along with other items, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

In order to verify full consistency with program elements (1) through (10) from GALL Report AMP XI.M13, the staff determined that additional information would be required from the applicant. Therefore, by letter dated July 13, 2010, the staff issued an RAI to address these issues. The applicant’s response to the staff’s RAI concerning the Columbia Thermal Aging and Neutron Embrittlement of CASS Program was provided by letter dated September 3, 2010. The staff’s RAI questions and the applicant’s responses are discussed below.

By letter dated July 13, 2010, the staff issued RAI B.2.52-1, asking the applicant to state whether the component-specific evaluations that was used to determine CASS component susceptibility to neutron embrittlement, will use an NRC-approved fluence methodology that is consistent with RG 1.190 when calculating neutron fluence values.

In its response dated September 3, 2010, the applicant stated that the component-specific evaluations to determine reduction in fracture toughness, as discussed in the applicant's "scope of program," will use neutron fluence values that are calculated using an NRC-approved fluence methodology that is consistent with RG 1.190. The staff found the applicant's response to RAI B.2.52-1 acceptable because the neutron fluence values used to determine reduction in fracture toughness will be calculated using a NRC-approved fluence methodology that is consistent with RG 1.190. The staff's concern discussed in RAI B.2.52-1 is resolved.

The staff noted that GALL Report AMP XI.M13, "acceptance criteria," states that flaws detected in CASS components shall be evaluated in accordance with the applicable procedures of the ASME Code, Section XI, Article IWB-3500. Therefore, by letter dated July 13, 2010, the staff issued RAI B.2.52-2, asking that the applicant explain why the description of the "acceptance criteria" element in LRA Section B.2.52 does not reference the IWB-3500 acceptance criteria for screening flaws detected in CASS components at Columbia.

In its response dated September 3, 2010, the applicant listed the CASS RV internals components that will be managed under this AMP. The CASS RV internals components include the control rod drive tube bases, the jet pump assembly castings, and the orificed fuel supports. The applicant stated that the Thermal Aging and Neutron Embrittlement of CASS Program does not reference the applicability of ASME Code, Section XI, IWB-3500 acceptance criteria because all of the CASS RV internals components, as listed above, are non-pressure boundary components, and Article IWB-3500 does not specify flaw acceptance criteria for these components. The applicant noted that this AMP is applicable only to CASS RV internal components and that is does not include any RCPB components. The applicant stated that the acceptance criteria for CASS RV internal components managed under this program will be developed in accordance with ASME Code, Section XI criteria and the BWRVIP guidance applicable to the CASS RV internal components listed above, consistent with the description of acceptance criteria for the program in LRA Section B.2.52.

The staff reviewed the applicant's response to RAI B.2.52-2, including the LRA Table 3.1.2-2, AMR Results for RV Internals line items, and verified that the CASS RV internals components are limited to those listed in the RAI response. In reviewing the ASME Code, Section XI, IWB-3500 acceptance criteria, the staff determined that the applicant was correct in stating that Article IWB-3500 does not specify flaw acceptance criteria for the subject CASS RV internals components. Therefore, the staff determined that the applicant's response to RAI B.2.52-2 demonstrated that referencing ASME Code, Section XI, IWB-3500 acceptance criteria under GALL Report AMP element "acceptance criteria" is not necessary for the Thermal Aging and Neutron Embrittlement of CASS Program. Furthermore, the staff agreed that specific flaw acceptance standards for the CASS RV internal components listed above will be developed in accordance with ASME Code, Section XI criteria and the BWRVIP documents applicable to these CASS RV internal components. The staff's concern discussed in RAI B.2.52-2 is resolved.

The staff noted that certain GALL Report screening criteria for determining susceptibility of CASS components to thermal aging (based on ferrite content, molybdenum content, and casting method) do not apply if the CASS components are fabricated from materials that are alloyed with Niobium. By letter dated July 13, 2010, the staff issued RAI B.2.52-3, asking that the applicant state whether any of the CASS components within the scope of the program are alloyed with Niobium. If any CASS components addressed under this AMP are alloyed with Niobium, the staff requested that the applicant state whether these Niobium-alloyed CASS components will be evaluated for susceptibility to reduction in fracture toughness on a case-by-case basis.

In its response dated September 3, 2010, the applicant stated that Columbia does not have any components within the scope of the program that are alloyed with Niobium. The staff found the applicant's response to RAI B.2.52-3 acceptable because the applicant stated that there are no CASS components within the scope of the program that are alloyed with Niobium. The staff's concern discussed in RAI B.2.52-3 is resolved.

The staff noted that LRA Section B.2.52 states that Columbia has no CASS RCPB components that are exposed to high levels of neutron radiation; therefore, there are no pressure boundary components addressed by this AMP. By letter dated July 13, 2010, the staff issued RAI B.2.52-4, asking that the applicant state whether there are any CASS RCPB components at Columbia, regardless of exposure to neutron radiation. For any CASS RCPB components at Columbia (regardless of exposure to neutron radiation), the staff requested that the applicant provide justification as to why these components will not be screened for susceptibility to reduction in fracture toughness due to thermal aging even if neutron embrittlement is not an issue for such CASS RCPB components.

In its response dated September 3, 2010, the applicant stated that all CASS RCPB components at Columbia are valves and pump casings that are located outside RV. Accordingly, the neutron exposure for these components is less than 2×10^{16} n/cm^2 (E > 1.0 MeV) through the end of the period of extended operation. The loss of fracture toughness due to thermal aging for these components is managed under the ISI Program, as indicated in LRA Table 3.1.1, Item Number 3.1.1-55. These RCPB components will not be screened for susceptibility to thermal aging because age-related degradation for these components is managed by the ISI Program. The staff found the applicant's response to RAI B.2.52-4 acceptable because the applicant's ISI Program, which follows the ASME Code, Section XI requirements for ISI of RCPB components, is acceptable for managing the effects of aging for the CASS RCPB components.

By letter dated July 13, 2010, the staff also asked in RAI B.2.52-4, asking that the applicant state when, relative to end of the current licensed operating period, Columbia is scheduled to have completed activities associated with CASS component screening, component-specific susceptibility evaluations, augmentation of the ISI program or BWRVIP programs, and the addition of supplemental CASS component inspections to Columbia's 10-year ISI Program Plan.

In its response dated September 3, 2010, the applicant stated that the above activities will be completed at least five year prior to the end of the current 40-year license term. The staff found the applicant's RAI response acceptable because completion of these activities five years prior to the end of the 40-year license term will ensure that any needed supplemental inspections for susceptible CASS components will be implemented in the ISI Program Plan for the period of extended operation. The staff's concern discussed in RAI B.2.52-4 is resolved.

Based on its audit and review of the applicant's responses to RAIs B.2.52-1 through B.2.52-4, the staff finds that elements one through six of the applicant's Thermal Aging and Neutron Embrittlement of CASS Program are consistent with the corresponding program elements of GALL Report AMP XI.M13 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.52 summarizes operating experience related to the Thermal Aging and Neutron Embrittlement of CASS Program. The applicant stated that a review of Columbia operating experience identified no examples of aging-related degradation in components managed by this AMP. Future operating experience will be captured through the normal operating experience review process, which will continue through the period of extended operation.

The applicant also stated that Industry operating experience will be considered when implementing this program. Plant operating experience for this program will be gained as it is implemented during the period of extended operations and will be factored into the program.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

In addition, the staff confirmed that the applicant addressed operating experience identified after issuance of the GALL Report. The applicant's review of this recent operating experience did not reveal any applicable occurrences or detrimental environments that could exacerbate a slow aging effect or accelerate an otherwise long incubation period, and none of these were identified in the staff's independent review of the applicant's recent operating experience. The staff, therefore, confirms that the Thermal Aging and Neutron Embrittlement of CASS Program is appropriate to verify whether the aging mechanisms exist and to what extent it may be occurring. In addition, the site's use of a Corrective Action Program and ongoing reviews of industry operating experience will assist the management of aging effects for the extended period of operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.52 provides the UFSAR supplement for the Thermal Aging and Neutron Embrittlement of CASS Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.1-2. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's Thermal Aging and Neutron Embrittlement of CASS Program, the staff finds all program elements consistent with the GALL Report. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2 AMPs that are Consistent with the GALL Report with Exceptions or Enhancements

In LRA Appendix B, the applicant identified the following AMPs that were, or will be, consistent with the GALL Report with exceptions or enhancements:

- Aboveground Steel Tanks Inspection
- Bolting Integrity
- Buried Piping and Tanks Inspection
- Closed Cooling Water Chemistry
- Electrical Cable Connections Not Subject to 10 CFR 50.49 EQ Requirements Inspection
- External Surfaces Monitoring
- Fatigue Monitoring
- Fire Protection
- Fire Water
- Flexible Connection Inspection
- Flow-Accelerated Corrosion
- Fuel Oil Chemistry
- Lubricating Oil Analysis
- Masonry Wall Inspection
- Material Handling System Inspection
- Metal-Enclosed Bus
- Open-Cycle Cooling Water
- Structures Monitoring Program
- Water Control Structures Inspection

For AMPs that the applicant claimed are consistent with the GALL Report, with exceptions or enhancements, the staff performed an audit to confirm that those attributes or features of the program for which the applicant claimed consistency with the GALL Report were indeed consistent. The staff also reviewed the exceptions and enhancements to the GALL Report to determine whether it was acceptable and adequate. The results of the staff's audit and reviews are documented in the following sections.

3.0.3.2.1 Aboveground Steel Tanks Inspection Program

Summary of Technical Information in the Application. LRA Section B.2.1 describes the new Aboveground Steel Tanks Inspection Program as consistent, with an exception, with GALL Report AMP XI.M29, "Aboveground Steel Tanks." The applicant stated that this program will detect and characterize the conditions on the bottom surfaces of the carbon steel condensate storage tanks. The applicant also stated that the inspection provides direct evidence through volumetric examination as to occurrence of loss of material due to corrosion in inaccessible areas (i.e., tank base and bottom surface). The applicant further stated that the inspection results from this program will supplement the existing inspection of the coated accessible external surfaces conducted by its External Surfaces Monitoring Program. Finally, the applicant stated that implementation of this program, in conjunction with its External Surfaces Monitoring Program, will ensure that the effects of corrosion on the condensate storage tank intended function are adequately managed.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M29. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.M29, with the exception of the "preventive actions" program element. For this element, the staff determined the need for additional clarification, which resulted in the issuance of an RAI, as discussed below in Exception 1.

The staff notes that GALL Report AMP XI.M29, "Aboveground Steel Tanks," includes recommended inspections of the accessible external surfaces of the tanks. The staff also notes that the applicant has included these inspections of the accessible external surfaces of the tanks within its External Surfaces Monitoring Program, as described in LRA Section B.2.23. The staff finds this acceptable because, between the two programs, appropriate visual and volumetric inspections will be conducted.

The staff also reviewed the portions of the "preventive actions" program element associated with an exception to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this exception follows.

Exception 1. LRA Section B.2.1 states an exception to the "preventive actions" program element. The applicant stated that there is no sealant or caulking at the interface edge between the tank and concrete foundation.

The staff reviewed this exception to the GALL Report and noted that the applicant took the exception because of the lack of sealant or caulking at the interface edge between the tank and concrete foundation. The "preventive actions" program element of GALL Report AMP XI.M29 states that sealant or caulking at the interface edge between the tank and concrete foundation mitigates corrosion of the bottom surface of the tank by preventing water and moisture from penetrating the interface, which would lead to corrosion of the bottom surface. It is not clear to the staff how potential corrosion of the tank bottom surface due to water and moisture penetrating the tank and concrete interface is mitigated without the presence of sealant or caulking at the interface. By letter dated June 30, 2010, the staff issued RAI B.2.1-1 requesting that the applicant explain how potential corrosion of the tank bottom surface can be managed without sealant or caulking at the tank and concrete interface.

In its response dated August 26, 2010, the applicant stated that the condensate storage tanks have a PM task to perform a visual and ultrasonic thickness measurement of the tank bottoms every 10 years. Based on its review, the staff lacks sufficient information to evaluate, given the lack of sealant or caulking at the interface between the tank and concrete foundation, whether the 10-year frequency of the PM task is adequate to detect degradation before it impacts the ability of the tank to meet its CLB function(s). By letter dated September 21, 2010, the staff issued followup RAI B.2.1-3 requesting that the applicant justify the 10-year frequency of the PM activity. In its response dated December 7, 2010, the applicant stated that a tank bottom ultrasonic thickness measurement will be performed prior to the period of extended operation. The applicant also stated that the frequency of the tank bottom ultrasonic thickness measurement will be shortened if necessary, dependent on the baseline inspection results. The applicant revised the Aboveground Steel Tanks Inspection Program to reflect that the inspections would occur at intervals equal to or less than 10 years based on the baseline inspection results.

Based on its review, the staff finds the applicant's responses and the program exception acceptable because the tank bottom's thickness measurement will be conducted prior to the period of extended operation, and the inspection interval will be based upon results of the baseline inspection. The staff's concern described in RAIs B.2.1-1 and B.2.1-3 is resolved.

Based on its audit and review of the applicant's response to RAIs B.2.1-1 and B.2.1-3, the staff finds that Elements one through six of the applicant's Aboveground Steel Tanks Inspection

Program, with acceptable exception, are consistent with the corresponding program elements of GALL Report AMP XI.M29 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.1 summarizes operating experience related to the Aboveground Steel Tanks Inspection Program. The applicant stated that this is a new program and that plant-specific operating experience has not shown the occurrence of the corrosion aging effect. The applicant also stated that no instances of degradation of condensate storage tanks were identified in a review of CRs. During the audit, the applicant stated that relevant industry operating experiences, including paint chipping and delaminated coating found on condensate storage tanks, has not occurred on its condensate storage tanks.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff identified operating experience, which could indicate that the applicant's program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of an RAI.

During the audit, the staff reviewed the onsite documentation provided by the applicant and noted that surface corrosion and peeling paint was evident at the base of the condensate storage tanks. It is not clear to the staff how the observed corrosion and paint degradation was evaluated and how this aging effect is effectively managed. By letter dated June 30, 2010, the staff issued RAI B.2.1-2 requesting that the applicant provide additional information on the program expectations with respect to evaluation and reporting of the observed surface corrosion and paint degradation on the condensate storage tanks and explain how this aging effect is effectively managed by its Aboveground Steel Tanks Inspection Program.

In its response dated August 26, 2010, the applicant stated the following:

- The system engineer identified the degradation during walkdowns but had not entered the issue into the Corrective Action Program because the issue was identified as surface corrosion and no significant material loss was noted.
- The area of corrosion was believed to be of low consequence because it was located outside of the bolting circle.
- Based on the evaluation of multiple scrams that occurred in the period of August 2008–November 2009, the applicant implemented many initiatives that will improve performance in the areas of corrective actions and system monitoring and trending by system engineers.
- These improvements include clarification of the system engineer's roles and responsibilities and enhancements to improve system health.

The applicant also stated that its expectation would have been that the issue would have been documented in the corrective action process. The staff noted that a CR to document the discrepancy was initiated by the applicant as a result of the staff's question during the audit.

Based on its review, the staff finds the applicant's response to RAI B.2.1-2 acceptable because, despite not being documented in the corrective action process, the corrosion had been recognized as a deficiency by the system engineer during walkdowns. Additionally, a CR was initiated to document the corrosion, and the applicant self-recognized a trend in corrective action and system engineering performance with follow-on corrective actions. The staff's concern described in RAI B.2.1-2 is resolved.

Based on its audit, review of the application, and review of the applicant's response to RAI B.2.1-2, the staff finds that operating experience related to the applicant's program demonstrate that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.1 provides the UFSAR supplement for the Aboveground Steel Tanks Inspection Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.3-2 and 3.4-2. The staff also notes that the applicant committed (Commitment No. 1) to implement the new Aboveground Steel Tanks Inspection Program prior to entering the period of extended operation for managing aging of applicable components. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Aboveground Steel Tanks Inspection Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exception and its justification and determines that the AMP, with the exception, is adequate to manage the aging effects for which the LRA credits it. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.2 Bolting Integrity

Summary of Technical Information in the Application. LRA Section B.2.4 describes the existing Bolting Integrity Program as consistent, with exceptions, with GALL Report AMP XI.M18, "Bolting Integrity." The applicant stated that its Bolting Integrity Program addresses the management of aging effects of cracking, loss of material, and loss of preload for the bolting of mechanical components and structural connections within the scope of license renewal. The applicant also stated that the program consists of the periodic inspections of bolting performed under its ISI Program (IWF), Structures Monitoring Program, ISI, and External Surfaces Monitoring Program. The applicant further stated that its bolting integrity program relies on manufacturer and vendor information and industry recommendations (in EPRI NP-5067, "Good Bolting Practices") for the proper selection, assembly, and maintenance of bolting for pressure-retaining closures and structural connections.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M18. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.M18, with the exception of the "detection of aging effects" program element. For this element, the staff determined the need for additional clarification, which resulted in the issuance of the RAI discussed below.

The staff reviewed the detection of aging effects program element of GALL Report AMP XI.M18 and noted that the potential for SCC of structural bolts and fasteners for nuclear steam supply system (NSSS) component supports should be assessed based on the actual yield strength. Additionally, for the identified high-strength bolting (greater than 1-in. nominal diameter), volumetric examination comparable to that of ASME Examination Category B-G-1 is required in addition to visual examination. From the review of the applicant's onsite documentation, the staff could not confirm if the potential for SCC in the applicable bolting was evaluated within the applicant's Bolting Integrity Program and whether the actual yield strength values were factored in the evaluation. Also, from the staff's discussion with applicant's technical staff during the audit, it appeared that only visual examination of these boltings may be covered under the applicant's bolting program. By letter dated June 24, 2010, the staff issued RAI B.2.4-5 requesting that the applicant determine whether its evaluation of whether NSSS bolting is high-strength is based on the actual yield strength values and confirm that high-strength bolting have been and will be inspected with visual and volumetric examinations, as required.

In its response dated August 19, 2010, the applicant stated that it will not perform volumetric examinations of high-strength bolting, since it has not identified cracking as an aging effect for high-strength structural bolting. The applicant also stated that, as per LRA Table 3.5.2-13, all aging effects for structural bolting at Columbia are managed by the ISI Program—IWF (ASME Class 1, 2, 3 and MC supports) and the Structures Monitoring Program (non-ASME supports). The applicant's response further stated that it did not attempt to identify if any Class 1 bolts were high-strength but conservatively assumed all Class 1 bolts were susceptible to SCC.

The staff finds the applicant's response acceptable for the following reasons:

- The applicant is treating all Class 1 bolting as susceptible to SCC.
- GALL Report AMP XI.M18 "detection of aging effects" program element states that the volumetric examination of high-strength structural bolts may be waived based on adequate plant-specific justification.
- The waiver for Columbia is justified on the basis that its plant-specific operating experience has not identified this aging effect and that any future identification will be possible through its existing ISI Program and will be managed subsequently.

The staff's concern described in RAI B.2.4-5 is resolved.

The staff also reviewed the portions of the "scope of program," "preventive actions," "detection of aging effects," "monitoring and trending," and "acceptance criteria" program elements associated with exceptions to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of these exceptions follows.

Exception 1. LRA Section B.2.4 states an exception to the "scope of program" and "preventive actions" program elements. In this exception the applicant stated that it does not explicitly address the guidelines outlined in EPRI NP-5769 (and EPRI TR-104213), or as delineated in

NUREG-1339, and instead relies on the recommendations contained in a related prior EPRI document, NP-5067.

The staff noted that GALL Report AMP XI.M18 is based on the staff's recommendations and guidelines delineated in NUREG-1339, which incorporate EPRI NP-5769 (with the exceptions noted in NUREG-1339) and EPRI TR-104213 as the industry's technical basis. The staff also noted that EPRI NP-5067 is primarily a "good practices" (maintenance) manual for solving maintenance problems as it occurs and is not focused on long-term management of aging issues; whereas, the GALL Report basis documents also address evaluation procedures for assuring integrity, appropriate acceptance criteria, and management of SCC in non-ASME bolting. It is not clear to the staff how the applicant's use of EPRI NP-5067 as the program basis is equivalent to the recommendations in the GALL Report, because the single document used by the applicant is an earlier report, which only includes a subset of the GALL Report recommendations. The staff further noted that other parts of the LRA were also affected by the exception, including the "detection of aging effects" and "corrective actions" program elements, and these impacted elements were not noted in the applicant's LRA description for this exception. By letter dated June 24, 2010, the staff issued RAI B.2.4-2 requesting that the applicant justify this exception and the element by element basis for equivalence of EPRI NP-5067 with the industry consensus documents recommended in the GALL Report and with the GALL Report AMP XI.M18 program elements. The staff also asked that the applicant include in the LRA description all elements affected by the applicant's use of, and sole reliance on, EPRI NP-5067 guidelines.

In its response dated August 19, 2010, the applicant stated that, although EPRI NP-5067 is not directly referenced in GALL Report AMP XI.M18, the recommendations set forth in EPRI NP-5067 Volumes 1 and 2, form an important basis to the industry documents referenced in GALL Report AMP XI.M18 such as EPRI NP-5769 and NUREG-1339. Additionally, and both EPRI NP-5769 and NUREG-1339 defer to EPRI NP-5067 for the identification of bolting practices associated with disassembly and assembly of bolted joints and identification of bolting practices for minimizing bolted joint problems such as leaks, vibration loosening, fatigue, and SCC. The applicant also stated that an element by element comparison between EPRI NP-5769 and EPRI 5067 was previously performed during the Millstone license renewal process (ADAMS Accession No. ML051020128), demonstrating that EPRI NP-5067 provides the same information as EPRI NP-5769 for addressing the bolting integrity recommendations in GALL Report AMP XI.M18. The applicant further stated that, since EPRI NP-5769 and EPRI NP-5067 were issued at about the same time (1988 and 1987, respectively) and it has not been revised, the comparison is still valid.

The staff finds the applicant's response to RAI B.2.4-2 acceptable for the following reasons:

- EPRI NP-5067 provides both the detailed bolting practices and the underlying basis for subsequent industry guideline documents.
- The staff confirmed that EPRI NP-5067 provides the same information as EPRI NP-5769 for addressing the bolting integrity recommendations in GALL Report AMP XI.M18.
- The applicant provided an Amendment 2 to its LRA, Appendix B, which shows the requisite program elements affected by this exception.

The staff's concern described in RAI B.2.4-2 is resolved.

Exception 2. LRA Section B.2.4 states an exception to the “monitoring and trending” program element. The applicant stated that its program performs the periodic inspection of bolting, other than the ASME Class 1, 2, 3, and MC bolting, through the External Surfaces Monitoring Program or Structures Monitoring Program, in which, if leakage or degradation is detected, the followup inspection frequency is established by an engineering evaluation of the identified problem.

The staff noted that GALL Report AMP XI.M18 recommends that if a bolting connection for pressure retaining component (not covered by ASME Section XI) is reported to be leaking, then it may be inspected daily, and, if the leak rate does not increase, the inspection frequency may be decreased to biweekly or weekly. It was not clear to the staff what the technical basis and effectiveness was of the applicant’s proposed alternative inspection frequency from the applicant’s LRA. By letter dated June 24, 2010, the staff issued RAI B.2.4-1 requesting that the applicant provide its technical basis and justification for adequacy of the event-specific and plant-specific determination of the monitoring frequency. The staff also asked that the applicant state reasons for the alternative method to be as effective as the GALL Report recommended method to manage bolting integrity during the extended period of operation.

In its response dated August 19, 2010, the applicant provided its technical basis and justification which the staff reviewed to determine the acceptability. The staff noted that the applicant’s justification includes the following:

- program requirement to document any identified leaks of any medium (steam, water, air or oil) in the corrective action process, with a specific expectation in plant procedures that assigns a responsible organization and individual to perform an evaluation and determine immediate actions including monitoring
- re-evaluation and revision of the monitoring frequency if the leak rate changes
- twice daily equipment operator rounds providing opportunities for leak monitoring

The staff also noted that the applicant has a Leak Reduction Program (LRP), based on guidance from EPRI TR-114761, “Establishing an Effective Fluid Leak Management Program, EPRI Sealing Technology and Plant Reduction Series,” which categorizes a leak based on severity to assign the frequency for monitoring. The staff finds the applicant’s response and this exception acceptable for the following reasons:

- Corrective action process implementation with assigned responsibilities in the acceptable plant procedures, in conjunction with LRP, are effective followup actions in response to an identified leak.
- Leak monitoring is further supplemented by daily operator rounds.
- EPRI guidance represents an acceptable industry practice with a documented technical basis in EPRI TR-114761 for assigning the monitoring frequency.

Therefore, the staff considers the monitoring of leaks in non-ASME bolted connections as managed under the applicant’s exception to the program meets the intent of the GALL Report AMP XI.M18 “monitoring and trending" element. The staff’s concern described in RAI B.2.4-1 is resolved.

Exception 3. LRA Section B.2.4 states an exception to the “acceptance criteria” program element. In this exception, the applicant stated that its program does not specify acceptance criteria for bolting. The applicant further stated that for those components for which periodic visual inspections are performed under its other related AMPs (ISI Program, ISI Program—IWF, Structures Monitoring Program, and External Surfaces Monitoring Program), either the programs do, or will prior to the period of extended operation, include acceptance criteria for evidence of degradation in the related bolting.

The staff noted that GALL Report AMP XI.M18 explicitly recommends that any indications of aging in ASME pressure retaining bolting are to be evaluated in accordance with Section XI of the ASME Code criteria. For other pressure retaining bolting, NSSS component support bolting, and structural bolting, indications of aging are to be dispositioned in accordance with the corrective action process. It is not clear to the staff that the LRA element is consistent with the GALL Report because the acceptance criteria are either not specified or do not indicate the incorporation of corrective action process in dispositioning of indications under the LRA AMP exception. By letter dated June 24, 2010, the staff issued RAI B.2.4-4 requesting that the applicant justify the current lack of acceptance criteria to be adequate for the bolting integrity management and explain why the corrective action process is not part of the implementation under this program element.

In its response dated August 19, 2010, the applicant provided justification and further clarification to the staff on the acceptance criteria of bolting. The staff finds the justification acceptable because it clarifies the following:

- The applicant is currently directing its periodic visual inspections of components including bolting within the scope of license renewal under its Structures Monitoring Program, External Surfaces Monitoring Program, and ISI—IWF based on the ASME Code, which has well defined acceptance criteria.
- Plant procedures that reflect these requirements for the CLB initiate a CR under Columbia’s corrective action process for any unacceptable, questionable, or undesired condition discovered during maintenance rule or system walkdowns, where these procedures also contain guidelines for evaluating and documenting as-found condition of bolted connections.
- The applicant will include in its Bolting Integrity Program the applicable acceptance criteria prior to the period of extended operation.
- The exceptions discussed in the Bolting Integrity Program do not include an exception to the corrective action program element.

The staff’s concern described in RAI B.2.4-4 is resolved.

The staff noted that the GALL Report states that GALL Program XI.S3, “ASME Section XI Subsection IWF” supplements the bolting integrity for managing inspection of safety-related bolting. This includes high-strength bolting for which EPRI NP-5769 and EPRI TR-104213 recommend inspections for SCC to prevent or mitigate degradation and failure of structural bolting with actual yield strength greater than or equal to 150 ksi. It was not clear to the staff that the applicant identified the applicable high-strength bolting with actual yield strengths and if the EPRI NP-5769 and EPRI TR-104213 recommended inspection for its SCC were included in the Bolting Integrity Program. By letter dated June 24, 2010, the staff issued RAI B.2.4-6 requesting that the applicant confirm its evaluation of the high-strength bolting under the AMPs and its implementation to prevent or mitigate the degradation and failure of these bolts as per the GALL Report.

In its response dated August 19, 2010, the applicant confirmed its evaluation of the high-strength bolts. The staff finds the justification acceptable because it clarifies how the applicant is classifying and evaluating high-strength bolting under each classification in its Bolting Integrity Program and confirms, in addition to requisite periodic inspections, that plant-specific conditions either do not meet the required factors to expect SCC or have not indicated such cracking in its operating experience. The staff's concern described in RAI B.2.4-6 is resolved.

Based on its audit, and acceptable resolution of RAIs B.2.4-1, B.2.4-2, B.2.4-4, B.2.4-5, and B.2.4-6, the staff finds that Elements one through six of the applicant's Bolting Integrity Program, with acceptable exceptions, are consistent with the corresponding program elements of GALL Report AMP XI.M18 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.4 summarizes operating experience related to the Bolting Integrity Program. In this summary, the applicant indicated that no instances of cracking have been identified for bolting or fasteners, although some corroded bolting and facing surfaces were identified and corrected. The applicant provided as examples of identified corrosion in some pump column-to-bowl bolting and on some valve body-to-bonnet bolting. The applicant also noted instances of system leaks that may have been due to loss of preload, which were identified and corrected by existing activities in the Bolting Integrity Program.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant had adequately incorporated and evaluated operating experience related to this program. During its review, the staff identified operating experience that could indicate that the applicant's program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of RAI B.2.4-3.

The staff noted that the operating experience described in the LRA AMP stated that, based on its review of the operating experience, the applicant found its program to be effective. The staff could not judge the program effectiveness since there was no consolidated list of the loss of preload, leaking joints and closures, corroded bolting occurrences, and (reduction in) its frequency over time. The staff also noted a recent instance of bolting degradation related to aging not discussed in the applicant's experience review.

The staff also noted that since the applicant's review showed that only leaks were found and no cracking in any bolting application under the license renewal scope; these must come from improper assembly or loss of preload or both. The staff's review of the operating experience summarized in its audit report also showed continued occurrence of loss of preload instances. These observations reflect on the training and implementation under applicant's reliance on EPRI NP-5067 guidance. Therefore, it was not clear to the staff if the effectiveness and any self-assessment of the training and procedural management of the Bolting Integrity Program, especially for the loss of preload, are adequate for the extended period of operation. By letter dated June 24, 2010, the staff issued RAI B.2.4-3 requesting that the applicant provide the following:

- the basis for concluding from the operating experience the effectiveness of the existing program to manage the aging effects over the extended period of operation

- justification for the timing and frequency of Columbia training in support of the implementation of proper procedures of assembly/disassembly or installation and inspection of the bolting
- confirmation as to the adequacy of monitoring and detection of bolting degradation in those locations that are normally in submerged condition

In its response dated August 19, 2010, the applicant provided the basis and justification for its conclusion regarding the effectiveness of the existing program and frequency of proper bolting training. The staff finds the justification acceptable for the following reasons:

- The applicant clarified its review process for the operating experience showing that the significant events were captured and addressed with regard to bolting integrity over the years and compared the frequency of these with rough estimates of expectations based on an EPRI report, which indicated the Columbia experience and program effectiveness to be acceptable.
- The applicant has a demonstrably robust maintenance and training program dealing with the skills and implementation relevant to the bolting practices, which are integrated with its Leak Reduction Program that references INPO and EPRI guidance.
- The applicant's ISI—IWF Program, B.2.35, consistent with GALL Report AMP XI.S3, manages some of the submerged bolting, while the other submerged bolting with limited accessibility when recently inspected (R19) on a sample basis did not show loose bolts, loss of material, or evidence of cracking, supporting the effectiveness of its monitoring and detection of bolting degradation in these locations.

The staff's concern described in RAI B.2.4-3 is resolved.

Based on its audit and review of the application, and review of the applicant's response to RAI B.2.4-3, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.4 the applicant provides the UFSAR supplement for the Bolting Integrity Program. The staff reviewed this UFSAR supplement description of the program against the recommended description for this type of program, as described in SRP-LR Tables 3.1-2, 3.2-2, 3.3-2, 3.4-2, and 3.5-2. The staff also notes that the applicant committed (Commitment No. 4) to ongoing implementation of the existing Bolting Integrity Program for managing aging of applicable components during the period of extended operation.

The staff finds that UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Bolting Integrity Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exceptions and its justifications, and determines that the AMP, with the exceptions, is adequate to manage the aging effects for which the LRA credits it. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.3 Buried Piping and Tanks Inspection Program

Summary of Technical Information in the Application. LRA Section B.2.5 describes the existing Buried Piping and Tanks Inspection Program as consistent, with enhancements, with GALL Report AMP XI.M34, "Buried Piping and Tanks Inspection." Subsequent to the audit, the staff issued RAIs B.2.5-1 and B.2.5-2 (see the staff evaluation of these RAI responses dated August 26, 2010, and October 20, 2010, respectively, under "Operating Experience" of this section). These RAIs resulted in the applicant using GALL Report AMP XI.M41, "Buried and Underground Piping and Tanks," to augment preventive actions and inspections, based on recent industry operating experience in its Buried Piping and Tanks Inspection Program. The applicant stated that this program will manage the effects of loss of material due to corrosion on the external surfaces of piping and tanks that are buried or underground. The applicant also stated that this program is a combination of a Mitigation Program consisting of protective coating, cathodic protection, and backfill quality, and a Condition Monitoring Program consisting of visual inspections to ensure effective management of the loss of material aging effect, electrochemical verification of cathodic protection, confirmation of backfill quality, and NDE of pipe or tank wall thickness as necessary.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated. The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M34. As discussed in the audit report, the staff confirmed that these elements are consistent with the corresponding elements of GALL Report AMP XI.M34. In revising its program to reflect augmented preventive actions and inspections based on GALL Report AMP XI.M41, the applicant added an exception, deleted the original enhancements, and added four new enhancements. The exception and enhancements are evaluated below.

The staff reviewed the portions of the "preventive actions" program element associated with an exception to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this exception follows.

Exception 1. LRA Section B.2.5 states an exception to the "preventive actions" program element. The applicant stated that cathodic protection will not be provided for the diesel fuel oil system piping and tanks in the scope of license renewal. The staff reviewed this exception to the GALL Report, and its evaluation is documented below under "Operating Experience."

The staff reviewed the portions of the "preventive actions," "parameters monitored and inspected," "detection of aging effects," "monitoring and trending," and "acceptance criteria" program elements associated with four enhancements to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of these four enhancements follows.

Enhancement 1. LRA Section B.2.5 states an enhancement to the "preventive actions" program element. The applicant stated that deepwell or distributed anode beds cathodically protect the circulating water, condensate nuclear, fire protection, standby service water (SSW), tower makeup, and radwaste heating, ventilation, and air conditioning (HVAC) systems. The cathodic protection for the radwaste building HVAC system could not be confirmed during testing. In Commitment No. 5, the applicant stated that it will ensure that, prior to the period of extended operation, all in-scope portions of buried piping and components, except for the diesel fuel oil system, are provided with cathodic protection through the period of extended operation, and will upgrade the system to ensure that cathodic protection is operable at least 90 percent of the time between inspections, and cathodic protection will not be out of service for more than 90 days. The staff reviewed this enhancement to the GALL Report and finds it acceptable because it will result in the program being consistent with the cathodic protection recommendations of GALL Report AMP XI.M41. The evaluation of the lack of cathodic protection for the diesel fuel oil system is documented under "Operating Experience."

Enhancement 2. LRA Section B.2.5 states an enhancement to the "parameters monitored and inspected" and "detection of aging effects" program elements. The applicant stated that it will revise its site program document to require one inspection each for polymeric, concrete, stainless steel, and steel buried in-scope piping; inspection of 2 percent of the buried in-scope steel piping containing hazardous materials; and one inspection of a buried steel diesel fuel oil storage tank during each of the 10-year periods starting 10 years prior to the period of extended operation. It will also require appropriate tactile (e.g., manual) examination of buried polymeric components to supplement visual inspections for confirmation that significant aging effects are not occurring, wall thickness measurement by an NDE technique such as UT if loss of material has been detected, and confirmation that backfill is acceptable with regards to degradation of pipe coatings. The staff reviewed this enhancement to the GALL Report and finds it acceptable because it will result in the program being consistent with the inspection recommendations of GALL Report AMP XI.M41.

Enhancement 3. LRA Section B.2.5 states an enhancement to the "monitoring and trending" program element. The applicant stated that it will revise its site program document to include collection of trending information on cathodic protection system effectiveness (e.g., potential difference and current measurements) and adjustment of the program as needed based on the results. It will also trend the results of visual inspections of the external surface condition or coating condition of buried and underground piping, piping components, and buried tanks and adjust the program as needed based on the results. The staff reviewed this enhancement to the GALL Report and finds it acceptable because it will result in the program being consistent with the monitoring and trending recommendations of GALL Report AMP XI.M41.

Enhancement 4. LRA Section B.2.5 states an enhancement to the "acceptance criteria" program element. That applicant stated that it will revise its site program document in the following ways:

- Criteria for soil to pipe potentials, as contained in National Association of Corrosion Engineers (NACE) standards, will be included.
- It will include a determination that backfill is acceptable if there is no degradation of pipe external coatings as a result of backfill noted during inspections.
- For coated piping or tanks, either no evidence of coating degradation or the type and extent of coating degradation is determined to be insignificant as evaluated by an individual with the qualifications to evaluate coatings.
- If coated or uncoated metallic piping show evidence of corrosion, the remaining wall thickness in the affected area is determined to ensure that the minimum wall thickness is maintained.

- Cracking or blistering of polymeric piping is evaluated.
- Concrete piping may exhibit minor cracking and spalling provided there is no evidence of leakage or exposed rebar or reinforcing “hoop” bands.

The staff reviewed this enhancement to the GALL Report and finds it acceptable because it will result in the program being consistent with the acceptance criteria recommendations of GALL Report AMP XI.M41.

Based on its audit, the staff finds that Elements one through six of the applicant’s Buried Piping and Tanks Inspection Program, with acceptable exceptions and enhancements, are adequate to manage the aging effects credited in the LRA.

Operating Experience. LRA Section B.2.5 summarizes operating experience related to the Buried Piping and Tanks Inspection Program. The applicant stated that the plant-specific environmental conditions are benign based on the sandy soil and electrolyte resistivity of the soil, which is considered very high. The applicant also stated that a review of plant-specific piping failure indicated that there are no documented failures attributed to externally-initiated corrosion. The applicant further stated that there has been no significant degradation caused by protective coating failure, as evidenced by buried pipe inspections conducted in 2007 on the standby pipe SW system.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant had adequately incorporated and evaluated operating experience related to this program. The staff determined the need for additional clarification, which resulted in the issuance of an RAI.

There have been many recent industry events involving leakage from buried and underground piping and tanks. It is not clear to the staff whether lessons learned from recent industry operating experience has been incorporated into the applicant’s Buried Piping AMP. By letter dated June 30, 2010, the staff issued RAI B.2.5-1 requesting that the applicant do the following:

(a) provide a list and brief summary of any leaks or adverse conditions discovered during inspections, which have occurred in buried or underground piping or tanks at the station in the past 5 years that were entered in the Corrective Action Program but are not included in the LRA

(b) describe how the Buried Piping and Tanks Inspection Program will address recent industry operating experience as well as any operating experience from its own history

In its response dated August 26, 2010, the applicant stated that a search of plant-specific operating experience did not identify any additional leaks or adverse conditions discovered during inspections. The applicant also stated that inspections revealed small sections of SW and control air system (CAS) piping with external coating deficiencies identified as being caused by mechanical damage that likely occurred during the excavation process. The applicant further stated that the Buried Piping and Tanks Inspection Program will use industry and plant-specific operating experience to inform inspection locations.

The staff finds the applicant's response to RAI B.2.5-1, item (a) acceptable because the applicant searched its plant-specific operating experience and only identified examples of degradation of buried piping coatings that were caused by excavation damage. The staff's concern described in RAI B.2.5-1 is not resolved for item (b) because the staff had further questions regarding the number and type of piping inspections planned, the extent to which cathodic protection is installed on buried piping, the quality of backfill, and the in-scope functions of the radwaste building HVAC piping.

By letter dated October 20, 2010, the staff issued RAI B.2.5-2 requesting that the applicant do the following:

(a) describe the number of piping inspections that will be performed during each 10-year period starting 10 years prior to the period of extended operation and what length of piping will be excavated and have a direct visual inspection

(b) state what alternative inspections would be conducted if direct visual inspections are not possible

(c) state what portions of buried steel in-scope piping are cathodically protected and state the availability of the cathodic protection system and if annual pipe to ground potential surveys are conducted

(d) describe the quality of backfill in the vicinity of buried in-scope piping

(e) state if the buried in-scope radwaste building HVAC piping has a safety-related function

In its response dated January 28, 2011, the applicant stated the following:

(a) It will conduct one inspection each for polymeric, concrete, stainless steel, and steel buried in-scope piping and inspect 2 percent of the buried in-scope steel piping containing hazardous materials during each of the 10-year periods starting 10 years prior to the period of extended operation. Each piping inspection will consist of a direct visual inspection of at least 10 ft of pipe. For underground piping, inspections will consist of one segment of stainless steel piping, two of steel piping and 2 percent of steel piping containing hazmat material during each of the 10-year periods starting 10 years prior to the period of extended operation.

(b) No alternative inspection methods are planned. Alternative volumetric examination methods will not be used to conduct interior wall thickness measurements in lieu of excavating and visually inspecting buried pipe.

(c) Cathodic protection is provided for the circulating water, condensate nuclear, fire protection, SSW, tower makeup water (TMU), and radwaste building HVAC systems. The radwaste building HVAC system's cathodic protection cannot be confirmed; however, Commitment No. 5 states that, prior to the period of extended operation, it will ensure that all in-scope portions of buried piping and components, except for the diesel fuel oil system, are provided with cathodic protection.

    It is not practical to provide cathodic protection for portions of the diesel fuel oil piping because of its location under the diesel generator building. Diesel oil pipe lines extending under the diesel generator building do not receive full protection from the exterior rectifier-anode system because of the electrical shielding effect of the ground grid and foundation reinforcing and structural steel. The earth under the building is sheltered and is typically much drier than the earth exterior to the building. The piping is coated with coal tar enamel.

Plant-specific operating experience has shown that portions of the cathodic protection system may not be available 90 percent of the time or may be unavailable for periods exceeding 90 days; however, Commitment No. 5 states that the cathodic protection system will be upgraded to ensure it will be maintained available at least 90 percent of the time and that cathodic protection will not be out of service for more than 90 days duration. Pipe-to-soil potential measurements are conducted annually in accordance with NACE standards.

(d) Plant-specific specifications require that backfill material be free of trash, roots, organic, frozen or other unsuitable material. Backfill material is granular, but the size limits are less restrictive than American Standards for Testing and Materials (ASTM) D448-08 and, as such, backfill quality will be confirmed by inspections demonstrating no mechanical damage to pipe coatings due to backfill as stated in GALL Report AMP XI.M41 Table 2a, Footnote 6.

(e) The buried in-scope radwaste building HVAC piping has a safety-related function.

The applicant also stated that it will conduct an inspection of one of the three buried steel fuel oil tanks every 10-year period starting 10 years prior to the period of extended operation.

The staff finds the applicant’s response to RAI B.2.5-2, items (a), (b), (d), and (e) acceptable for the following reasons:

- For item (a), the proposed number of inspections by material types are consistent with the condition monitoring recommendations of GALL Report AMP XI.M41.
- For item (b), all buried pipe inspections will be conducted by excavated direct visual examinations.
- For item (d), backfill quality will be confirmed by inspections demonstrating no mechanical damage to pipe coatings due to backfill as stated in GALL Report AMP XI.M41 Table 2a, Footnote 6.
- For item (e), the applicant stated that the buried in-scope radwaste building HVAC piping has a safety-related function and the system will be included in the inspection scope of the Buried Piping and Tanks Inspection Program.

The staff finds the applicant’s response to RAI B.2.5-2, item (c) partially resolved as follows:

- Cathodic protection is provided for the circulating water, condensate nuclear, fire protection, SSW, TMU, and radwaste building HVAC systems. The radwaste building HVAC system’s cathodic protection cannot be confirmed; however, Commitment No. 5 states that it will ensure that prior to the period of extended operation all in-scope portions of buried piping and components, except for the diesel fuel oil system, are provided with cathodic protection through the period of extended operation.
- The staff finds the lack of full cathodic protection for the diesel fuel oil system piping acceptable for the following reasons:

- The earth under the diesel generator building is sheltered; hence, it is much drier than the earth exterior to the building.
- The piping under the diesel generator building is otherwise inaccessible and not in a location conducive to supporting an effective cathodic protect system.
- The piping is coated with coal tar enamel.
- LRA Section B.2.29, Fuel Oil Chemistry Program, requires monitoring for fuel oil particulate and water, and this monitoring could provide an alternate indication that leakage is occurring.
- The applicant increased its number of inspections of the buried steel non-cathodically protected piping to 2 percent of its total linear feet, consistent with GALL Report AMP XI.M41.

• Cathodic protection has been or will be confirmed by Commitment No. 5 to be available greater than 90 percent of the time, cathodic protection will not be out of service for more than 90 days duration for all in-scope buried piping systems except diesel fuel oil, and annual pipe to soil potential measurements are conducted in accordance with NACE standards

The staff's concern described in RAI B.2.5-2, item (c) is not completely resolved because it is not clear if the diesel fuel oil tanks are provided with cathodic protection; therefore, inspecting one of the three fuel oil storage tanks every 10 years starting 10 years prior to the period of extended operation may not ensure that the tank's CLB function(s) would be met.

By letter dated March 9, 2011, the staff issued RAI B.2.5-3 requesting that the applicant state whether all three in-scope buried diesel fuel oil tanks are provided with cathodic protection, and if it is not, state why inspecting one tank every 10 years starting 10 years prior to the period of extended operation will ensure that the CLB function(s) of the tanks are maintained.

In its response dated April 5, 2011, the applicant stated that the three buried in-scope diesel fuel oil tanks are not provided with cathodic protection. The applicant also stated that the justification for inspecting one tank every 10 years is as follows:

• The tanks are buried in acceptable backfill.
• All tanks are coated with a coal tar enamel.
• All three tanks are located in close proximity to each other.
• All three tanks are ultrasonically wall thickness inspected every 10 years, and the 2005 inspection of all three tanks resulted in a projection of worst case corrosion being 0.0206 in. by the end of the period of extended operation with an allowable corrosion allowance of 0.1875 in.
• A site soil corrosivity assessment was conducted in February 2007, which demonstrated that for the soil in the vicinity of the buried tanks, the soil resistivity varies from 14,363–34,470 ohm-cm, chlorides were not detectable, sulfates were 20 parts per million (ppm), and the soil pH varied from 8.8–9.9.

The staff finds the applicant's response acceptable because ultrasonic examination of tank wall thickness is included in GALL Report AMP XI.M41 as an alternative to excavated direct visual examinations of a buried tank. The staff's concern described in RAI B.2.5-3 is resolved.

Based on its audit and review of the application, and review of the applicant's response to RAIs B.2.5-1, RAI B.2.5-2, and B.2.5-3, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.5 provides the UFSAR supplement for the Buried Piping and Tanks Inspection Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.3-2 and 3.4-2. The staff also notes that the applicant committed (Commitment No. 5) to enhance the Buried Piping and Tanks Inspection Program prior to entering the period of extended operation. Specifically, the applicant committed to revise the program document to include the changes as described in Enhancements 1–4, as documented.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Buried Piping and Tanks Inspection Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exception and its justification and determines that the AMP, with the exception, is adequate to manage the aging effects for which the LRA credits it. Also, the staff reviewed the enhancements and confirmed that its implementation through Commitment No. 5 prior to the period of extended operation would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes, that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.4 Closed Cooling Water Chemistry

Summary of Technical Information in the Application. LRA Section B.2.13 describes the existing Closed Cooling Water Chemistry Program as consistent, with an exception and enhancement, with GALL Report AMP XI.M21, "Closed-Cycle Cooling Water System." The applicant stated that the Closed Cooling Water Chemistry Program will mitigate damage due to loss of material, cracking, and reduction of heat transfer. The applicant also stated that the program manages chemistry that could lead to the onset and propagation of aging effects through monitoring and control of corrosion inhibitor concentrations consistent with the current EPRI close cooling water chemistry guidelines. The applicant further stated that this program includes the measurement of corrosion rates at select locations in the reactor closed cooling water (RCC) system. In addition, the applicant stated that this program is supplemented by one-time inspections associated with the Chemistry Program Effectiveness Inspection Program, which will confirm adequate mitigation of loss of material and cracking and the Heat Exchangers Inspection Program, which will confirm adequate mitigation of reduction in heat transfer.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M21. As discussed in the audit report, the staff confirmed that these elements are consistent with the corresponding elements of GALL Report AMP XI.M21.

The staff also reviewed the portions of the "parameters monitored or inspected," "detection of aging effects," "monitoring and trending," and "acceptance criteria" program elements associated with an exception and enhancement to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this exception and enhancement follows.

Exception 1. LRA Section B.2.13 states an exception to the "parameters monitored or inspected," "detection of aging effects," "monitoring and trending," and "acceptance criteria" program elements. The applicant stated that the program does not include performance or functional testing to manage aging due to loss of material or cracking, since testing mainly verifies active functions of components and provides little definitive information regarding the condition of passive components. The applicant also stated that, instead of testing, the Closed Cooling Water Chemistry Program includes measurement of corrosion rates in the RCC system. The applicant further stated that this program is supplemented by one-time inspections in the Chemistry Program Effectiveness Inspection Program for loss of material and cracking and the Heat Exchangers Inspection Program for reduction in heat transfer.

The staff reviewed this exception to the GALL Report and noted that GALL Report AMP XI.M21 states this program monitors the effects of corrosion and SCC by testing and inspection in accordance with EPRI's closed cooling chemistry guidelines. The staff also noted that EPRI's guidelines state that performance testing can be used to confirm that conditions in the closed cooling water system are not degrading heat exchanger performance. The staff finds this program exception acceptable because, in lieu of testing, the applicant's corrosion rate measurements within this AMP, combined with the one-time Chemistry Program Effectiveness Inspection Program, which will manage for loss of material and cracking, and the one-time Heat Exchangers Inspection Program, which will manage for reduction in heat transfer, are equivalent to the testing described in the GALL Report and EPRI's guideline.

Enhancement 1. LRA Section B.2.13 states an enhancement to the "detection of aging effects" program element. The applicant stated that at least one additional corrosion rate measurement in the RCC system will be performed and evaluated prior to the period of extended operation. The applicant further stated that if necessary, based on the results, it will establish a frequency for subsequent measurements.

The staff reviewed this enhancement against the corresponding program element in the GALL Report AMP XI.M21. The staff finds the program enhancement acceptable because the measurement of corrosion rate and one-time inspections will be used to confirm the adequacy of the water chemistry control consistent with the purpose of the items listed in the GALL Report program.

Based on its audit, the staff finds that Elements one through six of the applicant's Closed-Cooling Water Chemistry Program, with acceptable exception and enhancement, are consistent with the corresponding program elements of GALL Report AMP XI.M21 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.13 summarizes operating experience related to the Closed Cooling Water Chemistry Program. The applicant indicated the Closed Cooling Water Chemistry Program is an ongoing program, where monthly reports are generated addressing chemistry performance indicators. The applicant reviewed the CRs and did not identify any abnormal trends in chemistry conditions. The applicant also stated that it did not observe any chemistry control related equipment reliability issues.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant had adequately incorporated and evaluated operating experience related to this program. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.13 provides the UFSAR supplement for the Closed Cooling Water Chemistry Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.1-2, 3.2-2, 3.3 2, and 3.4-2.

The staff also notes that the applicant committed (Commitment No. 13) to ongoing implementation of the existing Closed Cooling Water Chemistry Program for managing aging of applicable components during the period of extended operation. The staff also notes that the applicant committed (Commitment No. 13) to enhance the Closed Cooling Water Chemistry Program prior to entering the period of extended operation. Specifically, the applicant committed to perform at least one additional corrosion rate measurement in the RCC system.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Closed Cooling Water Chemistry Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exception and its justification and determines that the AMP, with the exception, is adequate to manage the aging effects for which the LRA credits it. Also, the staff reviewed the enhancement and confirmed that its implementation, through Commitment No. 13, prior to the period of extended operation would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.5 Electrical Cable Connections Not Subject to 10 CFR 50.49 EQ Requirements Inspection

Summary of Technical Information in the Application. LRA Section B.2.21 describes the new Electrical Cable Connections Not Subject to 10 CFR 50.49 EQ Requirements Inspection Program as consistent, with exception to GALL Report AMP XI.E6, "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements." The applicant stated that the Electrical Cable Connections Not Subject to 10 CFR 50.49 EQ Requirements Inspection Program will detect and identify aging effects for the metallic parts of non-environmentally qualified electrical cable connections within the scope of license renewal. This inspection will address cable connections that are used to connect cable conductors to other cables or electrical end devices, such as motor terminations, switchgear, motor control centers, bus connections, transformer connections, and passive electrical boxes such as fuse cabinets. The applicant also stated that the most common types of connections used in nuclear power plants are splices (butt splices or bolted splices), crimp-type ring lugs, connectors, and terminal blocks. Most connections involve insulating material and metallic parts. The applicant further stated that this aging management inspection will account for aging stressors such as thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation of the metallic parts. The Electrical Cable Connections Not Subject to 10 CFR 50.49 EQ Requirements Inspection is a new aging management activity (a one-time inspection) that will be conducted prior to the period of extended operation.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.E6. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.E6 with the exception of "parameters monitored or inspected." For this element, the staff determined the need for additional clarification, which resulted in the issuance of an RAI.

In GALL Report XI.E6, under Element 3 ("parameters monitored or inspected"), it states that the applicant is to document the technical basis for the samples selected. However, the applicant had not developed the technical basis for selecting samples of bolted connections for one-time inspection. Therefore, in a letter dated July 7, 2010, the staff issued RAI B.2.21-1, asking the applicant to provide the technical basis for selecting samples of connections for one-time inspection.

In its response dated August 31, 2010, the applicant stated that the "parameters monitored or inspected" discussion in LRA B.2.21 states that a representative sample of electrical cable connections will be inspected. The following factors will be considered for sampling: application (high, medium, and low voltage), circuit loading, and physical location (high temperature, high humidity, vibration, etc.) with respect to connection stressors. The applicant also stated that 20 percent of the population with a maximum sample of 25 constitutes a representative sample size. The applicant amended (Amendment 5) LRA B.2.21 to specify that 20 percent of the population with a maximum sample of 25 constitutes a representative sample size.

The staff finds the applicant's response acceptable because the applicant provided the technical basis for selecting samples of connections for one-time inspection. The selected samples are based on application, circuit loading, physical location, and the sample size. The sample selection and sample size are consistent with the GALL Report. The staff's concern described in RAI B.2.21-1 is resolved.

The staff also reviewed portions of the "detection of aging effects" program element associated exception to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff evaluation of this exception follows.

Exception. LRA Section B.2.21 states an exception to the "detection of aging effects." The applicant stated that the one-time inspection does not provide for periodic testing (i.e., at least once every 10 years). Because electrical cable connections for many end devices (such as motors, bus connections, and transformers) are inspected (and repaired or remade as necessary) whenever the end device is tested or worked on, and because Columbia has a thermography program that routinely inspects electrical connections throughout the plant (based on current industry practices), a one-time inspection is adequate. The applicant also stated that this inspection will confirm the absence of aging degradation on electrical cable connections. The technical methodology used by the program (thermography augmented by contact resistance tests) is identical to that of GALL Report AMP XI.E6.

On December 23, 2009, the staff issued the final ISG for license renewal 2007-02, which proposes changes to GALL Report AMP XI.E6, "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements," to recommend a one-time inspection, on a representative sampling basis, to ensure that either aging of metallic cable connections is not occurring or an existing PM program is effective, such that a periodic testing is not required. The staff finds the exception to the "detection of aging effects" element acceptable because the applicant's proposed one-time inspection is consistent with the recommendation of the staff's final LR-ISG-2007-02. Subsequently, the final LR-ISG-2007-02 has been incorporated in the GALL Report, Revision 2.

Operating Experience. LRA Section B.2.21 summarizes operating experience related to the Electrical Cable Connections Not Subject to 10 CFR 50.49 EQ Requirements Inspection Program. The applicant stated that plant operating experience has shown that the Corrective Action Program has addressed issues related to degraded cable connections in recent years. Cable connections have been identified with degraded electrical continuity (i.e., increased resistance), primarily as a result of loosened electrical connections or corrosion. For example, corroded electrical connections were identified in the cooling tower lighting panels (which are not within the scope of license renewal), and an abnormally warm connection on a diesel generator power panel was identified via thermography. The applicant further stated that industry operating experience will be included in the development of this activity.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted walkdowns, interviewed the applicant's staff, and reviewed onsite documentation provided by the applicant. The staff also conducted an independent search of the applicant's operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. Further, the staff performed a search of regulatory operating experience for the period of

January 2000—October 2009. Databases were searched using various key word searches and then reviewed by technical auditor staff.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.21 provides the UFSAR supplement for the Electrical Cable Connections Not Subject to 10 CFR 50.49 EQ Requirements Inspection Program.

The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program as described in SRP-LR Table 3.6-2, as modified by the applicant's implementation of LR-ISG-2007-02 and GALL Report, Revision 2.

The staff also notes that the applicant committed (Commitment No. 21) to implement the new Electrical Cable Connections Not Subject to 10 CFR 50.49 EQ Requirements Inspection Program prior to entering the period of extended operation for managing aging of applicable components.

The staff determines that the information in the UFSAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Electrical Cable Connections Not Subject to 10 CFR 50.49 EQ Requirements Inspection Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent with the GALL Report, Revision 2 and LR-ISG-2007-02. In addition, the staff has reviewed the exception and its justification and determines that the AMP, with the exception is adequate to manage the aging effects for which the LRA credits it. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.6 External Surfaces Monitoring Program

Summary of Technical Information in the Application. LRA Section B.2.23 describes the existing External Surfaces Monitoring Program as consistent, with enhancements, with GALL Report AMP XI.M36, "External Surfaces Monitoring." The applicant described the External Surfaces Monitoring Program as one that manages the following:

- loss of material for steel, stainless steel, aluminum, copper, copper alloy (greater than15 percent zinc (Zn)), and gray cast iron exposed to condensation, air-indoor uncontrolled and air-outdoor

- cracking of aluminum exposed to condensation environments
- hardening and loss of strength for elastomer mechanical sealants and flexible connections in the HVAC systems

Further, the applicant stated that the External Surfaces Monitoring Program is supplemented by the Aboveground Steel Tanks Inspection Program to manage loss of material for the inaccessible external surfaces of carbon steel tanks and tank bottoms. In addition, the applicant stated in Amendment 25 that it plans to inspect the underground piping using the Buried Piping and Inspection Program. The staff's evaluation of the applicant's Buried Piping and Inspection Program is documented in SER Section 3.0.3.2.3.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M36. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.M36, with the exception of the "scope of program," and "monitoring and trending" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

The staff also reviewed the portions of program elements associated with enhancements to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of these enhancements follows.

Enhancement 1. LRA Section B.2.23 states an enhancement to the "scope of program" program element. The applicant stated that it will add aluminum, copper alloy, copper alloy (greater than 15 percent Zn), gray cast iron, stainless steel, and elastomers to the External Surfaces Monitoring Program.

The staff reviewed this enhancement against the corresponding program element in GALL Report AMP XI.M36. The staff noted that the addition of aluminum, copper alloy, copper alloy (greater than 15 percent Zn), gray cast iron, stainless steel, and elastomers, expands the scope of the program beyond what is recommended by the GALL Report. Therefore, the applicant's program scope is not consistent with the GALL Report. By letter dated June 30, 2010, the staff submitted RAI B.2.23-1 requesting that the applicant provide a basis for not taking an exception to GALL Report AMP XI.M36 for managing aging of aluminum, copper, copper alloy (greater than 15 percent Zn), grey cast iron, stainless steel, and elastomer components within the scope of the program.

In its response dated August 26, 2010, the applicant stated that its system engineers can use the EPRI field guide for aging assessment to identify aging effects of the additional materials beyond the scope of GALL Report AMP XI.M36. Further, the staff noted that aging processes for copper alloy, copper alloy (greater than 15 percent Zn), and gray cast iron surfaces exposed to air-indoor uncontrolled and air-outdoor will be similar to steel surfaces, for which the program was intended. These surfaces will produce oxide by-products that are readily identifiable for visual inspections to identify general corrosion of these materials. The staff determined that the applicant has included additional testing such as physical manipulation and visual inspection (VT-1 or equivalent) or volumetric testing that will be able to adequately identify hardening and loss of strength in elastomer mechanical sealants and flexible connections and cracking in aluminum components. Based on its review, the staff finds the program enhancement acceptable because, when implemented, physical manipulation and visual inspection will be effective in detecting loss of material of aluminum, copper alloy, copper alloy (greater than 15 percent Zn), gray cast iron, stainless steel, and elastomer components that are in the scope of the program. The staff's concern described in RAI B.2.23-1 is resolved.

Enhancement 2. LRA Section B.2.23 states an enhancement to the "scope of program" program element. The applicant stated that it will add management of cracking as an aging effect for aluminum components to the External Surfaces Monitoring Program.

The staff reviewed this enhancement against the corresponding program element in GALL Report AMP XI.M36. The staff noted that the inclusion of the management of cracking as an aging effect for aluminum expands the scope of the program beyond what is recommended by the GALL Report. Therefore, the applicant's program scope is not consistent with the GALL Report. By letter dated June 30, 2010, the staff submitted RAI B.2.23-2 requesting that the applicant provide a basis for not taking an exception to GALL Report AMP XI.M36 for including the aging management of cracking.

In its response dated August 26, 2010, the applicant stated that its system engineers can use the EPRI field guide for aging assessment to identify aging effects of the additional materials beyond the scope of GALL Report AMP XI.M36. Further, the staff noted that the applicant included enhancements to its program that include visual (VT-1 or equivalent) or volumetric examination techniques to detect cracking in aluminum components. These inspection techniques have proven reliable for identifying cracking in metal components. Based on its review, the staff finds the program enhancement acceptable because, when implemented, visual inspection (VT-1 or equivalent) or volumetric examination techniques will be effective in detecting cracking in aluminum components that are in the scope of the program. The staff's concern described in RAI B.2.23-2 is resolved.

Enhancement 3. LRA Section B.2.23 states an enhancement to the "scope of program," program element. The applicant stated that it will add management of hardening and loss of strength for elastomer mechanical sealants and flexible connections in the HVAC systems to the External Surfaces Monitoring Program.

The staff reviewed this enhancement against the corresponding program element in GALL Report AMP XI.M36. The staff noted that the applicant's program inclusion of the management of hardening and loss of strength expands the scope of the External Surfaces Monitoring Program beyond what is recommended by the GALL Report. The staff also noted that the applicant's program will be enhanced, beyond the GALL Report AMP XI.M36 recommendations, to detect the aging effect of hardening and loss of strength in elastomer mechanical sealants and flexible connectors using physical examination in addition to visual inspection. The staff determined that the use of physical examination, such as physical manipulation, and visual inspection are effective in detecting hardening and loss of strength in elastomer components prior to loss of intended function. Based on its review, the staff finds the program enhancement acceptable because, when implemented, physical manipulation and visual inspection will be effective in detecting hardening and loss of strength in elastomer mechanical sealants and flexible connections that are in the scope of the program.

Enhancement 4. LRA Section B.2.23 states an enhancement to the "monitoring and trending" program element. The applicant stated that it will add physical examination in addition to visual inspection to detect hardening and loss of strength for elastomer mechanical sealants and flexible connections in the HVAC systems to the External Surfaces Monitoring Program.

The staff reviewed this enhancement against the corresponding program element in GALL Report AMP XI.M36. The staff noted that the applicant's program will be enhanced, beyond the GALL Report AMP XI.M36 recommendations, to detect the aging effect of hardening and loss of strength in elastomer mechanical sealants and flexible connectors using physical examination in addition to visual inspection. The staff determined that the use of physical examination, such as physical manipulation, and visual inspection are effective in detecting hardening and loss of strength in elastomer components prior to loss of intended function. Based on its review, the staff finds the program enhancement acceptable because, when implemented, physical manipulation and visual inspection will be effective in detecting hardening and loss of strength in elastomer mechanical sealants and flexible connections that are in the scope of the program.

Enhancement 5. LRA Section B.2.23 states an enhancement to the "monitoring and trending" program element. The applicant stated that it will add visual (VT-1 or equivalent) or volumetric examination techniques to detect cracking in aluminum components within the scope of the External Surfaces Monitoring Program.

The staff reviewed this enhancement against the corresponding program element in GALL Report AMP XI.M36. The staff noted that the applicant's program will be enhanced, beyond the GALL Report AMP XI.M36 recommendations, to detect the aging effect of cracking in aluminum components using visual inspection (VT-1 or equivalent) or volumetric examination techniques. The staff determined that the visual inspection (VT-1 or equivalent) or volumetric examination techniques are effective in detecting cracking in aluminum components prior to loss of intended function. Based on its review, the staff finds this enhancement acceptable because, when implemented, visual inspection (VT-1 or equivalent) or volumetric examination techniques will be effective in detecting cracking in aluminum components that are in the scope of the program.

Based on its audit, and review of the applicant's responses to RAIs B.2.23-1 and B.2.23-2, the staff finds that Elements one through six of the applicant's External Surfaces Monitoring Program, with acceptable enhancements, are consistent with the corresponding program elements of GALL Report AMP XI.M36 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.23 summarizes operating experience related to the External Surfaces Monitoring Program. In the LRA, the applicant stated that it reviewed plant-specific operating experience, searching for reports that were related to leakage, damage, and degradation relevant to the scope of the External Surfaces Monitoring Program. Based on its review, the applicant stated that its External Surfaces Monitoring Program would be effective to manage loss of material for aluminum, copper, copper alloy (greater than 15 percent Zn) gray cast iron, steel, and stainless steel. With enhancements, it would be able to manage cracking for aluminum and hardening and loss of strength for elastomer mechanical sealants and flexible connections in the HVAC systems.

During the onsite audit, the staff requested additional site-specific operational experience, which was provided by the applicant. The staff reviewed the operational experience and describes two examples of the operation experience provided.

On March 3, 2006, a one-in. tear in the elastomer sealant at an outlet duct was identified during a routine plant walkdown. The tear was documented in a plant-CR, which assessed that the tear did not appreciably affect air flow of the air handling unit. Based on the identification of the tear, a dedicated inspection of similar elastomer sealants was conducted, which identified similar tears in other elastomer sealants. The tears were repaired and assessments were performed, which determined that none of these tears appreciably affected air flows in the affected systems. The applicant presented this example of operational experience as evidence that the External Monitoring Program system walkdowns are effective in identifying degraded components. Further, the applicant states this example provides evidence that Columbia is effective in using operational experience to identify and take corrective actions to mitigate or correct issues resulting from aging and degradation.

On May 11, 2008, the applicant stated that it identified corrosion on a location of CASS piping in the auxiliary boiler room. The cause of the corrosion was determined to be a result of water dripping on to the surface of the piping. The applicant stated that the piping was repaired by removing corrosion products and painting the surface of the pipe. Further, the applicant stated that it evaluated the impact of the corrosion and determined that the integrity of the piping was not significantly affected. The applicant presented this example of operational experience as evidence that the External Monitoring Program walkdowns are effective in identifying and correcting conditions prior to the loss of intended functions.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects, industry, and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

<u>UFSAR Supplement</u>. LRA Section A.1.2.23 provides the UFSAR supplement for the External Surfaces Monitoring Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.2-2, 3.3-2, and 3.4-2.

The staff also notes that the applicant committed (Commitment No. 23) to enhance the External Surfaces Monitoring Program prior to entering the period of extended operation. Specifically, the applicant committed to add the following to the scope of the program:

- aluminum, copper alloy, copper alloy (greater than 15 percent Zn), gray cast iron, stainless steel, and elastomers
- cracking as an aging effect for aluminum components
- visual (VT-1 or equivalent) or volumetric examination techniques to detect cracking
- hardening and loss of strength as aging effects for elastomer mechanical sealants and flexible connections in the HVAC systems

- physical examination techniques in addition to visual inspection to detect hardening and loss of strength for elastomer mechanical sealants and flexible connections in the HVAC systems

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d)

Conclusion. On the basis of its audit and review of the applicant's External Surfaces Monitoring Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.7 Fatigue Monitoring

Summary of Technical Information in the Application. LRA Section B.2.24 describes the existing Fatigue Monitoring Program as consistent, with enhancements, with GALL Report AMP X.M1, "Fatigue Monitoring Program." The program is a combination of TLAAs and transient counting procedures. The applicant stated that the program manages fatigue of the RPV by tracking thermal cycles as required by TS 5.5.5, "Component Cyclic or Transient Limit," and of other components such as ASME Class 1 RCPB, high-energy line break (HELB) locations, and primary containment, by tracking transient cycles. The applicant further added that the program periodically updates the cycle counts, and when the accumulated cycles approach the analyzed design cycles, corrective action is required to ensure the analyzed number of cycles is not exceeded. The applicant also stated that it has assessed the impact of the reactor coolant environment on the sample of critical components identified in NUREG/CR-6260. In addition, the applicant will enhance the Fatigue Monitoring Program to include the cycles analyzed for the effects of the reactor coolant environment on fatigue prior to the period of extended operation.

The applicant also stated that the BWR Vessel Internals Program contributes to managing fatigue of the jet pumps by checking the jet pump set screw gaps each outage.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP X.M1. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP X.M1, with the exception of the "acceptance criteria" program element. For this element, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

The staff noted that the applicant's program acceptance criterion maintains the number of actual transient cycles below the analyzed number of cycles. Furthermore, when the actual cycles approach the analyzed cycles, corrective action is required to ensure the analysis remains valid and may include an update of the fatigue usage factor. However, the staff noted that LRA Section B.2.24 does not provide the details regarding the design cycles that are being tracked for each transient or the action limits. LRA Section 4.3 indicates that the scope of the Fatigue

Monitoring Program includes transients that are listed in UFSAR Section 3.9 and additional transients that are not listed in UFSAR Section 3.9. The staff noted that LRA Section B.2.24 does not identify which UFSAR Section 3.9 transients and transients not in UFSAR Section 3.9 are within the scope of the program.

By letter dated August 26, 2010, the staff issued RAI B.2.24-02 requesting the applicant to identify all UFSAR-defined and non-UFSAR defined transients that are within the "scope of program" and "parameters monitored/inspected" program elements. The staff also requested that the applicant justify any differences between the transients within the scope of the program, UFSAR Section 3.9, and those in LRA Tables 4.3-1 or 4.3-2. Furthermore, the staff asked the applicant to clarify and justify whether or not operating-basis earthquake (OBE) transients need to be within the scope of the Fatigue Monitoring Program.

In its response dated November 11, 2010, the applicant stated that all transients listed in LRA Table 4.3-1 and UFSAR Table 3.9-1 are within the scope of the its Fatigue Monitoring Program with the following exceptions:

- daily reduction to 75 percent power—10,000 cycles
- weekly reduction to 50 percent power—2,000 cycles
- rod pattern change—400 cycles

The applicant further stated that the above cycles are not tracked as part of the Fatigue Monitoring Program because the temperature follows the saturation curve such that power reductions are accomplished with little change in bulk vessel temperature for a BWR. The applicant stated that since the rate of change for both temperature and pressure are very slow and, for most power changes, the total temperature change is less than 5.5 °Celsius (C) (10 °Fahrenheit (F)), these cycles were not included in the design basis fatigue analyses. The applicant also stated that the rod pattern change does not cause a temperature or pressure change for the vessel and attached piping; thus, it does not impact any design basis fatigue analysis. The staff finds that it is reasonable that the power change transients are not monitored because the stress resulting from the slow temperature and pressure changes does not significantly contribute to fatigue usage and were not included in the applicant's design basis fatigue analyses. Furthermore, since the rod pattern transient does not cause a temperature or pressure change, the staff also finds it reasonable that this transient does not need to be monitored because, without a pressure or temperature change, fatigue usage is not incurred.

The applicant also stated that the plant experiences dynamic load cycles that were not listed in UFSAR Table 3.9-1 and are not in the Fatigue Monitoring Program. These fatigue significant dynamic events are listed in UFSAR Table 3A.4.1-3 which lists the following events and cycles:

- OBE—five events with 10 equivalent stress cycles per event for 50 total cycles
- safety relief valve (SRV)—4,478 events with three equivalent stress cycles per event for 13,434 cycles
- chugging—one event with 1,000 equivalent stress cycles for 1,000 total cycles
- safe shutdown earthquake (SSE)—one event with 10 equivalent cycles for 10 total cycles

The applicant stated that the current event count is 876 for SRV and zero for OBE, SSE, and chugging. The applicant stated that the Fatigue Monitoring Program will be modified to count OBE, SRV, and chugging events. The staff noted that, since the applicant added OBE, SRV, and chugging events into the scope of its Fatigue Monitoring Program, this is consistent with the recommendations of the GALL Report to include monitoring of all plant transients that cause cyclic strains, which are significant contributors to the fatigue usage factor. The applicant also explained that since SSE event is a faulted condition, it is not included in the plant fatigue analyses. The staff noted since ASME Code fatigue analysis does not include one-time loads, such as the SSE, the staff finds it reasonable that SSE does not need to be monitored. The applicant stated that any other transient that is determined to be fatigue significant as a result of updating analyses to account for projected 60-year cycles will be added to the scope of its Fatigue Monitoring Program.

Based on its review, the staff finds the applicant's response to RAI B.2.24-02 acceptable for the following reasons:

- The applicant has identified all transients that are within the scope of its Fatigue Management Program.
- The applicant justified any differences between the transients that are within the scope of the program and those listed in LRA Table 4.3-1 and UFSAR Table 3.9-1.
- The applicant clarified which of the plant dynamic load cycles (e.g., OBE, SSE, SRV, and chugging) are included in its fatigue analyses and which will be included in the B.2.24 program.
- The applicant included OBE, SRV, and chugging transients, consistent with the recommendations of GALL Report to include monitoring of all plants transients that cause cycle strains.

The staff's concern described in RAI B.2.24-02 is resolved.

The staff noted that the transient cycle projection data in LRA Table 4.3-2 indicates the cycle counts for some design basis transients (e.g., startup and shutdowns) may exceed its design limits prior to the expiration of the period of extended operation or prior to the expiration of the current operating period. By letter dated August 26, 2010, the staff issued RAI B.2.24-03 requesting the applicant to clarify whether the design transients are projected to exceed the design limits during the current licensed operating period or the period of extended operation. The staff asked the applicant to clarify whether corrective actions for cycle counting will be implemented for the current program or for the enhanced program. If a cumulative number of occurrences for a given transient are projected to exceed the allowable during the current operating period, the staff requested that the applicant clarify whether the appropriate plant engineering department will be notified for action.

In its response dated November 11, 2010, the applicant stated that the transients in LRA Table 4.3-2 that are projected to exceed its design basis limits within the currently licensed 40 years of operation include reactor startups, reactor shutdowns, and scrams with loss of FW pumps. The applicant added that this situation has been brought to management's attention, and corrective actions have been initiated under the existing Cycle-Counting Program via its Corrective Action Program. The applicant also stated that the transient projected to exceed its design basis limit during the period of extended operation is "scrams with turbine trip, feedwater on and isolation valves open." For this transient, the applicant stated that corrective actions may be initiated either under the existing Cycle-Counting Program or under the Fatigue Monitoring Program during the period of extended operation. The applicant also explained that any new fatigue analyses performed prior to the period of extended operation to incorporate additional heatup and cooldown cycles will also include additional cycles of any transient (such as scram with turbine trip, FW on, isolation valves open) that is projected to approach the current analyzed number of cycles during the period of extended operation.

Based on its review, the staff finds the applicant's response to RAI B.2.24-03 acceptable because the applicant has identified the transients in LRA Table 4.3-2 that are projected to exceed its design basis limit during the current licensed operating period and those projected to exceed during the period of extended operation. Additionally, the applicant clarified whether the corrective actions will be initiated under the currently licensed 40-year operation or during the period of extended operation to ensure fatigue usage is maintained below the design limit of 1.0. The staff's concern described in RAI B.2.24-03 is resolved.

The staff noted that, in LRA Section 4.3, the OBE event at rated operating conditions has been excluded from LRA Table 4.3-2, which provides the analyzed cycles and projected cycles. Furthermore, footnote "d" of LRA Table 4.3-1 states that the OBE event includes 50 peak OBE cycles for NSSS piping and 10 peak OBE cycles for other NSSS equipment and equipment. It further states that 50 peak OBE cycles are postulated for all balance of plant piping and components. By letter dated August 26, 2010, the staff issued RAI B.2.24-04 requesting the applicant to explain why the cycles due to an OBE event at rated operating conditions have been excluded from the analyzed cycles and projected cycles for future analyses listed in LRA Table 4.3-2.

In its response dated November 11, 2010, the applicant stated that LRA Table 4.3-2 (actual cycles and projected cycles) will be updated to show that OBE projected cycles remain unchanged, and the change to the LRA is provided in the enclosure as Amendment 13.

Based on its review, the staff finds the applicant's response to RAI B.2.24-04 acceptable because the actual and projected cycles of OBE are incorporated and tracked by the Fatigue Monitoring Program to ensure corrective actions will be taken to maintain fatigue usage below the design limit of 1.0, consistent with the recommendations of the GALL Report AMP X.M1. The staff's concern described in RAI B.2.24-04 is resolved.

LRA Section B.2.24 does not provide the details regarding the action limits and corrective actions for transient cycle counting and cumulative usage factor (CUF) monitoring activities. The staff has noted that the design limit on CUF values and environmentally-adjusted CUF values are set to 1.0; however, for HELB locations, the design limit is set to 0.1. By letter dated August 26, 2010, the staff issued RAI B.2.24-05 requesting that the applicant define the "action limit or limits" used by the program's cycle counting activities and CUF monitoring activities for design basis CUF values, environmentally-assisted CUF values, and Class 1 components associated with the applicant's HELB analyses. The staff also asked the applicant to clarify the corrective actions that with certainty will be implemented and those additional corrective options that may be implemented if an action limit on cycle counting or CUF monitoring is reached.

In its response dated November 11, 2010, the applicant stated that the Fatigue Monitoring Program described in LRA Section B.2.24 does not address action limits because it is compared to the GALL Report AMP X.M1, which also does not include action limits. The applicant added that its Fatigue Monitoring Program counts cycles at least once per year and projects those cycles for the remainder of the plant life. If the projected cycles are expected to exceed the number of cycles analyzed in fatigue analyses (i.e., design CUF analyses, environmentally assisted fatigue analyses, and HELB location analyses), then that condition is entered into its Corrective Action Program, which performs a more detailed evaluation and assigns a corrective action accordingly. The applicant stated that the corrective action could recommend re-evaluation the following year or updating fatigue analyses. The applicant also stated that if the update of the fatigue analyses is unsuccessful, additional corrective actions, such as an inspection program or component repair and replacement that are discussed in LRA Section B.2.24 and are consistent with the GALL Report AMP X.M1, will be evaluated.

Based on its review, the staff finds the applicant's response to RAI B.2.24-05 acceptable because the applicant clarified that the Fatigue Monitoring Program is based on cycle counting, which ensures that the analyzed number of cycles in its design fatigue analysis are not exceeded. Additionally, the applicant described the corrective actions that may be taken, which are consistent with the recommendation of GALL Report AMP X.M1. The staff's concern described in RAI B.2.24-05 is resolved.

The staff also reviewed the portions of the "scope of program," "preventive actions," "monitoring and trending," and "acceptance criteria" program elements associated with enhancements to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of these enhancements follows.

Enhancement 1. LRA Section B.2.24 states an enhancement to the "preventive actions," "monitoring and trending," and "acceptance criteria" program elements. The applicant stated it has analyzed the effects of the reactor coolant environment on fatigue for the six locations recommended by NUREG\CR-6260. Furthermore, these analyses are based on the projected cycles for 60 years of operation (plus some conservatism) rather than the original design cycles in UFSAR Table 3.9-1. The applicant also stated that the Fatigue Monitoring Program will be enhanced to ensure that action will be taken when the lowest number of analyzed cycles is approached.

The staff noted that the "preventive actions" program element states that maintaining the fatigue usage factor below the design code limit and considering the effect of the reactor water environment will provide adequate margin against fatigue cracking due to anticipated cyclic strains. The staff noted that the "monitoring and trending" program element states the program monitors a sample of high fatigue usage locations, which should include the locations identified in NUREG/CR-6260, as a minimum. The staff noted that the "acceptance criteria" program element states that it involves maintaining the fatigue usage below the design code limit, considering environmental fatigue effects.

The staff noted that the applicant's enhanced Fatigue Monitoring Program will include the effects of the reactor coolant environment on fatigue for the six locations recommended by NUREG\CR-6260. The staff noted that the "monitoring and trending" program element recommends including the locations from NUREG/CR-6260, as a minimum; however, the applicant did not justify only including the minimum set and that this set bounds the applicant's plant-specific configuration. By letter dated August 26, 2010, the staff issued RAI 4.3-06 asking the applicant to provide its basis for selecting the RPV and Class 1 piping locations that were chosen as the limiting environmentally-assisted fatigue locations. By letter dated February 3, 2011, the staff issued also RAI 4.3-09 asking the applicant to confirm and justify that the locations selected for environmentally assisted fatigue analyses in LRA Table 4.3-6 consist of the most limiting locations for the plant (beyond the generic components identified in the NUREG/CR-6260 guidance). The staff's evaluation of RAI 4.3-06 and 4.3-09 are documented in SER Section 4.3.5.2.

The staff also noted that the applicant's enhanced Fatigue Monitoring Program will include actions to maintain fatigue usage below the design code limit, will include the effect of the reactor water environment, and will take action when the lowest number of analyzed cycles in its fatigue analyses are approached to ensure the assumptions in these analyses remain valid and the design limit of 1.0 is not exceeded, consistent with the recommendations in the “preventive actions” and “acceptance criteria” program elements.

Based on its review, the staff finds the applicant’s Enhancement 1 acceptable because the applicant has analyzed the effects of reactor water environment on fatigue usage and will ensure the design limit of 1.0 is not exceeded or else corrective actions will be taken, consistent with the recommendations in GALL Report AMP X.M1.

Enhancement 2. LRA Section B.2.24 states an enhancement to the “acceptance criteria” program element. The applicant stated that, for each location that may exceed a CUF of 1.0, the Fatigue Monitoring Program will implement one or more of the following:

- refine the fatigue analyses (by increasing accuracy and decreasing conservatism) to determine valid CUFs less than 1.0
- manage the effects of aging due to fatigue at the affected locations by an approved inspection program (e.g., periodic NDE)
- repair or replace the affected locations before exceeding a CUF of 1.0

The applicant further stated that implementation of one or more of these options will manage the aging effect of fatigue for the period of extended operation, with consideration of the effects of the reactor coolant environment on fatigue.

The staff reviewed this enhancement and noted that this program is a preventive measure to mitigate fatigue cracking of metal components by maintaining the fatigue usage factor below the design code limit. The staff also noted that an acceptable corrective action when cumulative fatigue usage exceeds 1.0, consistent with GALL Report AMP X.M1, is to refine the analysis to increase accuracy and decrease conservatism, which can be achieved by using more realistic values for transient cycles and loading parameters during the transient. However, it is not clear to the staff whether the applicant’s Fatigue Monitoring Program includes more detailed local monitoring of the plant transient to obtain accurate values of the loading parameters and to validate the loading parameters that were used for the fatigue analysis, including environmental effects.

By letter dated June 24, 2010, the staff issued RAI B.2.24-01 asking the applicant to do the following:

- clarify how the Fatigue Monitoring Program provides ongoing assessment of transients on plant components and monitors all plant transients that cause cyclic strains, which are significant contributors to fatigue usage
- address how periodic plant cycle tracking and trending lead to updating plant design basis fatigue analyses
- discuss corrective actions taken when the design code limit is projected to be exceeded during the period of extended operation

In its response dated August 19, 2010, the applicant clarified that it used an enveloping number of design cycles to determine a maximum usage over the plant life; therefore, it does not project that a design code fatigue limit will be exceeded. The applicant noted that it will not project CUFs based upon the transients that have occurred and that plant cycles are tracked and trended annually, including a projection of what the number of events will be at the end of 60 years. The applicant stated that the Fatigue Monitoring Program will not provide an ongoing assessment of transients and will not calculate real-time CUFs. Furthermore, if the projected number of events has the potential to exceed the number of design events, the issue will be entered into the applicant's Corrective Actions Program. The applicant stated that when a projection indicated the number of design cycles may be exceeded, and before the design number of cycles is actually reached, the fatigue analysis will be refined to ensure that the resultant CUF does not exceed 1.0 for the projected number of cycles for 60 years, and the reanalysis will be performed using the revised projected cycles. The applicant stated that if the design code limit is projected to be exceeded, then a refined analysis may be required to increase accuracy and decrease conservatism by using more realistic values for transient cycles and loading parameters such as strain rates and temperature during the transient based upon plant on-line fatigue monitoring data. The applicant stated that if such reanalysis is unsuccessful, other options, such as repair or replacement, will be implemented.

Based on its review, the staff finds the applicant's response to RAI B.2.24-01 and Enhancement 2 acceptable because the applicant clarified the use of cycle counting, including monitoring and trending, to ensure the fatigue usage factors remain within the allowable limit of 1.0. Additionally, the applicant's proposed corrective actions are consistent with the "corrective actions" program element of GALL Report AMP X. M1. The staff's concern described in RAI B.2.24-01 is resolved.

Enhancement 3. LRA Section B.2.24 states an enhancement to the "scope of program" program element. The applicant stated that the program will be enhanced to correlate information relative to fatigue monitoring and provide more definitive verification that the transients monitored and its limits are consistent with or bound the UFSAR and the supporting fatigue analyses, including the environmentally-assisted fatigue analyses.

The staff noted that the "scope of program" program element of GALL Report AMP X.M1 states that preventive measures are included to mitigate fatigue cracking of metal components of the RCPB caused by anticipated cyclic strains in the material. The staff noted that the applicant's enhancement ensures that the assumptions of transient cycles used in the supporting fatigue analyses and environmentally-assisted fatigue analyses are monitored and remain valid, such that fatigue cracking of metal components caused by anticipated cyclic strains in the material is mitigated. The staff noted that these actions that will be taken by the applicant are preventive measures to ensure that cumulative usage on applicable components remains below the design limit of 1.0.

Based on its review, the staff finds the applicant's Enhancement 3 acceptable because, when implemented prior to the period of extended operation, the applicant's program will be consistent with the recommendations in GALL Report AMP X.M1, to include preventive measures to mitigate fatigue cracking caused by anticipated cyclic strains.

Based on its audit, and review of the applicant's responses to RAIs B.2.24-1–B.2.24-4, the staff finds that Elements one through six of the applicant's Fatigue Monitoring Program, with acceptable enhancements, are consistent with the corresponding program elements of GALL Report AMP X.M1 and, therefore, are acceptable.

<u>Operating Experience</u>. LRA Section B.2.24 summarizes operating experience related to the Fatigue Monitoring Program. The applicant stated that the three most recent counting of cycles show the systematic implementation of the Fatigue Monitoring Program. The applicant also stated that in August 2000, Columbia operated for a period of time with the recirculation pumps in an unbalanced mode (i.e., pump speeds were different by more than 50 percent). The effect of the difference in flow on fatigue usage of the jet pumps was evaluated. The applicant further

stated that during RFO in 2005 (R-17), each jet pump mixer was clamped to its diffuser to minimize FIVs. The applicant added that BWR Vessel Internals Program contributes to managing fatigue of the jet pumps by checking the jet pump set screw gaps each outage; as long as the set screw gaps remain within its revised criteria, no additional fatigue due to bypass leakage FIV is accumulated.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.24 provides the UFSAR supplement for the Fatigue Monitoring Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 4.3.2. The staff also notes that the applicant committed (LRA Table A-1, Commitment No. 24) to enhance the Fatigue Monitoring Program prior to entering the period of extended operation. Specifically, the applicant committed to the following enhancements:

- Columbia has analyzed the effects of the reactor coolant environment on fatigue for the six locations recommended by NUREG/CR-6260. These analyses are based on the projected cycles for 60 years of operation (plus some conservatism) rather than the original design cycles in UFSAR Table 3.9-1. The Fatigue Monitoring Program will be enhanced to ensure that action will be taken when the lowest number of analyzed cycles is approached.
- For each location that may exceed a CUF of 1.0 (due to projected cycles exceeding analyzed, or due to as-yet undiscovered industry issues), the Fatigue Monitoring Program will do one or more of the following:
  - refine the fatigue analyses to determine valid CUFs less than 1.0
  - manage the effects of aging due to fatigue at the affected locations by an inspection program that has been reviewed and approved by the NRC
  - repair or replace the affected locations before exceeding a CUF of 1.0.
- The applicant will correlate information relative to fatigue monitoring and provide more definitive verification that the transients monitored and its limits are consistent with or bound the UFSAR and the supporting fatigue analyses, including the environmentally-assisted fatigue analyses.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Fatigue Monitoring Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. Also, the staff reviewed the enhancements and confirmed that its implementation through Commitment No. 24 prior to the period of extended operation would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.8 Fire Protection Program

Summary of Technical Information in the Application. LRA Section B.2.25 describes the existing Fire Protection Program as consistent, with exceptions, with GALL Report AMP XI.M26, "Fire Protection Program." The applicant stated that its Fire Protection Program is credited with managing loss of material, cracking, delamination, separation, and change in material properties for susceptible components in the scope of license renewal that have a fire barrier function. The applicant also stated that periodic visual inspections and functional tests are performed on fire dampers, fire barrier walls, ceilings and floors, fire-rated penetration seals, fire wraps, fire proofing, and fire doors to ensure that functionality and operability are maintained. The applicant further stated that the Fire Protection Program supplements the Fuel Oil Chemistry Program and External Surfaces Monitoring Program through performance monitoring of the diesel-driven fire pump fuel oil supply components and testing and inspection of the halon suppression system, respectively. Further the applicant stated that the fire protection program is a condition monitoring program, comprised of tests and inspections in accordance with National Fire Protection Association (NFPA) recommendations.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M26. As discussed in the audit report, the staff confirmed that each element of the applicant's program for which the applicant claimed consistency with the GALL Report, is consistent with the corresponding element of GALL Report AMP XI.M26, with the exception of the "detection of aging effects," and "monitoring and trending," program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

The GALL Report recommends that periodic tests are performed at least once every RFO, such as flow and discharge tests, sequential starting capability tests, and controller function tests. During the audit, the staff noted that the "detection of aging effects" program element in the program basis document stated that the sequential starting and controller function tests for the diesel-driven fire pump are conducted every 5 years. It is not clear to the staff how the 5-year testing frequency is adequate to manage aging for these systems given that the applicant uses a much longer test interval than the test interval recommended in the GALL Report. The staff also noted that degradation may not be detected in a timely manner before there is a loss of component intended function due to the prolonged test interval.

By letter dated June 24, 2010, the staff issued RAI B.2.25-1 requesting that the applicant provide justification of the test interval of 5 years in the LRA AMP as compared to the interval of at least once every RFO recommended in the GALL Report. In its response dated August 19, 2010, the applicant stated the following:

> The five-year frequency was only documented in the basis document. The purpose of five-year frequency test is related to the plant loss of offsite power testing. Columbia also performs a sequential start/controller function test every 18 months. This surveillance tests the two electric fire pumps and the two diesel driven fire pumps. This is an existing surveillance that was not discussed in the LRA.

Based on its review, the staff finds the applicant's response to RAI B.2.25-1 acceptable because the applicant performs the sequential starting and controller function tests for the diesel-driven fire pumps every 18 months, which is consistent with the GALL Report recommendations. The staff's concern described in RAI 2.25-1 is resolved.

During the audit, the staff noted that the "monitoring and trending" program element in the program basis document stated that there are no aging effects that require management for fire barrier walls, floors, and ceilings, fire wraps, and fire proofing. The applicant stated that the Fire Protection Program will be used to confirm the absence of significant aging effects in the fire barrier walls, floors, and ceilings, fire wraps, and fire proofing during the period of extended operation. The GALL Report states loss of material caused by chemical attack, reaction with aggregates, cracking, and spalling are aging effects for management of fire barriers (walls, floors, and ceilings). During the audit, the staff noted that the applicant's procedure for inspection of fire wraps states that the inspection is to ensure no obvious degradations such as splits, tears, holes, gaps, or missing pieces. The staff also noted that the applicant's procedure for inspection of Thermo-lag states that the inspection is to verify that the Thermo-lag is free of obvious holes, cracks, splits, voids, gouges, or broken pieces. It is not clear to the staff why the applicant does not consider the aging effects of chemical attack, reaction with aggregates, cracking, and spalling for concrete fire barrier walls, floors, and ceilings and the aging effects of splits, tears, cracks, holes, gaps or missing pieces for wire wraps and fire proofing. By letter dated June 24, 2010, the staff issued RAI B.2.25-2 requesting that the applicant justify why the aging effects mentioned above for fire barrier walls, floors, and ceilings, fire wraps, and fire proofing do not have any aging effects that require aging management during the period of extended operation.

In its response to RAI B.2.25-2, dated August 19, 2010, the applicant stated the following:

> While most concrete fire barriers have no aging effects requiring management, there are aging effects (cracking and change of material properties) for concrete walls in the Radwaste Building (LRA Table 3.5.2-8 line 12) and cracking of concrete block walls (LRA Table 3.5.2-4, line 12; Table 3.52-8, line 10; and Table 3.5.2-10, line 11). Corresponding line items for concrete fire barrier walls/floors/ceiling are in the following LRA tables: Tables 3.5.2-2, 3.5.2-5, 3.5.2-8, and 3.5.2-10 with Plant Specific Note 0501. Plant Specific Note 0501 committed the identified aging management program(s) (Structures Monitoring Program and Fire Protection Program) to confirm the absence of significant aging effects for the period of extended operation.

> Fire wraps and fireproofing at Columbia are located inside plant buildings and are exposed to the ambient (Air-indoor) environment within the buildings.
>
> Loss of material due to flaking is not an aging effect requiring management for fire wraps or fireproofing. Based on industry and Columbia experiences, rigid fire wrap materials (trowelable grades with smooth, hard finishes) have not been observed to readily release fibers from the surfaces and are not susceptible to flaking. Fireproofing material at Columbia is applied by trowel technique built up to desired thickness. The texture of the finished application is trowelled smooth. Fireproofing and fireproofed members at Columbia are not exposed to strong airflow or induced vibrations.
>
> Loss of material due to abrasion is not an aging effect requiring management for fire wraps and fireproofing. Fire wraps and fireproofed members at Columbia are not in contact with vibrating items or exposed to continuous movement or vibration (self excited or imposed vibration from adjacent components) that can cause abrasion.
>
> Cracking and delamination due to vibration is not an aging effect requiring management for fire wraps and fireproofing. Fire wraps and fireproofed members at Columbia are not in contact or exposed to continuous movement or vibration (self excited or imposed vibration from adjacent components).
>
> Cracking/delamination and change in material properties due to gamma irradiation exposure is not an aging effect requiring management for fire wraps and fireproofing since this aging mechanism applies to elastomeric material. Therefore, these components are not prone to irradiation damage.
>
> The corresponding line items for fire wraps and fireproofing are in the LRA Table 3.5.2-13, lines 164-168, with Plant Specific Note 0501. Plant Specific Note 0501 committed the identified aging management program (Fire Protection Program) to confirm the absence of significant aging effects for fire wraps and fireproofing the period of extended operation.

Based on its review, the staff finds the applicant's response to staff's RAI B.2.25-2 acceptable because the applicant clarified that cracking and change of material properties are aging effects requiring aging management for concrete walls, floors, and ceilings in the radwaste building, and cracking is an AERM for concrete block walls at the circulation water pump house, radwaste building, and turbine generator building. Additionally, industry and plant operating experience show that loss of material, cracking, and delamination are not applicable aging effects for fire wraps and fire proofings at the station. The staff's concern described in RAI 2.25-2 is resolved.

The staff also reviewed the portions of the “scope of program,” “parameters monitored or inspected,” “detection of aging effects,” and “acceptance criteria” program elements associated with the exceptions to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of these exceptions follows.

Exception 1. LRA Section B.2.25 states an exception to the “scope of program” program element. The applicant stated that a low pressure carbon dioxide (CO_2) system automatically provides fire protection for the turbine generator exciter housing, but neither the turbine generator exciter nor the associated CO_2 suppression system is in the scope of license renewal.

The applicant also stated that aging management of the CO_2 suppression system is not required, and the associated facets of the site Fire Protection Program are not credited for license renewal.

GALL Report AMP XI.M26 includes periodic inspection and testing of the halon and CO_2 fire suppression systems for management of the aging effects on the intended function of the halon and CO_2 fire suppression systems. During the audit, the staff noted that neither the CO_2 fire suppression system for the turbine generator exciter nor the halon 1301 fire suppression system for the main control room subfloor are in-scope for license renewal because the applicant determined that it is not required for the post-fire safe shutdown. It is not clear to the staff whether there were any systems or components added to the LRA when the halon 1301 fire suppression systems were removed from the scope of license renewal. If no systems and components were added, it is unclear which fire suppression system is being used for the control room. By letter dated June 24, 2010, the staff issued RAI B.2.25-4 requesting that the applicant clarify whether there were any systems or components added to the LRA when the halon 1301 fire suppression systems were removed from the scope of license renewal. Additionally, if no systems or components were added, the staff asked the applicant to clarify which fire suppression system is being used for the control room.

In its response to RAI B.2.25-4, dated August 19, 2010, the applicant stated the following:

> The automatic fire protection carbon dioxide system was not originally within the scope of license renewal because Energy Northwest did not determine that the system performed a license renewal intended function. After further review, Energy Northwest established that the fire protection carbon dioxide system is relied upon to demonstrate, compliance with, and meet the 10 CFR 54.4(a)(3) scoping criteria, for the fire protection (10 CFR 50.48) regulated event. The revised boundary drawings showing the increase in scope are provided in Enclosure 2.
>
> The Halon 1301 suppression system and associated components are included within the scope of license renewal; however, this distinction is not clear within the LRA. The revised boundary drawings provided in Enclosure 2 clarify that the Halon 1301 system is within the scope of license renewal.
>
> Also, LRA Section 2.3.3.22, Amendment 1, states the following: "Halon cylinders are within the scope of license renewal. The principal design criterion for these bottles is Department of Transportation Standards (DOT). The Halon cylinders comply with the requirements of the DOT standards. The Halon cylinders are consumables, replaced periodically in accordance with DOT standards, and are not subject to AMR." The Halon cylinders are not replaced periodically and therefore, are subject to AMR. The LRA Amendment 2, provided in Enclosure 1 specifies that the Halon cylinders are subject to AMR.

The staff confirmed that the applicant deleted the exception from the LRA in Amendment 2. Based on its review, the staff finds the applicant's response to staff's RAI B.2.25-4 acceptable because the applicant has included the carbon dioxide and halon 1301 fire suppression systems, including the halon cylinders, within the scope of license renewal and deleted the exception. The staff's concern described in RAI 2.25-4 is resolved.

Exception 2. LRA Section B.2.25 states an exception to the “parameters monitored or inspected” and “detection of aging effects,” program elements. The applicant stated that functional tests and inspections of the halon suppression system that are included in the Fire Protection Program are performed at an interval greater than biannually, which has been demonstrated to be adequate based on the absence of any related problems as reported through the Corrective Action Program.

The GALL Report recommends that the periodic visual inspection and function test is performed at least once every 6 months for the halon and CO_2 fire suppression systems. The staff noted that the applicant did not include the include basis for or duration of the inspection interval. By letter dated October 20, 2010, the staff issued RAI B.2.25-5 requesting that the applicant provide the frequency of the periodic visual inspection and function tests for the halon 1301 and CO_2 fire suppression systems and its basis, including the frequency outlined in its CLB and any TS requirements. Additionally, if the inspection frequency is greater than at least once every 18 months, the staff asked that the applicant provide a detailed summary of any deficiencies found during the last three visual inspection and functional tests for each system.

In its response dated January 20, 2010, the applicant stated that the halon fire suppression system functional actuation test and tank pressure check are each performed every 12 months, and the accessible surfaces of the halon tanks are visually inspected during the tank pressure check. The applicant also stated that the inaccessible portions of the halon tanks are inspected every 3 years when the tanks are removed to be weighed. The applicant further stated that the system is located in the main control room subfloor area, which is temperature-controlled with the surface of the tanks normally dry; therefore, the inaccessible surfaces are not expected to experience aging differently from the accessible portions of the tanks.

Regarding the CO_2 fire suppression system, the applicant stated that the system is visually inspected every 96 weeks, as determined by the PM optimization program, and functionally is tested every 2 years, as determined by engineering evaluation. The applicant also stated that the CO_2 suppression system is located in an area that can only be safely entered during shutdown and the station is on a 2-year refueling cycle. The applicant further stated that the last three functional tests and PM tasks have had no failures.

The applicant stated that both the halon and CO_2 fire suppression systems are non-essential systems which do not support post-fire safe shutdown and whose surveillances are not controlled by the licensee controlled specifications. The staff finds the applicants response to RAI B.2.25-5 and this exception acceptable because both the halon and CO_2 fire suppression systems are non-essential fire suppression systems that are being functionally tested and visually inspected in accordance with station operating experience, and there has been no history of related problems with the halon and CO_2 fire suppression system in the applicant's Corrective Action Program. The staff's concern described in RAI B.2.25-5 is resolved.

Exception 3. LRA Section B.2.25 states an exception to the "scope of program," and "acceptance criteria," program elements. The applicant stated that the Fire Protection Program does not include specific confirmation of "no degradation in the fuel oil supply line for the diesel-driven fire pump." The applicant stated that any degradation noted for fuel oil supply components during periodic performance testing of the diesel-driven fire pumps through the Fire Protection Program is evaluated prior to loss of intended function. The applicant also stated that the Chemistry Program Effectiveness Inspection Program characterizes the condition of the internal surface of the fuel oil supply line (tubing) for confirmation of the effectiveness of the Fuel Oil Chemistry Program.

The "acceptance criteria" program element of GALL Report AMP XI.M26 states that no corrosion is acceptable in the fuel supply line for the diesel-driven fire pump. The staff's review of the applicant's Chemistry Program Effectiveness and Fuel Oil Chemistry Programs is discussed in Sections 3.0.3.1.8 and 3.0.3.2.12, respectively. The staff noted that the Chemistry Program Effectiveness Inspection Program is a new One-Time Inspection Program for detection and characterization the material conditions in representative low-flow and stagnant areas of plant systems, which will provide direct evidence as to whether, and to what extent, a loss of material due to crevice, general, galvanic, or pitting corrosion has occurred in the fuel oil environment. The staff finds this exception acceptable because the "acceptance criteria" program element of the Chemistry Program Effectiveness Inspection Program states that indications or relevant conditions of degradation, such as corrosion, detected during the inspection will be compared to pre-determined acceptance criteria, such as design minimum wall thickness for piping and that if the acceptance criteria are not met, then the indications and conditions will be evaluated under the Corrective Action Program to determine whether it could result in a loss of component intended function during the period of extended operation.

Based on its audit, and review of the applicant's responses to RAIs B.2.25-1, B.2.25-2, B.2.25-4, and B.2.25-5, the staff finds that Program Elements one through six of the applicant's Fire Protection Program, with acceptable exceptions, are consistent with the corresponding program elements of GALL Report AMP XI.M26 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.25 summarizes operating experience related to the Fire Protection Program. The applicant stated that a review of fire barrier, essential fire-rated penetration seal, fire wrap, fireproofing, fire door, diesel-driven fire pumps, and halon suppression system inspections confirmed the reasonableness and acceptability of the inspections and its frequency in that degradation of the subject components, although unrelated to aging, was detected prior to loss of function. The applicant also stated that these inspections have not found any age-related problems. The applicant further stated that a search was performed of CRs for the fire protection system, which found that when conditions were found that required correction, it was appropriately evaluated in accordance with the Corrective Action Program.

The applicant stated that the triennial fire protection team inspections conducted in March of 2006 identified one non-significant, non-cited violation related to electrical circuit vulnerabilities, which was deferred to allow industry evaluation of the issue. It also found one finding of very low safety significance related to multiple "hot" shorts in reactor protection system circuitry and one unresolved item that was not related to the portions of the program credited for aging management. The applicant also stated that the inspection team verified that fire protection-related issues are entered into the Corrective Action Program at an appropriate threshold for evaluation. The applicant further stated that the inspection team reviewed the program implementation of compensatory measures for out-of-service, degraded, or inoperable fire protection, with no findings identified.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff identified operating experience which could indicate that the applicant's program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of an RAI.

An independent search by the staff identified an event in which 15–20 gallons of water spilled onto the floor of the radwaste building cable spreading room (CSR) and leaked down into the remote shutdown room and the Division II switchgear room below the CSR floor (LER 2002-003-00). The pathway for leakage through the floor of the CSR was through cracks in the concrete that allowed a penetration flood seal to be bypassed and through shrinkage and flexural cracks in the concrete floor slab. The root cause of the event was unsealed cracks in the concrete floor slab. The “operating experience” program element of the LRA AMP does not include a description of this LER or discuss any followup corrective action taken as a result of this event. The concrete floor fire barriers in the CSR appeared to have lost its intended function during this event. Given this operating experience example, it is unclear to the staff whether the Fire Protection Program will be effective at managing aging for the components for which it is credited. By letter dated June 24, 2010, the staff issued RAI B.2.25-3 requesting that the applicant describe the root cause evaluation of this event and the followup corrective actions taken to ensure the intended function of the CSR floor fire barrier will be maintained during the period of extended operation.

In its response to RAI B.2.25-3, dated August 19, 2010, the applicant stated the following:

> The root cause of the 15 to 20 gallons of water spilled from a firewater drain line onto the floor of the radwaste building 484' elevation cable spreading room and into the remote shutdown room and the Division II switchgear room is a result of cracks in the concrete floor. The cracks in the concrete floor resulted from flexing and shrinkage of the floor. In the case of the spalled concrete around a penetration seal, the material was degraded to the point that cracks provided a pathway for water to bypass the penetration seal and enter the remote shutdown room. The degradation was caused by cracking of the concrete during installation of the concrete anchors adjacent to the penetration seal.
>
> The cracking occurred due to insufficient distance between the concrete anchors which allowed the formation of tensile shear cracks. This occurrence dealt with event driven (spilled water), design issue (unsealed floor), and improper anchorage installation (not age related). The floor in the radwaste building 484' cable spreading room has been sealed (finish coat). Plant procedures were revised to 1) include inspection criteria for essential flood barriers, coatings and seal, 2) include inspection of surrounding concrete for degradation, and 3) to incorporate the essential flood barriers into the existing 18-month essential fire barrier inspection program.
>
> Based on the sealing of the cable spreading room and procedure revisions for inspection of flood barriers, coating and seal, the intended function of the cable spread room floor barrier will be maintained through the period of extended operation.

Based on its review, the staff finds the applicant's response to RAI B.2.25-3 acceptable because the applicant made appropriate changes to the Fire Protection Program as a result of the event, which included revision of the plant inspection procedure to include the essential floor barriers, coatings, and seals to ensure the intended function of the CSR floor fire barrier will be maintained during the period of extended operation. The staff’s concern described in RAI 2.25-3 is resolved.

Based on its audit and review of the application’s response to RAI B.2.25-3, the staff finds that operating experience related to the applicant’s program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.25 provides the UFSAR supplement, as amended, for the Fire Protection Program. The staff reviewed this UFSAR supplement description of the program and noted that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.3-2. The staff also noted that the applicant committed (Commitment No. 25) to ongoing implementation of the existing Fire Protection Program for managing aging of applicable components during the period of extended operation. The staff determines that the information in the UFSAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Fire Protection Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exceptions and its justifications and determines that the AMP, with the exceptions, is adequate to manage the aging effects for which the LRA credits it. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement, as amended, for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.9 Fire Water Program

Summary of Technical Information in the Application. LRA Section B.2.26 describes the existing Fire Water Program as consistent, with enhancements, with GALL Report AMP XI.M27, "Fire Water System." The applicant stated that its Fire Water Program is a condition monitoring program, comprised of tests and inspections based on National Fire Protection Association (NFPA) recommendations. The program is applicable to a variety of materials, including carbon steel, gray cast iron, copper alloy, copper alloy (greater than 15 percent Zn), and stainless steel, for piping and piping components such as valve bodies, tubing, strainer bodies, standpipes (piping), sprinklers (spray nozzles), pump casings, orifices, and hydrants. It is credited with managing loss of material due to corrosion (including MIC), erosion, macrofouling, selective leaching, and cracking due to SCC and IGA of susceptible water-based fire suppression components in the scope of license renewal. The applicant added that periodic inspection and testing activities include hydrant and hose station inspections, fire main flushing, flow tests, and sprinkler inspections. The applicant also stated that periodic inspection and testing of the water-based fire suppression systems ensures that the systems will remain capable of performing its intended function. The applicant further stated that, prior to the period of extended operation, the Fire Water Program will be enhanced to incorporate sprinkler head sampling or replacements, in accordance with NFPA 25, and either UT or internal visual inspection of representative above ground portions of water suppression piping that are exposed to water.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M27. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.M27, with the exception of the "scope of program" program element. For this element, the staff determined the need for additional clarification, which resulted in the issuance of RAIs, as discussed below.

During its review, the staff noted that in the applicant's Fire Water Program, the "scope of program" program element of GALL Report AMP XI.M27 has been expanded to do the following:

- include components constructed of copper alloys, copper alloys greater than 15 percent Zn, and stainless steels
- manage loss of material due to erosion and macrofouling of all materials
- manage cracking due to SCC/IGA of copper alloy greater than 15 percent Zn components exposed to raw water
- manage loss of material due to selective leaching for the copper alloy greater than 15 percent Zn components exposed to raw water

The staff noted that the "scope of program" element of GALL Report AMP XI.M27 includes managing the loss of material due to corrosion, MIC, or biofouling of only carbon steel and cast iron components exposed to raw water. Also, it does not address cracking due to SCC or loss of material due to erosion, macrofouling, or selective leaching. The staff also noted that inclusion of other materials and other aging effects should be considered enhancements because the GALL Report AMP program scope has been expanded to include other aging effects and components constructed of other materials. However, the LRA does not provide justification that the GALL Report AMP is adequate to manage loss of material due to corrosion, erosion, MIC, or biofouling, and cracking due to SCC of components constructed of these materials. Therefore, by letter dated June 24, 2010, the staff issued RAI B.2.26-1 requesting that the applicant justify why its Fire Water Program, with the enhancement, is adequate to manage loss of material due to erosion and macrofouling of carbon steel, cast iron, copper alloys, copper alloys greater than 15 percent Zn, and stainless steels as well as the loss of material due to corrosion (including MIC) as well as cracking due to SCC/IGA of copper alloys, copper alloys greater than 15 percent Zn, and stainless steels exposed to raw water.

In its response to RAI B.2.26-1, dated August 19, 2010, the applicant stated that the GALL Report recommends the Fire Water System Program to manage loss of material due to general, pitting, crevice, and MIC, and fouling in carbon steel, copper alloy, and stainless steel piping, piping elements, and piping components exposed to raw water in Table VII.G. The applicant also stated that the GALL Report, in Table IX.F, states that "biofouling, as a subset of fouling, can be caused by either macro-organisms (such as barnacles, Asian clams, zebra mussels, and others found in fresh and salt water) or microorganisms, e.g., algae." The staff reviewed the GALL Report and noted that Table IX.F defines that fouling includes particulate fouling, biofouling, and macrofouling. The staff also noted that the GALL Report, in Table VII.G, includes line items for steel, copper alloy, and stainless steel components exposed to raw water and recommends the Fire Water System Program to manage loss of material and fouling.

Regarding the adequacy of its Fire Water Program to manage loss of material due to erosion, the applicant stated that because of the presence of large amounts of particulates in the fire water system, erosion is another mechanism that can cause loss of material in the raw water environment in locations of high fluid velocities and flow discontinuities. The applicant also stated that the fire water system is normally in a standby mode, but erosion may occur in those portions of the system that experience flow during periodic tests. The applicant further stated that to manage the loss of material due to erosion in portions of the system that experience flow during periodic tests, the Fire Water Program will be enhanced to credit the periodic PM activity to perform ultrasonic wall thickness measurements at the most susceptible locations. The staff confirmed that the LRA has been amended (Amendment No. 2) to include an enhancement to perform periodic wall thickness measurements of a representative sample of fire protection locations susceptible to erosion during periodic tests.

Regarding the adequacy of its Fire Water Program to manage cracking due to SCC/IGA, the applicant stated that copper alloys with greater than 15 percent Zn are susceptible to SCC in environments containing ammonia or ammonium compounds, which, for conservatism, are assumed to be present in the raw water environment as a by-product of organic decay, as a by-product of MIC, or possibly from fertilizers. The applicant also stated that although its operating experience had not identified cracking of copper alloys greater than 15 percent Zn exposed to raw water, the Fire Water Program will be enhanced to include visual inspections of a representative sample of susceptible components (spray nozzles, strainer bodies, and valve bodies) for evidence of cracking. The staff confirmed that the LRA has been amended (Amendment No. 2) to include an enhancement to perform visual examinations of copper alloy greater than 15 percent Zn components exposed to raw water.

The staff finds the applicant’s response to RAI B.2.26-1 acceptable for the following reasons:

(a) Macrofouling is a form of fouling, which is within the scope of GALL Report AMP XI.M27; therefore, inclusion of macrofouling in the Fire Water Program is consistent with the GALL Report recommendations.

(b) The GALL Report, in Table VII.G, recommends the Fire Water System Program to manage loss of material due to fouling in carbon steel, copper alloy, and stainless steel piping, piping elements, and piping components exposed to raw water; therefore, inclusion of these components in the Fire Water Program is consistent with the GALL Report recommendations.

(c) The applicant’s Fire Water Program will be enhanced to incorporate periodic ultrasonic wall thickness measurements in those portions of the system that experience flow during periodic tests, which is an appropriate technique to identify loss of material due to erosion.

(d) The applicant’s Fire Water Program will be enhanced to include visual inspections of a representative sample of copper alloy with greater than 15 percent Zn components exposed to raw water, which is an appropriate technique to identify cracking due to SCC/IGA.

The staff’s concern described in RAI B.2.26-1 is resolved.

During its review, the staff noted that neither the LRA or the program basis document provided sufficient details regarding aging management for portions of the fire water system that are normally empty (dry) and below ground. Therefore, by letter dated June 24, 2010, the staff issued RAI B.2.26-2 requesting that the applicant provide a list of fire water system piping and components (and identify whether it is indoor or outdoor), that are normally empty (dry) and below ground. The staff also asked that the applicant describe the AMPs for each of these two types of components.

In its response to RAI B.2.26-2, dated August 19, 2010, the applicant stated that the majority of the fire water system piping and components within the scope of license renewal that are normally empty (dry) are located above ground inside various buildings, which includes piping and components downstream of relief valve discharge lines, lines downstream from closed vent and drain valves, and sprinklers that are normally drained. The applicant also stated that there are no normally empty fire water system piping and components that are located outdoors or buried. The applicant further stated that the environment for the buried piping and components is soil (external) and raw water (internal). Additionally, the applicant stated that fire water system piping and components that are normally empty (dry) are managed by the External Surfaces Monitoring Program, which consists of observation and surveillance activities intended to detect degradation resulting from loss of material due to corrosion for mechanical components. The applicant also stated that the internal surfaces of the fire protection system piping, hydrants, and valve bodies that are buried are managed by the Fire Water Program, and the external surfaces of these components are managed by the Buried Piping and Tanks Inspection Program, which requires visual inspection of a representative sample of the buried piping within the 10-year period prior to the period of extended operation, and additional inspection within 10 years after entering the period of extended operation. The staff's evaluations of the applicant's External Surfaces Monitoring and Buried Piping and Tanks Inspection Programs are documented in SER Sections 3.0.3.2.6 and 3.0.3.2.3, respectively.

During its review of the applicant's response to RAI B.2.26-2, the staff noted that the applicant credited the Inspection of External Surfaces Program to manage aging for the internal surfaces of several components in the fire protection system. In its response the applicant stated, "Also, as described in plant-specific Notes 0302 and 0309 (in LRA Table 3.3.2-22), the monitoring of the external surface condition will be used to characterize the aging effects on the internal surfaces (where the material and environment is the same)." The staff also noted that indoor fire water system piping is often painted or coated, and the condition of coated surfaces cannot be used to characterize internal surfaces of indoor piping and components that are not coated. It is not clear to the staff whether the external surfaces of the above ground indoor fire water system piping and components are coated. By letter dated October 14, 2010, the staff issued a followup to RAI B.2.26-2 requesting that the applicant state whether there are components available for inspection that are constructed of the same material and exposed to the same environment as all of the components for which the LRA credits the External Surfaces Monitoring Program to manage aging for the internal surface. If there are components for which there is no external surface available to characterize the condition of the internal surface of the component, the staff asked that the applicant state how aging will be managed for the internal surfaces.

In its response dated January 18, 2010, the applicant stated that equivalent, unpainted external locations have been identified for all of the internal material and environment combinations, except for the space between the inner and outer vessels of component CN-TK-1. The applicant also stated the environment between the internal and outer vessels of CN-TK-1 was conservatively evaluated as air (internal) instead of a vacuum and, therefore, an equivalent external environment is not necessary because the external surface of the vessel is exposed to a more aggressive outdoor air environment such that aging effects will appear on the external surface before it occurs on the internal surface.

The staff finds the applicant's response to RAI B.2.26-2 and the followup RAI acceptable because it has no normally empty fire protection components that are outdoors or below ground, and the internal and external surfaces of the remaining components are being managed by appropriate programs. Additionally, there are external surfaces available for inspection in equivalent or more aggressive environments as each of the internal surfaces of the components being managed by the External Surfaces Monitoring Program. The staff's concerns described in RAI B.2.26-2 and its followup RAI are resolved.

The staff also reviewed the portions of the "scope of program," "parameters monitored or inspected," "detection of aging effects," and "acceptance criteria" program elements associated with the enhancements to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of these enhancements follows.

Enhancement 1. LRA Section B.2.26 states an enhancement to the "parameters monitored or inspected" and "detection of aging effects," program elements. The applicant stated that the Fire Water Program will be enhanced to perform either UT or internal visual inspection of representative portions of above ground fire protection piping that are exposed to water but do not normally experience flow. The applicant stated that these inspections would occur after the issuance of the renewed license but prior to the end of the current operating term and at reasonable intervals thereafter, based on engineering review of the results. The staff reviewed this enhancement and noted that the GALL Report recommends that wall thickness evaluations or visual inspections of the internal surfaces of the piping be performed before the end of the current operating term and at plant-specific intervals thereafter during the period of extended operation. The GALL Report also recommends that the plant-specific intervals be determined by engineering evaluation of the fire protection piping to ensure that degradation will be detected before loss of intended function. On the basis of its review, the staff finds this enhancement acceptable because, when it is implemented prior to the period of extended operation, it will make the program consistent with the recommendations in GALL Report AMP XI.M27.

Enhancement 2. LRA Section B.2.26 states an enhancement to the "detection of aging effects" program element. The applicant stated that, prior to the period of extended operation, it will either replace sprinkler heads that have been in place for 50 years or submit representative samples to a recognized laboratory for field service testing in accordance with NFPA 25 recommendations. The applicant also stated that subsequent replacement or field service testing of representative samples will be performed at 10-year intervals thereafter or until there are no sprinkler heads installed that will reach 50 years of service life during the period of extended operation. The staff noted that these inspection intervals and procedures are consistent with the recommendations in the GALL Report. On the basis of its review, the staff finds this enhancement acceptable because, when it is implemented prior to the period of extended operation, it will make the program consistent with the recommendations in GALL Report AMP XI.M27.

Enhancement 3. LRA Section B.2.26 states an enhancement to the "acceptance criteria" program element. The applicant stated that, prior to the period of extended operation, Columbia will perform hardness testing (or equivalent) of the sprinkler heads as part of its NFPA sampling to determine whether loss of material due to selective leaching is occurring. The staff reviewed this enhancement and noted that SRP-LR Table 3.3-1, Item 84, recommends GALL Report AMP XI.M33, "Selective Leaching of Materials" to manage loss of material due to selective leaching of copper alloy greater than 15 percent Zn piping, piping components, piping elements, and heat exchanger components exposed to raw water, treated water, or closed cycle cooling water. GALL Report AMP XI.M33 recommends a one-time visual inspection and hardness measurement of selected components that may be susceptible to selective leaching to determine whether loss of material due to selective leaching is occurring and whether the process will affect the ability of the components to perform its intended function during the period of extended operation. The GALL Report also recommends that, if selective leaching is occurring, an engineering evaluation be initiated to determine acceptability of the affected components for further service. If necessary, the evaluation should include a root cause analysis.

During its review of the applicant's Fire Water Program and its basis document, the staff noted that the AMP does not include any details regarding how it will detect whether selective leaching has occurred, acceptance criteria, or whether followup evaluation is required when selective leaching is identified. By letter dated July 15, 2010, the staff issued RAI B.2.26-3 requesting that the applicant describe how selective leaching of copper alloy greater than 15 percent Zn components will be detected by hardness testing or equivalent method. The staff also asked the applicant to define the acceptance criteria and followup actions that will be implemented when selective leaching is identified.

In its response dated September 13, 2010, the applicant stated that the Fire Water Program includes visual inspection of sprinklers and associated piping and fittings for corrosion, obstructions, and damage. The applicant also stated that either all sprinkler heads will be replaced or hardness testing of a sampling of sprinkler heads will be performed by the Fire Water Program. The applicant further stated that hardness testing will be performed in accordance with and using the acceptance criteria in applicable NFPA standards and laboratory testing procedures, test results will be evaluated by engineering, and any required followup actions will be handled in accordance with the QA Program, as discussed in LRA Section B.1.3. The staff finds the applicant's response and the enhancement acceptable because hardness testing is capable of detecting whether selective leaching is occurring, acceptance criteria will be established in accordance with applicant industry standards, and deficiencies will be evaluated by engineering. The staff's concern described in RAI B.2.26-3 is resolved.

Enhancement 4. In its response to RAI B.2.26-1 dated August 19, 2010, discussed in the "Staff Evaluation" section above, the applicant stated that the "parameters monitored or inspected" and "detection of aging effects" program elements of its Fire Water Program will be enhanced to incorporate periodic UT of representative portions of the above ground fire protection piping that experiences flowing water during periodic tests and are susceptible to loss of material due to erosion. The applicant also stated that it will perform engineering review of the results and trends to determine future inspection intervals and expansion of representative portions, if needed.

The staff reviewed this enhancement and noted that the GALL Report recommends that wall thickness evaluations or visual inspections of the internal surfaces of the piping be performed before the end of the current operating term and at plant-specific intervals thereafter during the period of extended operation. The staff finds this enhancement acceptable because the applicant has plant-specific operating experience of loss of material due to erosion in the fire water system and has included an appropriate inspection method, UT, to determine whether loss of material due to erosion is occurring.

Enhancement 5. In its response to RAI B.2.26-1 dated August 19, 2010, discussed in the "Staff Evaluation" section above, the applicant stated that the "scope of program" and "detection of aging effects" program elements of its Fire Water Program will be enhanced to include visual inspections of a representative sample of copper alloy with greater than 15 percent Zn components (spray nozzles, strainer bodies, and valve bodies) exposed to water for evidence of cracking within the 10 year period prior to entering the period of extended operation and within 10 years after entering the period of extended operation.

The staff noted that cracking is an applicable aging effect for copper alloy with greater than 15 percent Zn components in contact with water where ammonia or ammonium compounds may be present. The staff finds this enhancement acceptable because the applicant has included an appropriate aging effect, cracking, and an appropriate method for detecting whether the aging effect is occurring.

Enhancement 6. In its response to RAI B.2.26-6/B.2.42-4 dated January 28, 2011, discussed in the "Operating Experience" section below, the applicant stated that the "scope of program" and "detection of aging effects" program elements of its Fire Water Program will be enhanced to address loss of material due to cavitation erosion with activities such as scheduled inspections of the fire protection piping locations that have had indications of cavitation erosion in the past.

The staff finds this enhancement acceptable because the applicant has plant-specific operating experience of loss of material due to cavitation erosion in the fire water system and has included an appropriate inspection method to manage loss of material due to cavitation erosion in those areas where it has been identified.

Based on its audit, and the responses to RAIs B.2.26-1, B.2.26-2, followup to B.2.26-2, and B.2.26-6/B.2.42-4, the staff finds that Elements one through six of the applicant's Fire Water Program, with acceptable enhancements, are consistent with the corresponding program elements of GALL Report AMP XI.M27 and, therefore, are acceptable.

<u>Operating Experience</u>. LRA Section B.2.26 summarizes operating experience related to the Fire Water Program. The applicant stated that, with one exception (a water hammer event in 1998 that led to a valve rupture and subsequent flooding), the water-suppression systems have demonstrated reliable performance with no significant problems in the approximate 20 years since its installation. The applicant also stated that the NRC presently conducts triennial fire protection team inspections at the station to assess whether an adequate Fire Protection Program has been implemented and maintained, and the most recent inspection in March 2006 identified one non-significant, non-cited violation (related to electrical circuit vulnerabilities), one finding of very low safety significance (related to multiple "hot" shorts), and one unresolved item that was not related to the portions of the program credited for aging management. The applicant further stated that the inspection provided verification that manual and automatic detection systems were installed, tested, and maintained in accordance with the NFPA code of record. The applicant added that no NRC concerns or station management concerns were identified with respect to inspection, testing, and maintenance of water-suppression portions of the fire protection system.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff identified operating experience which could indicate that the applicant's program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of RAIs, as discussed below.

In its review of Columbia operating experience, the staff noted problem evaluation request (PER) 201-0825 dated May 17, 2001, regarding biofouling (MIC) found in the fire protection system in which analysis of water samples taken from wet pipe sprinkler systems for buildings 80 and 88, and solid materials discovered on the alarm valve in the wet system for building 62 indicated significant MIC in the form of sulfate reducing bacteria in the solid from building 62 and the wet system for building 80. The MIC concern was considered moderate for these two buildings and low for the system in building 88; since building 88 is only 1 year old and buildings 62 and 80 are about 20 years old. The applicant's initial assessment stated that MIC corrosion may, at some point, lead to a breach of the system in the form of pinhole leaks. The followup corrective actions to mitigate MIC stated in the PER included sampling of the fire protection system water for MIC concurrent with the annual performance testing and initiation of a MIC trending program for the various plant systems. However, the staff noted that although the Fire Water System Program includes activities capable of managing the aging effects of MIC, neither the LRA nor any of the other supporting documents reviewed during the AMP audit discussed the results of the followup analyses and trending performed regarding the MIC concern in the fire protection system. Without this information, it is unclear to the staff whether the MIC issues in the fire protection system are being adequately managed by the Fire Water System Program. By letter dated August 6, 2010, the staff issued RAI B.2.26-4 requesting that the applicant describe the water sampling and MIC trending program results for the fire protection systems and discuss how these results are used to mitigate MIC.

In its response dated September 24, 2010, the applicant stated that, as a result of the referenced PER, periodic water sampling is performed for MIC during sprinkler system flushes and that scrapes or solid swabs are taken from inside sprinkler system piping. The applicant also stated that samples are evaluated by a laboratory, entered into a database for trending, and used to determine if additional actions are required to return the system to optimal condition. The applicant further stated that recent trends indicate that MIC is not pervasive within the fire protection system. The staff finds the applicant's response to RAI B.2.26-4 acceptable because the applicant has revised its Fire Water System Program to include water sampling and scrape or solid swab testing activities to manage loss of material due to MIC as a result of this operating experience example and subsequent plant-specific operating experience confirms that the appropriate actions have been taken. The staff's concern described in RAI B.2.26-4 is resolved.

In its review of Columbia operating experience the staff noted CR 2-05-01670 dated March 22, 2005, in which UT of 10-in. piping downstream of valves in the fire water system identified significant internal pipe wall thinning at two separate locations due to cavitation erosion. In both cases, the valves were used to throttle flow when performing annual performance tests of the fire pumps. The followup actions stated in the CR included periodic NDE of the pipe downstream from the two valves and established a database to track and trend the wall thickness of piping downstream of throttle valves in fire protection system piping. The staff also noted that, although the applicant's Fire Water Program includes activities capable of managing the aging effects of erosion due to cavitation (e.g., volumetric examinations of piping), there is no supporting information in the LRA regarding how cavitation erosion is being managed by the Fire Water Program (e.g., inspection technique and frequency). Without this information, it is unclear to the staff whether this plant-specific loss of material aging effect is being adequately managed by the Fire Water Program. By letter dated August 3, 2010, the staff issued RAI B.2.26-5 requesting that the applicant do the following:

- describe the followup corrective actions taken to mitigate cavitation erosion damage in the fire protection system piping addressed in CR 2-05-01670, including the NDE technique that is being used to manage cavitation erosion for those components and the basis for the inspection frequency

- describe how wall thickness reference points are established if volumetric testing is not being performed
- based on plant-specific operating experience for other systems within the scope of license renewal, describe where cavitation erosion has been identified and what programs are being used to manage cavitation erosion

In its response dated September 27, 2010, the applicant stated that it performs periodic UT to manage cavitation erosion within the fire protection system and has performed evaluations of erosion rates to determine the inspection frequency for the two locations being monitored. The applicant also stated that an extent of condition review for susceptibility to cavitation erosion was performed. The applicant further stated that a piping system cavitation guide was developed using EPRI guidelines, plant-specific calculations and specifications, the *Chemical Engineer's Handbook*, Fifth Edition, "Cavitation Erosion Model," and ISA RP75.23-1995, "Considerations for Evaluating control Valve Cavitation." However, the applicant did not provide the criteria being used to predict locations susceptible to cavitation erosion.

The applicant stated the root cause analysis conducted as a result of the cavitation erosion concluded that high energy systems were being addressed by the Flow-Accelerated Corrosion Program, but it subsequently identified that the Flow-Accelerated Corrosion Program in effect at that time did not check for cavitation erosion. The applicant also stated that locations that were mitigated with the installation of stainless steel pipe to resolve the identified cavitation erosion issues should have had subsequent inspections to ensure that the material change adequately addressed the cavitation erosion issue but did not. The applicant further stated that these two issues have been entered into its corrective action process for resolution.

Given that the extent of condition review for cavitation erosion at the station was incomplete, the staff cannot evaluate whether all of the AERMs have been identified for the components in those systems susceptible to cavitation erosion. The staff also cannot evaluate whether the criteria used to predict locations susceptible to cavitation erosion were acceptable because the criteria were not provided. The staff noted that LRA Section B.2.26 and Commitment No. 26 state an enhancement to the Fire Protection Program to "perform either ultrasonic testing or internal visual inspection of representative portions of the above-ground fire protection piping, which normally do not experience flow," but the LRA does not include any information regarding what specific examination will be performed to manage cavitation erosion. By letter dated December 27, 2010, the staff issued RAI B.2.26-6/B.2.42-4 requesting that the applicant do the following:

(a) Provide the complete list of AMR line items that are susceptible to loss of material due to cavitation erosion and describe any proposed changes to the existing AMPs required to manage cavitation erosion for these components.

(b) Describe the criteria used in the extent of condition evaluation for cavitation erosion and in the plant-specific cavitation guide and, if either of the criteria are less conservative then the mechanism-specific criteria described in NRC approved EPRI TR-112757, "Revised Risk-Informed Inservice Inspection Evaluation Procedure," provide the technical basis for why the criteria used will ensure component intended functions are maintained during the period of extended operation.

(c) Clarify how the periodic ultrasonic inspections of the locations susceptible to cavitation erosion in the fire protection system are included within the scope of the Fire Protection Program.

In its response to question (a) of RAI B.2.26-6/B.2.42-4 dated January 28, 2011, the applicant stated that the SSW, plant service water (TSW), circulating water, tower makeup, and fire protection systems were originally considered susceptible to cavitation erosion, but the condensate and reactor feedwater (RFW) systems were not included in the original scope. The applicant also stated that a corrective action was written to screen the condensate and RFW systems for cavitation. The applicant committed (Commitment No. 68) to ensure that the condensate and RFW systems are screened for cavitation prior to entering the period of extended operation, and if either system is determined to be susceptible to loss of material due to cavitation, the applicant will modify or create a program to manage the loss of material. The staff finds the applicants response to question (a) of RAI B.2.26-6/B.2.42-4 acceptable because the applicant has committed to screen those systems for susceptibility to cavitation that were not originally screened prior to the period of extended operation and to create or modify a program to manage loss of material due to cavitation for those systems if cavitation is identified.

The staff's evaluation of the applicant's response to question (b) of RAI B.2.26-6/B.2-42-4 is documented in SER Section 3.0.3.2.17, "Open-Cycle Cooling Water Program."

In its response to question (c) of RAI B.2.26-6/B.2.42-4 dated January 28, 2011, the applicant stated that it will enhance the Fire Water Program to credit ultrasonic examination in cavitation susceptible locations. The staff finds the applicant's response to question (c) of RAI B.2.26-6/B.2.42-4 acceptable because the applicant is using an appropriate method, periodic ultrasonic examinations, to manage loss of material due to cavitation erosion for those areas susceptible to cavitation. The staff's concern described in RAI B.2.26-6/B.2.42-4 is resolved.

Based on its audit, review of the application, and review of the applicant's response to RAIs B.2.26-4, B.2.26-5, and B.2.26-6/B.2.42-4, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.26 provides the UFSAR supplement for the Fire Water Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.3-2. The staff also notes that the applicant committed (Commitment No. 26) to enhance the Fire Water Program prior to entering the period of extended operation. The staff further noted that the applicant amended its commitment (Commitment No. 26) to enhance the Fire Water Program in Amendment 2 dated August 19, 2010, and in Amendment 26 dated January 28, 2011. Specifically, the applicant committed to the following enhancements:

- perform either UT or internal visual inspections of representative portions of above ground fire protection piping that is exposed to water but does not normally experience flow, after the issuance of the renewed license, but prior to the end of the current operating term and at reasonable intervals thereafter, based on engineering review of the results

- replace sprinkler heads that have been in place for 50 years or submit representative samples to a recognized laboratory for field service testing, in accordance with NFPA 25 recommendations, and perform subsequent replacement or field service testing of representative samples at 10-year intervals thereafter or until there are no sprinkler heads installed that will reach 50 years of service life during the period of extended operation
- perform hardness testing (or equivalent) of the sprinkler heads as part of its NFPA sampling to determine whether loss of material due to selective leaching is occurring
- perform UT of representative portions of the above ground fire protection piping that is exposed to flowing water during periodic tests and susceptible to loss of material due to erosion
- perform visual inspection of a representative sample of copper alloy with greater than 15 percent Zn fire protection components for evidence of cracking within the 10-year period prior to entering the period of extended operation
- perform an additional visual inspection of a representative sample of copper alloy with greater than 15 percent Zn fire protection components exposed to water for evidence of cracking within the 10-year period after entering the period of extended operation
- address loss of material due to cavitation erosion with activities such as scheduled inspection of the fire protection piping locations that have had indications of cavitation erosion in the past

The staff also determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Fire Water Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. Also, the staff reviewed the enhancements and confirmed that its implementation through Commitment No. 26 prior to the period of extended operation would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.10 Flexible Connection Inspection

Summary of Technical Information in the Application. LRA Section B.2.27 originally described the new Flexible Connection Inspection Program as consistent, with an exception, with GALL Report AMP XI.M32, "One-Time Inspection." During its review, the staff identified inconsistencies in the use of a One-Time Inspection Program to manage aging for components for which the GALL Report recommends an aging effect. As a result, by letter dated January 28, 2011, the applicant revised its Flexible Connection Inspection Program to become a new, plant-specific AMP. The staff's evaluations of the RAIs submitted regarding the original Flexible Connection Inspection Program are documented below. The resolutions to these RAIs have been incorporated into the new plant-specific program. The staff's evaluation of the new plant-specific Flexible Connection Inspection Program is documented in SER Section 3.0.3.3.6.

Staff Evaluation of RAIs. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M32 and identified inconsistencies with the "parameters monitored/inspected" and "detection of aging effects" program elements. For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs, as discussed below. The staff also identified inconsistencies in the use of a One-Time Inspection Program to manage aging for components for which the GALL Report recommends an aging effect, which resulted in the issuance of an RAI, as discussed below.

GALL Report AMP XI.M32 recommends that inspections are to be performed by qualified personnel under the "parameters monitored or inspected," program element description; however, the staff noted that the applicant did not describe the inspecting personnel's qualifications. By letter dated July 15, 2010, the staff issued RAI B.2.A-1 requesting that the applicant provide details on the qualifications and training requirements for its personnel assigned to perform the inspections and its conformance to the applicable ASME Codes.

In its response dated September 13, 2010, the applicant stated that personnel performing the visual examinations, UT, or other NDE techniques in accordance with ASME Code Section V and ASME Code Section XI will be trained in accordance with ASME Code requirements. The applicant further stated that training requirements for all inspections will be consistent with 10 CFR Part 50, Appendix B.

The staff finds the applicant's response acceptable because the one-time inspection will be performed by qualified personnel following procedures consistent with the ASME Code and 10 CFR Part 50, Appendix B. The staff's concern described in RAI B.2.A-1 is resolved.

GALL Report AMP XI.M32 recommends that "the inspection includes a representative sample of the system population, and where practical, focuses on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin." However, under the "detection of aging effects" program element description, the applicant stated that the sample population will be determined by engineering evaluation based on sound statistical sampling methodology. By letter dated July 15, 2010, the staff issued RAI B.2.A-2 requesting that the applicant provide details on the proposed sampling methodology.

In its response dated September 13, 2010, the applicant stated that the selected components will be those most susceptible to aging effects defined by time in service, severity of operating conditions, and design margins. The applicant provided a flow chart that described how the sample size would be selected based on the discrete number of components in the population. For example, in a population size of 21–200 components, 5 percent of the components would be inspected. The applicant also stated that supplemental inspection sample size would be determined as part of the corrective action process. However, the staff noted that a larger sample sizes may be required to adequately confirm an aging effect is not occurring because of the uncertainty in determining the most susceptible locations and the potential for aging to occur in other locations. By letter dated December 3, 2010, the staff issued RAI B.2.A-3 requesting that the applicant provide technical justification for ensuring, based on the sample size chosen, that the components not inspected are not experiencing degradation.

In its response dated January 20, 2011, the applicant stated that the Flexible Connections Inspection Program will be revised to become a plant-specific program and will no longer be a One-Time Inspection Program. By letter dated January 28, 2011, the applicant revised its Flexible Connections Inspection Program to become a new plant-specific AMP. The applicant stated that the new plant-specific program will include baseline inspections of 20 percent of the population of each material, environment, and aging effect group, with up to a maximum of 25 inspections per group. The applicant also stated that the inspections will be focused on the components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margins. The staff finds the applicant's response acceptable because the applicant's sampling methodology ensures that a representative sample of material and environment combinations is considered, ensures sample locations will focus on the most susceptible components, and includes an appropriate sample size. The staff's concerns described in RAIs B.2.A-2 and B.2.A-3 are resolved.

Conclusion. On the basis of its review, the staff concludes that the applicant is no longer claiming its program is consistent with GALL Report AMP XI.M32. The staff's evaluation, acceptance, and conclusion on the adequacy of the applicant's new plant-specific Flexible Connections Inspection Program is documented in SER Section 3.0.3.3.6.

3.0.3.2.11 Flow-Accelerated Corrosion

Summary of Technical Information in the Application. LRA Section B.2.28 describes the existing Flow-Accelerated Corrosion Program as consistent, with an enhancement, with GALL Report AMP XI.M17, "Flow-Accelerated Corrosion (FAC) Program." The applicant stated that the Flow-Accelerated Corrosion Program will manage loss of material for steel and gray cast iron components located in the treated water environment of systems that are susceptible to flow-accelerated corrosion. The applicant further stated that the program follows the guidance and recommendation of EPRI NSAC-202L Revision 03, "Recommendations for an Effective Flow-Accelerated Corrosion Program."

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M17. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.M17, with the exception of the "parameters monitored or inspected" program element. For this element, the staff determined that additional clarification is needed. This resulted in the issuance of an RAI.

In Element 3, "parameters monitored or inspected," of the LRA AMP, the applicant states that Columbia monitors and inspects pipe wall thickness but did not provide information regarding the accuracy of the Flow-Accelerated Corrosion Program in predicting flow-accelerated corrosion degradation in components. The GALL Report recommends that the effects of flow-accelerated corrosion on the intended function of piping and components be monitored by measuring wall thickness.

In RAI B.2.28.1-1 dated June 21, 2010, the staff requested that the applicant provide a sample list of components, from the systems most affected by flow-accelerated corrosion, for which thinning is predicted and measured by UT or other methods to assess the accuracy of the flow-accelerated corrosion predictions from the CHECWORKS™ steam/feedwater application (SFA) model. In its response dated August 19, 2010, the applicant included a sample list of system components for which wall thinning is predicted and measured by UT in a table titled, "Wear Rate Analysis: Combined Summary Report." The list includes the initial wall thickness (nominal), current (measured) wall thickness, and the thickness predicted by the CHECWORKS™ SFA model. The data submitted by the applicant shows that the CHECWORKS™ SFA model predicts the measured thickness within an average of 9 percent of the actual measured thickness. The CHECWORKS™ SFA model predicted measurements are conservative when compared to the actual measurements of the components and the highest average wear rate was observed to be 14 millimeters per year for component COND-5601-N in the condensate system.

With the information provided in the applicant's RAI response, the staff finds the program acceptable because the CHECWORKS™ SFA model is able to conservatively predict the wall thickness in piping components susceptible to flow-accelerated corrosion, which makes the program consistent with the one described in GALL Report AMP XI.M17. The staff's concern described in RAI B.2.28-1 is resolved.

The staff also reviewed the portions of the "scope of program" program element associated with an enhancement to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this enhancement follows.

Enhancement 1. LRA Section B.2.28 states an enhancement to the "scope of program," program element. This enhancement expands on the existing Program Element 1 by adding the CN system components supplied with steam from the auxiliary steam system and adding gray cast iron as a material identified as susceptible to flow-accelerated corrosion. The applicant further stated that the enhancements will be implemented prior to the period of extended operation.

The staff reviewed this enhancement against the corresponding program element in GALL Report AMP XI.M17. The staff noted that the applicant uses the methodology in EPRI guidance document NSAC 202L to predict and monitor the wear rate in piping systems susceptible to flow-accelerated corrosion. The predictive methodology (i.e., CHECWORKS™ SFA) discussed in this document is modeled for carbon and low-alloy steel piping. The predictive methodology is not modeled for gray cast iron material. The LRA does not contain information regarding the method that will be used to monitor or inspect gray cast iron components susceptible to flow-accelerated corrosion.

In RAI B.2.28-2 dated August 16, 2010, the staff asked the applicant to discuss how monitoring and inspection of gray cast iron susceptible to flow-accelerated corrosion will be performed to ensure that structural integrity will be maintained. In its response dated September 21, 2010, the applicant confirmed that CHECWORKS™ SFA is not a suitable model for gray cast iron components susceptible to flow-accelerated corrosion (i.e., steam trap bodies). As such, the applicant stated that engineering judgment is the primary tool used in selecting examination locations for such systems and components. In addition, the applicant stated that, as recommended by NSAC-202L, when examinations detect significant unexpected flow-accelerated corrosion wear in a component, the sample size for the line is expanded and is repeatedly expanded until no additional components with significant wear are detected. The applicant further stated that piping components that are determined to not meet the wall thickness requirements for continued operation are repaired or replaced.

The staff finds the applicant's response acceptable for the following reasons:

- The use of engineering judgment by flow-accelerated corrosion experienced engineers is an acceptable tool, per NSAC-202L, to select examination locations and ensure that the sample size is sufficient.
- When examinations detect significant unexpected flow-accelerated corrosion wear, the sample size is expanded until no additional component with significant wear is detected.
- The applicant will repair or replace piping components that are determined to not meet the wall thickness requirements for continued operation.

On the basis of its review, the staff finds this enhancement acceptable because, when it is implemented prior to the period of extended operation, it will make the program consistent with the recommendations of GALL Report AMP XI.M17. The staff's concern described in RAI B.2.28-2 is resolved.

Based on its audit, and review of the applicant's responses to RAIs B.2.28-1 and B.2.28-2, the staff finds that Elements one through six of the applicant's Flow-Accelerated Corrosion Program, with an acceptable enhancement, are consistent with the corresponding program elements of GALL Report AMP XI.M17 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.28 summarizes operating experience related to the Flow-Accelerated Corrosion Program. The applicant stated that the Flow-Accelerated Corrosion Program is an ongoing program that has implemented the recommended actions of GL 89-08, "Erosion/Corrosion Induced Pipe Wall Thinning." The applicant stated that, based on INPO operating experience 14865, the program was enhanced to require evaluation of replacements for future inspection. The applicant also stated that periodic self-assessments are also conducted, and gaps identified during the most recent self-assessment have all been closed. The Flow-Accelerated Corrosion Program plan was recently updated, and the current revision addresses all issues identified by the self-assessment. The applicant stated that the last self-assessment was performed in March 2007, and no issues or weaknesses were identified.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant had adequately incorporated and evaluated operating experience related to this program.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.28 provides the UFSAR supplement for the Flow-Accelerated Corrosion Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.1-2, 3.2-2, and 3.4-2.

The staff also notes that the applicant committed (Commitment No. 28) to ongoing implementation of the existing Flow-Accelerated Corrosion Program for managing aging of applicable components during the period of extended operation.

The staff also notes that the applicant committed (Commitment No. 28) to enhance the Flow-Accelerated Corrosion Program prior to entering the period of extended operation. Specifically, the applicant committed to, "add the Containment Nitrogen System components supplied with steam from the Auxiliary Steam System to the scope of the program." In addition, the applicant committed to, "add gray cast iron as a material identified as susceptible to FAC."

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Flow-Accelerated Corrosion Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. Also, the staff reviewed the enhancements and confirmed that its implementation prior to the period of extended operation would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.12 Fuel Oil Chemistry

Summary of Technical Information in the Application. LRA Section B.2.29 describes the existing Fuel Oil Chemistry Program as consistent, with exceptions, with GALL Report AMP XI.M30, "Fuel Oil Chemistry." The applicant stated that the Fuel Oil Chemistry Program will mitigate the effects of aging for the storage tanks, and associated components containing fuel oil that are within the scope of license renewal, by verifying and maintaining the quality of the fuel oil used in the emergency diesel generators and the diesel-driven fire pumps. The applicant also stated that the program manages conditions that could lead to the onset and propagation of a loss of material due to corrosion or cracking due to SCC of susceptible copper alloys. The applicant stated that this is done by monitoring and maintaining control of fuel oil contamination consistent with plant TSs and ASTM standards for fuel oil.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff also reviewed the portions of the "scope of program," "preventative actions," "parameters monitored or inspected," and "detection of aging effects" program elements associated with exceptions to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of these exceptions follows.

Exception 1. LRA Section B.2.29 states an exception to the "scope of program" program element. The GALL Report recommends managing the conditions that cause corrosion of the diesel fuel tank internal surfaces in accordance with TSs and the guidelines of ASTM Standards D1796, D2276, D2709, D6217, and D4057. Alternatively, this program element in the LRA states that the program does not include sampling and testing of new fuel in accordance with the above standards for the diesel-driven fire pumps. The applicant stated that the stored fuel is periodically sampled and tested following the guidelines of the above-mentioned ASTM Standards.

The staff reviewed this exception and the ASTM Standards recommended by the GALL Report AMP. Based on this review, the staff found that the applicant not performing sampling and testing of new fuel for the diesel-driven fire pumps is acceptable because the applicant stated and provided information demonstrating that stored fuel as opposed to new fuel is periodically sampled and tested in accordance with the ASTM Standards recommended by the GALL Report. The periodic testing of stored fuel is an acceptable means to detect for contaminants found in the fuel oil that may cause corrosion of the diesel fuel tank internal surfaces.

The staff finds this program exception acceptable and consistent with the one described in the GALL Report Section XI.M30 because sampling and testing of stored fuel in accordance with the above-mentioned ASTM Standards, which is recommended by the GALL Report AMP, is an acceptable means to monitor fuel quality.

Exception 2. LRA Section B.2.29 states an exception to the “preventative actions” program element. The GALL Report recommends the use of biocides, stabilizers, and corrosion inhibitors. Alternatively, this program does not include the addition of biocides, stabilizers, or corrosion inhibitors to the fuel oil for the emergency diesel generators. The applicant stated that the combination of controlling the testing specification of new diesel fuel physical and chemical properties, accompanied with periodic cleaning and draining of the tanks, mitigates corrosion inside the tanks.

The staff reviewed this exception and the recommendations of the GALL Report AMP. The exclusion of biocides, stabilizers, and corrosion inhibitors to the fuel oil of the emergency diesel generators is acceptable because the applicant demonstrated that periodic cleaning and draining of the tanks is adequate in mitigating corrosion inside the tanks.

The staff finds this program exception acceptable and consistent with the one described in the GALL Report Section XI.M30 because periodic cleaning and draining of the tanks is adequate in mitigating corrosion inside the tanks.

Exception 3. LRA Section B.2.29 states an exception to the “parameters monitored or inspected,” program element. The GALL Report AMP recommends the use of ASTM Standards D4057, D1796, D2709, and D2276, Method A for the determination of water, sediment contamination, and particulates. Alternatively, this program does not include testing of the fuel oil used for the diesel-driven fire pumps for particulates. The applicant stated that obtaining samples in accordance with ASTM Standards D2709 and D4057 has proven to be adequate. The applicant stated that the determination of adequacy is based on the absence of related problems reported through the Corrective Action Program.

The staff reviewed this exception and the GALL Report AMP recommendations. It was determined that, since the applicant is testing for water and sediment contamination in accordance with the GALL Report recommendations, not testing for particulates is acceptable. The testing of water and sediment contamination are acceptable means of detecting conditions that may cause corrosion.

The staff finds this program exception acceptable and consistent with the one described in the GALL Report Section XI.M30 because testing for water and sediment contamination is adequate to maintain minimum corrosion levels in the diesel-driven fire pumps fuel oil tanks.

Exception 4. LRA Section B.2.29 states an exception to the "detection of aging effects," program element. The GALL Report recommends the use of ASTM Standards D4057, D1796, D2709, and D2276, Method A. In addition, the GALL Report recommends periodic multi-level sampling. The ASTM Standards and multi-level sampling provide assurance that fuel oil containments are below unacceptable levels. Alternatively, this program does not perform multi-level sampling of the fuel oil storage tanks. Rather, a representative fuel sample is drawn from the flushing line during recirculation and transfer.

The staff reviewed this exception to the GALL Report and noted that the applicant takes exception to the GALL Report in that multi-level sampling is not performed to obtain samples from the emergency diesel generator storage tanks (1A, 1B, and 2).

In RAI B.2.29-2 dated June 21, 2010, the staff requested that the applicant discuss how the sampling method used for the fuel oil storage tanks is consistent with the recommendations of the GALL Report (i.e., multi-level sampling). In its response dated August 19, 2010, the applicant stated that the current method of sampling is performed using the diesel fuel oil filter and polisher system. During sampling, the applicable storage tank is recirculated for a minimum of 5 minutes, and a sample is drawn from the recirculation flow. The applicant stated that this is considered to be a more representative sample than a multi-level sample. The system takes suction from the bottom of the tank and, after 5 minutes, draws a flowing sample. The staff finds this method of sampling acceptable because suction is taken from the bottom of the tank, where contaminants, water, and sediments, tend to settle.

On the basis of its review, the staff finds this program exception acceptable because the sampling used in the AMP is equivalent or more conservative than the ASTM Standards recommended by the GALL Report AMP XI.M30. The staff's concern described in RAI B.2.29-2 is resolved.

Based on its audit, and review of the applicant's response to RAI B.2.29-2, the staff finds that Program Elements one through six of the applicant's Fuel Oil Chemistry Program, with acceptable exceptions, are consistent with the corresponding program elements of GALL Report AMP XI.M30 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.29 summarizes operating experience related to the Fuel Oil Chemistry Program. The staff reviewed this information and interviewed the applicant's technical personnel to confirm that the applicable aging effects and industry and plant-specific operating experience have been reviewed by the applicant and are evaluated in the GALL Report. During the audit, the staff independently verified that the applicant adequately incorporated and evaluated operating experience related to this program.

The applicant provided the following for operating experience:

- With respect to the fuel oil tanks for the emergency diesel generators, review of Columbia operating experience reveals that the Fuel Oil Chemistry Program is adequately preventing a loss of component function of subject components that contain fuel oil. Fuel oil delivered to the site is sampled and analyzed prior to addition to the fuel oil storage tanks for the emergency diesel generators. Stored fuel oil is periodically sampled and analyzed for both the emergency and fire protection diesel generators. Water is removed from the stored fuel oil, and particulates are filtered. In addition, visual and ultrasonic inspection of an emergency diesel generator fuel oil storage tank, as listed in UFSAR Section 9.5.4.4.a, revealed acceptable conditions for the tank internal surfaces—only light corrosion in previously identified areas with no material loss or obvious changes to the condition of the tank.

- The fuel oil tanks for the diesel-driven fire pumps are also periodically sampled and analyzed. Water is removed, and particulates are filtered based on condition (e.g., when unacceptable levels during periodic sampling necessitate cleaning of the fuel oil). Quarterly sampling of the fuel oil tanks for the diesel-driven fire pumps has been effective in identifying unacceptable levels of water and sediment prior to a loss of function. Higher than expected amounts of water or sediment during periodic sampling has resulted in cleaning of tanks and filtering of the fuel to restore acceptable conditions. The periodic cleaning and filtering has included the addition of a biocide due to evidence of biofouling.

To obtain the information necessary to verify whether the applicant's operating experience supports the sufficiency of the LRA AMP, the staff issued RAI B.2.29-1 dated June 21, 2010, and requested that the applicant provide a summary of the actions that were taken to determine the impact of IN 2009-02, "Biodiesel in Fuel Oil Could Adversely Impact Diesel Engine Performance," and the use of biodiesel fuel oil at Columbia. In its response dated August 19, 2010, the applicant stated the following:

> Energy Northwest performed an evaluation of IN 2009-02 to determine the impact of biodiesel [fuel oil use] at Columbia. The evaluation determined that biodiesel is not acceptable for use at Columbia due to the limited stability for long term storage and the adverse effect on components in the emergency diesel generator system. Actions taken as a result of this evaluation include revision in the blanket purchase order for procurement of No. 2 diesel fuel for the emergency diesel generators to state, "Straight biodiesel is not acceptable. Any blended biodiesel is not acceptable." The facilities contract was also revised to prohibit vendor deliveries of B5 blended biodiesel for use in non-emergency equipment, such as the diesel fire pumps and diesel generators for emergency preparedness and response function.
>
> A screening test is performed for biodiesel prior to receiving fuel oil for emergency diesel generators. If the test is positive for biodiesel, the shipment is rejected. For non-emergency diesel generator fuel oil, no receipt tests are performed, however a water and sediment test is performed on the storage tank on a quarterly basis. B5 biodiesel blends contain suspended particles of water from the manufacturing process which will, in time, fall out of suspension and form "dirty water" in the fuel oil storage tank. If the water and sediment test results are above the limit of 0.05%, then a condition report would be entered in the [corrective action process] to document the unsatisfactory results and notification made to the system engineer. Corrective action would be taken, if necessary, to clean the storage tank to remove the water and sediment.

The staff finds the applicant's response acceptable because the applicant stated that biodiesels are not used at Columbia, and appropriate measures are taken to ensure biodiesel fuel is not accepted. The applicant appropriately considered the information contained IN 2009-02 regarding operating experience. The staff's concern described in RAI B.2.29-1 is resolved.

The staff reviewed the operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program.

During its review, the staff found no operating experience to indicate that the applicant's program would be ineffective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.29 provides the UFSAR supplement for the Fuel Oil Chemistry program. The staff reviewed this UFSAR supplement description of the program and notes that it confirms to the recommended description for this type of program, as described in SRP-LR Tables 3.3-2.

The staff also notes that the applicant committed (Commitment No. 29) to ongoing implementation of the existing Fuel Oil Chemistry Program for managing aging of the applicable components during the period of extended operation.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Fuel Oil Chemistry Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exceptions and its justifications and determines that the AMP, with the exceptions, is adequate to manage the aging effects for which the LRA credits it. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.13 Lubricating Oil Analysis

Summary of Technical Information in the Application. LRA Section B.2.36 describes the existing Lubricating Oil Analysis Program as consistent, with enhancements, with GALL Report AMP XI.M39, "Lubricating Oil Analysis." The applicant stated that the Lubricating Oil Analysis Program will mitigate the effects of aging for plant components that are within the scope of license renewal and exposed to a lubricating oil environment. The applicant also stated that the program manages the relevant conditions that could lead to the onset and propagation of a loss of material due to crevice, galvanic, general, or pitting corrosion or selective leaching, or reduction in heat transfer due to fouling, through monitoring of the lubricating oil.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated

The staff also reviewed the portion of the "scope of program" program element associated with an enhancement to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this enhancement follows.

Enhancement 1. LRA Section B.2.36 states an enhancement to the "scope of program," program element. This enhancement will include the fire protection system components that are exposed to lubricating oil in the scope of the program. The components include protection diesel engine heat exchangers (i.e., lubricating oil coolers), fire protection diesel engine lubricating oil piping, and fire protection engine lubricating oil pump casings.

On the basis of its review, the staff finds this enhancement acceptable because, when it is implemented, prior to the period of extended operation, it will make the program consistent with the recommendations of GALL Report AMP XI.M39.

The staff finds that Program Elements one through six of the applicant's Lubricating Oil Analysis program, with acceptable enhancement, are consistent with the corresponding program elements of GALL Report AMP XI.M39 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.36 summarizes operating experience related to the Lubricating Oil Analysis Program. The staff reviewed this information and interviewed the applicant's technical personnel to confirm that the applicable aging effects and industry and plant-specific operating experience have been reviewed by the applicant and are evaluated in the GALL Report. During the audit, the staff independently verified that the applicant adequately incorporated and evaluated operating experience related to this program.

The applicant provided the following information regarding operating experience:

> Review of Columbia operating experience did not reveal a loss of component intended function for components exposed to lubricating oil that could be attributed to an inadequacy of the Lubricating Oil Analysis Program. Abnormal lubricating oil conditions are promptly identified, evaluated, and corrected. For example, lubricating oil in the feedwater turbine has previously been found contaminated with water. The lubricating Oil Analysis Program evaluated the condition, determined the source of the water through sampling and analysis, and initiated corrective action. The lubricating oil was replaced and the source of the water leakage was repaired. In addition, levels of lead in emergency diesel generator lubricating oil have been found that exceeded the specified limits and showed an increasing trend. The evaluation determined the source to be soldered joints on the lubricating oil coolers. A planned replacement of the oil coolers with a different design was already in place at the time the source was determined, and the coolers have since been replaced.

The staff reviewed the operating experience information, in the application and during the audit, to determine whether the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program.

During its review, the staff found no operating experience to indicate that the applicant's program would be ineffective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.36 provides the UFSAR supplement for the Lubricating Oil Analysis Program. The staff reviewed this UFSAR supplement description of the program and notes that it confirms to the recommended description for this type of program, as described in SRP-LR Tables 3.2-2, 3.3-2, and 3.4-2.

The staff also notes that the applicant committed (Commitment No. 36) to ongoing implementation of the existing Lubricating Oil Analysis Program for managing aging of applicable components during the period of extended operation.

The staff also notes that the applicant committed (Commitment No. 36) to enhance the Lubricating Oil Analysis Program prior to entering the period of extended operation. Specifically, the applicant committed to include the fire protection system components that are exposed to lubricating oil with the scope of the program.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Lubricating Oil Analysis Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the enhancement and confirmed that the implementation prior to the period of extended operation would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.14 Masonry Wall Inspection

Summary of Technical Information in the Application. LRA Section B.2.50 describes the existing Masonry Wall Program as being consistent, with an enhancement, with GALL Report AMP XI.S5, "Masonry Wall Program." In the LRA, the applicant stated that the Masonry Wall Program is implemented as part of the Structures Monitoring Program. The applicant further stated that the Masonry Wall Program is a Condition Monitoring Program consisting of inspection activities to detect aging and age-related degradation for masonry walls identified as performing intended functions in accordance with 10 CFR 54.4. Masonry walls that perform a fire barrier intended function are also managed by the Fire Protection Program. Aging effects are detected by visual inspection of external surfaces to detect cracking prior to loss of the component's intended function(s). The applicant also stated that masonry walls are inspected at a frequency selected to ensure that there is no loss of intended function between inspections and that the evaluation basis established for each masonry wall within the scope of license renewal remains valid through the period of extended operation.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine if it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.S5. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.S5 with the exception of "parameters monitored or inspected," "detection of aging effects," and "acceptance criteria." For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

While reviewing the "parameters monitored or inspected" program element, the staff noted that the LRA states that, in the Structures Monitoring Program, it is recommended to list American Concrete Institute (ACI) 349.3R-96 and American National Standards Institute (ANSI)/American Society of Civil Engineers (ASCE) 11-90 as references to indicate that it provides guidance for selection of parameters monitored or inspected. The listing of these documents is provided as a recommended enhancement. The staff believes recommended enhancements provided in the LRA should be included in the scope of the program. It is not clear to the staff if recommended enhancements such as these are required to meet GALL criteria or if the applicant will commit to the recommended enhancements prior to the period of extended operation.

By letter dated July 7, 2010, the staff issued RAI B.2.50-1, asking the applicant to do the following:

- provide information to clarify the distinction between recommended enhancements and in particular describe the criteria that will be used to determine if recommendations will be implemented
- specify whether the recommended enhancements are required to meet or exceed GALL provisions (e.g., adoption of ACI 349.3R-96 acceptance criteria
- identify whether Columbia will commit to the recommended enhancements prior to the period of extended operation or, if a commitment will not be made to all recommended enhancements, identify which recommended enhancements will be adopted in each of the AMPs

A summary of the applicant's response and the staff's review and resolution of this issue can be found in the Structures Monitoring Program review, SER Section 3.0.3.2.18.

While reviewing the "acceptance criteria" program element, the staff noted that the LRA basis documents state that, in the Masonry Wall Program, as implemented by the Structures Monitoring Program, the inspection criteria used to assess the condition of structures and structural components is found in the structures inspection checklist. A review of referenced program basis documents indicated that these documents provide only a listing of conditions to inspect related to the concrete, masonry walls, structural steel, liner plate, roof systems, siding, windows and doors, earthen structures and dams, settlement, structure and seismic gap, interfaces, equipment supports, piping, tanks, cable trays and conduits, outside structures, and general structures. No inspection criteria used to assess the condition of structures and structural components were identified. The staff was unclear what criteria are used to provide a basis for acceptance of the condition of the structures.

By letter dated July 7, 2010, the staff issued RAI B.2.50-2, asking the applicant to provide the acceptance criteria used for the Masonry Wall, Structures Monitoring, and Inspection of Water

Control Structures Programs to establish whether or not corrective actions are required prior to loss of function and provide justification that the acceptance criteria used for the structures or structural components meet or exceed the criteria provided in ACI 349.3R-96.

In its response dated September 3, 2010, the applicant stated that the Masonry Wall Program requires an enhancement to acceptance criteria prior to the period of extended operation requiring that the extent of observed masonry cracking or degradation of steel edge supports and bracing to be evaluated is sufficient to ensure that the current evaluation basis is still valid. The applicant also stated that quantitative acceptance criteria from the Structures Monitoring Program will be used during the inspections, and the implementing procedure will be revised to include additional acceptance criteria details developed from Chapter 5 of ACI 349.3R-96.

Based on its review of the applicant’s responses to RAI B.2.50-2, the staff finds that the acceptance criteria related to the masonry walls is acceptable because, prior to the period of extended operation, the applicant committed to revise the Masonry Wall and Structures Monitoring Programs to develop and add to the inspection procedure sufficient acceptance criteria and critical parameters to trigger levels of inspection and initiation of corrective actions based on plant-specific quantitative degradation limits similar to the three-tier hierarchy acceptance criteria from Chapter 5 of ACI 349.3R-96. The staff’s concern described in RAI B.2.50-2 is resolved. More information on this issue can be found in the staff’s review of the Structures Monitoring Program, SER Section 3.03.2.18.

While reviewing the “detection of aging effects” program element, the staff noted that the LRA basis documents state that, in the Masonry Wall Program, Structures Monitoring Program, and Water Control Structures Inspection Program, inspections are performed by individuals normally assigned to maintenance rule activities. If individuals are used that are not normally assigned to maintenance rule activities it is briefed prior to conduct of inspections or accompanied by a maintenance rule staff engineer. A review of referenced program basis documents did not identify information related to qualifications of inspection personnel. The staff was unclear how the qualifications of the inspection personnel are commensurate with those identified in industry codes, standards, and guidelines.

By letter dated July 7, 2010, the staff issued RAI B.2.50-3, asking the applicant to provide qualification criteria of the personnel performing the inspections and demonstrate that it meets or exceed the criteria identified in industry codes, standards, and guidelines.

In its response dated September 3, 2010, the applicant stated that the implementing program documents will be revised prior to the period of extended operation to establish minimum qualifications for the individual performing the inspections to be a civil or structural engineer with an engineering degree and at least 4 years experience associated with nuclear power plant structures.

Based on its review of the applicant’s response to RAI B.2.50-3, the staff finds that the qualifications of the personnel performing the inspections are commensurate with those provided in ACI 349.3R-96 and ANSI/ASCE 11-90. The staff’s concern described in RAI B.2.50-3 is resolved.

The staff also reviewed the portions of the “parameters monitored or inspected,” and “acceptance criteria” program elements associated with enhancements to determine if the program will be adequate to manage the aging effects for which it is credited. The staff’s evaluation of the enhancement follows.

Enhancement 1. LRA Section B.2.38 states an enhancement to “parameters monitored or inspected” and “acceptance criteria” that does the following:

- expands the Masonry Wall Program to specify that for each masonry wall the extent of observed masonry cracking or degradation of steel edge supports and bracing are evaluated to ensure that the current evaluation basis is still valid
- requires corrective action if the extent of masonry cracking and steel degradation is sufficient to invalidate the evaluation basis
- provides an option to develop a new evaluation basis that accounts for the degraded condition of the wall (i.e., acceptance by further evaluation)

The staff finds this enhancement acceptable because it brings the parameters monitored and the acceptance criteria in to compliance with general guidance provided in GALL Report AMP XI.S5, “Masonry Wall Program.” However, specific acceptance criteria that are to be used during the period of extended operation in order to evaluate masonry walls with respect to the extent of observed masonry cracking or degradation of steel edge supports and bracing to ensure that the current evaluation basis is still valid were not provided in the LRA. This issue was addressed above in RAI B.2.50-2.

Based on its onsite audit, and review of the applicant’s response to the above RAIs, the staff finds that elements one through six of the applicant’s Masonry Wall Program, with acceptable enhancements, are consistent with the corresponding program elements of GALL Report AMP XI.S5. Therefore, it is acceptable.

<u>Operating Experience</u>. LRA Section B.2.38 summarizes operating experience related to the Masonry Wall Program. The LRA stated that visual examinations have found no age-related problems or degraded conditions for masonry walls within the scope of license renewal.

The staff reviewed operating experience information in the application and during the onsite audit to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program.

During its review, the staff found no operating experience to indicate that the applicant’s program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant’s program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the “operating experience” program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

<u>UFSAR Supplement</u>. LRA Sections A.1.2.38 provides the UFSAR supplement for the Masonry Wall Program.

The staff reviewed this UFSAR supplement section and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.5-2. The staff also notes that the applicant committed (Commitment No. 38) to enhance the Masonry Wall Program prior to entering the period of extended operation. Specifically, the applicant committed to do the following:

> Specify that for each masonry wall, the extent of observed masonry cracking or degradation of steel edge supports and bracing are evaluated to ensure that the current evaluation basis is still valid. Corrective action is required if the extent of masonry cracking or steel degradation is sufficient to invalidate the evaluation basis. An option is to develop a new evaluation basis that accounts for the degraded condition of the wall (i.e., acceptance by further evaluation).

The staff determined that the information in the UFSAR supplement is an adequate summary description of the programs, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Masonry Wall Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent, based on the resolution of the RAIs as discussed above. Also, the staff reviewed the enhancements and confirmed that its implementation through Commitment No. 38 prior to the period of extended operation would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.15 Material Handling System Inspection

Summary of Technical Information in the Application. LRA Section B.2.39 describes the existing Material Handling System Inspection AMP as consistent, with an enhancement, with GALL Report AMP XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program." The applicant stated that its Material Handling System Inspection Program is credited with managing loss of material for cranes (including bridge, trolley, rails, and girders), monorails, and hoists within the scope of license renewal. Additionally, the program is based on guidance contained in ANSI B30.2 for overhead and gantry cranes, ANSI B30.11 for monorail systems and underhung cranes, and ANSI B30.16 for overhead hoists. The applicant further stated that the inspections are performed periodically for installed cranes and hoists (e.g., annually for the reactor building crane, other NUREG-0612 heavy load handling systems, and the refueling platform), and the inspections monitor structural members for signs of corrosion and wear.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.M23. As discussed in the audit report, the staff confirmed that these elements are consistent with the corresponding elements of GALL Report AMP XI.M23.

The staff also reviewed the portions of the “detection of aging effects” program element associated with an enhancement to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff’s evaluation of this enhancement follows.

Enhancement 1. LRA Section B.2.39 states an enhancement to the “detection of aging effects” program element. The applicant stated that this enhancement expands on the existing program element to ensure that jib cranes and electrically-operated hoists are visually inspected for corrosion.

During the audit, the staff noted that this enhancement was removed from the LRA because the applicant stated that the inspection of jib cranes and electrically-operated hoists for loss of material due to corrosion and wear is already included in the present AMP. The staff verified that the procedure of inspection, maintenance, and testing of jib cranes and electrically-operated hoists is indeed included in the applicant’s present AMP. The removal of this enhancement is contained in the applicant’s LRA supplement, dated July 16, 2010.

During the audit, the staff asked what the acceptance criteria for loss of material due to corrosion for inspection of crane materials and rails and girders are. The applicant stated that the acceptance criteria of corrosion is consistent with the GALL Report, which states any significant visual indication of loss of material due to corrosion is evaluated according to the applicable industry standards and good industry practices, and the applicable industry standards are based on ANSI B30.2, B30.11, and B30.16. The applicant further stated that corrosion identified during periodic inspection by qualified personnel is noted under Columbia’s existing Corrective Action Program. The staff found the applicant’s response acceptable because it is consistent with the GALL Report.

The staff finds the enhancement acceptable because it is consistent with the GALL Report AMP XI.M23, “Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems Program.” Furthermore, the staff reviewed the applicant’s LRA supplement, dated July 16, 2010, and confirmed that the LRA was appropriately updated to remove this as an enhancement.

Based on its audit, the staff finds that Elements one through six of the applicant’s Material Handling System Inspection Program are consistent with the corresponding program elements of GALL Report AMP XI.M23 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.39 summarizes operating experience related to the Material Handling System Inspection Program. The applicant stated that a review of crane and hoist inspections previously conducted at Columbia and of industry operating experience confirms the acceptability of the inspections and its frequency in that degradation of cranes (including bridge, trolley, rails, and girders), monorails, and hoists was detected prior to loss of function. The related crane and hoist inspections have found no age-related degradation problems. The applicant further stated that the health of the Material Handling System Inspection Program is reported periodically in terms of performance indicators, and no age-related improvements for the program is noted in the program health reports for 2007 and 2008.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff also conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.39 provides the UFSAR supplement for the Material Handling System Inspection Program. The staff reviewed this UFSAR supplement description of the program and noted that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.3-2.

The staff also noted that the applicant committed (Commitment No. 39) to ongoing implementation of the existing Material Handling System Inspection Program for managing aging of applicable components during the period of extended operation. The staff further noted that the applicant appropriately amended the UFSAR supplement to reflect the deleted enhancement. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Material Handling System Inspection Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. The staff concludes the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.16 Metal-Enclosed Bus

Summary of Technical Information in the Application. LRA Section B.2.40 describes the new Metal-Enclosed Bus (MEB) Program as consistent, with an exception, to GALL Report AMP XI.E4 "Metal-Enclosed Bus." The applicant stated that the MEB Program will manage the aging of MEB within the scope of license renewal. The applicant also stated that the program provides for the periodic visual inspection of MEB, along with the use of thermography, to determine if age-related degradation is occurring. The applicant further stated that the program ensures that the electrical components will perform its intended functions for the period of extended operation.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.E4. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.E4.

The staff also reviewed portions of the "parameters monitored or inspected" program element associated with the exception to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of this exception follows.

Exception. LRA Section B.2.40 states an exception to LRA Program Element 3, "parameters monitored or inspected." The applicant will perform the inspection of the various bus joints, seals, and gaskets when the bus assembly covers are removed for inspection of the internal components rather than using the Structures Monitoring Program. The staff finds that the visual inspection is appropriate to detect aging of the elastomeric seals at the bus joints, seals, and gaskets of the MEB sections because the MEB program elements have been modified to include an inspection of these components consistent with the GALL Report. Therefore, the exception is acceptable.

Based on its audit, the staff finds that Elements one through six of the applicant's MEB Program, with exception, are consistent with the corresponding program elements of GALL Report AMP XI.E4 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.40 summarizes operating experience related to the MEB Program. The applicant stated its program is a new program for which there is no direct plant-specific program operating experience. GALL Report AMP XI.E4 states that operating experience has shown that bus connections in MEB exposed to appreciable ohmic heating during operation may experience loosening due to repeated cycling of connected loads. During the walkdowns on May 25, 2010, the staff found smoke residue on the MEB of the 6.9kV E-BUS-NONSEG/N2/X and the surrounding cable trays. In Action Request (AR) 202384, the applicant states that the bus failed catastrophically on August 5, 2009. The applicant determined that the failure of the bus was caused by loosening or relaxing of the bolted connections on the central phase flexible link due to repeated thermal cycles over time.

Even though these MEBs are not in the scope of license renewal, the staff is concerned that a similar failure mode may occur in the in-scope MEBs during the extended period of operation. Operating experience may not support the applicant's conclusion that LRA AMP B.2.40 will ensure that the aging effects will be managed such that the in-scope MEBs will continue to perform its intended functions consistent with the CLB for the period of extended operation.

In letter dated July 7, 2010, the staff issued RAI B.2.40-1 requesting that the applicant describe the corrective action taken or planned to prevent recurrence of similar failures of MEBs, including MEBs which are in the scope of the license renewal. In its response dated August 31, 2010, the applicant stated that it repaired the damage to the 6.9 kV bus and installed infrared (IR) thermography windows in the bus duct covers to allow for more direct thermography monitoring of the bus links. The applicant stated that an appropriate frequency for thermography checks will be established in conjunction with performing torque checks on the other non-segregated buses to prevent recurrence of this event. The applicant also stated that the content and controls for PM activities will be strengthened to ensure completion of critical steps, appropriate levels of review, and approval applied to all changes. The applicant further stated that the other non-segregated buses were visually inspected and had insulators torque checked. Finally, the applicant confirmed that IR thermography windows were installed in the bus housing covers at all flexible and rigid link locations, with the exception of some locations in two start-up buses that are scheduled to be installed during the next RFO in 2011. Both the thermography inspection and the visual inspections will be performed at least once every 10 years, with the first inspection to be completed prior to the end of the current operating license.

Although the applicant described the corrective actions taken, the staff finds that the applicant's response did not adequately justify the proposed test and inspection frequencies stated in the GALL Report AMP XI.E4 (10 years) as applicable to Columbia, based on plant-specific MEB operating experience (including previous Columbia MEB test and inspection frequencies). The staff was concerned that applicant's new AMP, using thermography and visual inspections performed at least every 10 years, is similar to previous maintenance activities (including procedure and schedules), and, as such, the management of aging effects under the new program may not be adequate to allow in-scope MEBs to continue to perform its intended function consistent with the CLB for the period of extended operation. In a letter dated October 20, 2010, the staff asked the applicant to describe maintenance activities (including procedures and schedules) for the MEB PM Program applied to non-segregated MEB prior to the August 5, 2009, 6.9 kV E-BUS-NONSEG/N2/X MEB event. Given that there has been an MEB failure, the staff asked the applicant to discuss how the proposed inspection frequency of at least once every 10 years will be adequate and ensure that the aging effects will be managed such that in-scope MEBs will continue to perform its intended functions consistent with the CLB for the period of extended operation. In addition, the staff asked the applicant to discuss how the torque checks are consistent with the guidance provided in EPRI document TR-104213, "Bolt Joint and Applications Guide," with regard to electrical bolted connection torque checks at Columbia.

In response to the staff's request, in a letter dated January 27, 2011, the applicant stated that the maintenance activities for the MEB E-BUS-NONSEG/N2/X (not within the scope of license renewal) prior to the August 5, 2009, event were as follows:

- Perform thermography inspections every 24 weeks—There were locations which had IR inspection windows, which were installed in response to previous heating events, but most locations did not have them installed. The thermography inspection that occurred prior to the event was not done through an IR inspection window because the window had not yet been installed in the bus. This indicates that bus duct temperature measurements were not sensitive enough to detect problems with a high degree of confidence. Since duct temperature is not indicative of bus temperature, an action was initiated following the bus failure to install thermography windows at all link locations so that bus temperatures can be monitored.
- Inspect and clean bus support insulators per plant procedure
- Perform high-potential or megger testing—A review of 11 PM work orders for 6.9kV and 4.16kV non-segregated bus inspections for the period 2001–2009 found that, in each case, the work scope was revised to remove high-potential or megger testing. However, these PM scope revisions were neither reviewed nor approved in accordance with direction in plant procedures.
- Inspect bus rigid and flexible connections for proper torque—A review of 11 PM work orders for 6.9kV and 4.16kV non-segregated bus inspections for the period 2001–2009 found that, in each case, the work scope was revised to remove bus connection torque verifications. However, these PM scope revisions were neither reviewed nor approved in accordance with direction in plant procedures. The root cause of the event was determined to be failure to perform the full scope of PM on E-BUS-NONSEG/N/2X, as directed by the PM Program.
- Inspect bus mounting bolts for proper torque if accessible

The applicant stated that the proposed inspection frequency of at least once every 10 years will be adequate and ensure that the aging effects will be managed such that in-scope MEBs will continue to perform its intended functions consistent with the CLB for the period of extended operation. The applicant also stated that MEB duct temperature measurements, as opposed to bus temperature, were not sensitive enough to detect problems with a high degree of confidence. Since duct temperature is not indicative of bus temperature, an action was initiated following the bus failure to install thermography windows at critical locations so that bus temperatures can be monitored. In addition, the applicant committed to install IR windows at all locations of bolted connections of the in-scope bus to be completed within the period prior to the end of the current operating license. The applicant further stated that as part of the corrective actions associated with the event, the frequency of the thermography PM was increased to every 12 weeks until all of the bus connections are reworked in RFO 20. This frequency was recommended to allow the acquisition of a range of temperatures expected during a year-long period of exposure to changing atmospheric conditions that will be encountered thus establishing a "normal" range of temperatures for these influences. The applicant stated that frequency of the thermography will be at least once every 10 years and will be adjusted based on industry and plant-specific operating experience, but the interval will not exceed 10 years.

The applicant stated that the configuration for the link connections was revised after the event to use Belleville washers in place of the split lock washer and a heavy flat washer in place of the standard flat washer. This configuration change results in an improved torque at the links because it has less relaxation over time due to thermal cycles. The failed connection had not been upgraded to the new design prior to failure. The Corrective Action Program is tracking the completion of work orders to replace the hardware for any connections. Since the event occurred at a flexible link connection, and the MEB manufacturer identified the flexible links as being marginally rated following the power up-rate for the adjustable speed drive, all marginally sized flexible connections were replaced.

Regarding the torque checks, the applicant responded that the torque checks that were identified in the response to RAI B.2.40-1, dated August 31, 2010, are consistent with the guidance provided in EPRI document TR-104213, "Bolt Joint and Applications Guide." The EPRI technical report states the following:

> Inspect bolted joints for evidence of overheating, signs of burning or discoloration, and indications of loose bolts. The bolts should not be retorqued unless the joint requires service or the bolts are clearly loose. Verifying the torque is not recommended. The torque required to turn the fastener in the tightening direction (restart torque) is not a good indicator of the preload once the fastener is in service.

The applicant stated that the torque checks are not part of the B.2.40 program. Thermography is the B.2.40 credited inspection. In addition, the applicant stated that torque checks are better categorized as a looseness check and the joint is serviced after the "torque check." The revised model work orders that implement the current PM requirements state the following:

> Using a torque wrench set 10 ft-lbs below the required torque obtains As-Found torque for each link location. If fastener turned, record "Loose" on the link inspection signoff sheet, "As found torque". If fastener did NOT turn, record "OK" on signoff sheet. The work orders then go on to remove the bolting hardware and link then require a visual inspection of the disassembled connection and cleaning the contact area. The work orders require the inspection of the bolting

hardware and replacement if needed then re-installation of the connection. The instructions require torquing of the bolting to defined requirements and re-insulating the connection. Therefore the joint is serviced and the torque check is consistent with the EPRI guidance.

The staff finds the applicant's response acceptable. The applicant described maintenance activities for the MEBs prior to the August 5, 2009, event, and the root causes of the event due to PM deficiency leading to the MEB failures. The applicant has taken corrective actions to prevent recurrence of similar failures of MEBs. These actions include installing thermography windows at all link locations so that bus temperatures can be monitored; revising the configuration of the link connections to use Belleville washers in place of the split lock washers and a heavy flat washer in place of the standard flat washer; and replacing all marginally sized flexible connections. As part of the corrective actions associated with the event, the applicant increased the thermography PM to every 12 weeks until all of the buses connections are reworked in RFO 20. With the corrective actions taken, the staff finds that the proposed inspection frequency at least once every 10 years is consistent with that in GALL Report AMP XI.E3 and is, therefore, acceptable. The applicant proposed to adjust this frequency based on industry and plant-specific operating experience. The staff also finds that although torque check is not credited in the MEB program, the torque check practice at Columbia is consistent with the EPRI guidance.

Based on review of the applicant's response to RAI B.2.40-1, the staff's concern is resolved.

On July 19, 2011, the staff held a conference call with the applicant to discuss the status of a planned replacement of bolted connections with welded connections and the potential changes to the MEB Program to reflect these changes.

In a letter dated July 29, 2011, the applicant informed the staff that the bolted connections that were inspected under the MEB Program were replaced with welded connections during refueling outage 20. The applicant stated that the reason for upgrading the MEB through the installation of welded connections was to significantly reduce the potential for bolts to loosen on the MEB and effectively create a fault which could potentially shut down the unit. The applicant also stated that the bus manufacturer has indicated that fatigue failure or cracking of the new welded flex connections which are made of laminations is not expected. However, the effects of thermal expansion on the laminations will be validated through visual inspections by looking for cracks in the lamination, which will be included in the MEB Program.

The applicant revised the Metal-Enclosed Bus Program in Amendment 39 to conduct visual inspection of the welded flex connections to ensure that the flex connections do not have any breaks or cracks in the welds. The applicant further stated that the MEB Program will conduct sample inspections of the welded flex connections at least once every 10 years with the first inspections to be completed prior to the period of extended operation. The applicant further stated that inspection of the filament and butt welds for rigid connections is not required since these welds are designed to meet the lifespan of the bus itself. The bus material and welded connections are made of aluminum and the weld filler is an aluminum alloy. The applicant also stated that the manufacturer has indicated based on its experience of installing welded connections on MEB, no applicable operating experience identified problems with the welds. The installation of welded connections on aluminum sections of iso-phase bus is a common design practice for the manufacturer, and no known failures have resulted.

The applicant also revised the "parameter monitored or inspected," "detection of aging effects," and "acceptance criteria" program elements to require that the welded flexible connection laminations be visually inspected for damage or cracking due to fatigue. The program will still require that in-scope bolted connections (if it is ever reinstalled) will be subject to inspection by thermography through infra-red windows. It will also continue to require inspection of the internal bus enclosure, bus insulation, internal bus supports and bus enclosure joints, seals, and gaskets for signs of aging.

The staff reviewed the MEB Program as amended by LRA Amendment 39 and finds it acceptable because the changes to the MEB Program through the installation of welded connections reduces the potential for bolts loosening on the MEB. In addition to industry operating experience related to the problems on bolted connections of MEB, the applicant stated that the cause of the main turbine trip at Columbia on August 5, 2009, was determined to be a loose connection on the 6.9 kV MEB. The replacement of bolted connections with welded connections will eliminate the potential loosening of bolted connections to the MEB due to thermal expansion. The staff finds that visual inspection of a sample of the flexible welded connections is acceptable because it is designed to detect fatigue or cracking of the welded flexible connections. The staff also finds that 10-year frequency inspections on a sample of welded flexible connections are acceptable because it is consistent with the inspection frequency as recommended in GALL Report AMP XI.E4 for bolted connections which is conservative for MEB welded flexible connections.

The staff reviewed the operating experience, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program.

During its review, the staff found no additional operating experience to indicate that the applicant’s program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its audit and review of the application, the staff finds that operating experience related to the applicant’s program demonstrates that the program can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirmed that the “operating experience” program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.40 provides the UFSAR supplement for the MEB Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.6-2.

The staff also notes that the applicant committed (Commitment No. 40) to implement the new MEB Program inspections once every 10 years, with the first inspection to be performed prior to entering the period of extended operation, to manage aging of applicable components.

The staff determines that the information in the UFSAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant’s MEB Program, applicant’s response to RAI B.2.40-1, and the revision to the MEB Program (Amendment 39), the staff determines that those program elements for which the applicant claimed consistency with the

GALL Report are consistent. In addition, the staff reviewed the exception and its justification and determines that the AMP, with the exception, is adequate to manage the aging effects for which the LRA credits it. In addition, the staff has reviewed the exception and its justification and determines that the AMP, with the exception is adequate to manage the aging effects for which the LRA credits it. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.17 Open-Cycle Cooling Water Program

Summary of Technical Information in the Application. LRA Section B.2.42 describes the existing Open-Cycle Cooling Water Program as consistent, with exceptions and enhancements, with GALL Report AMP XI.M20, “Open-Cycle Cooling Water System.” The applicant stated that this program will manage loss of material due to erosion and crevice, galvanic, general, pitting, and microbiologically-induced corrosion for components in the SSW, TSW, TMU, and circulating water systems. The applicant also stated that this program will manage reduction in heat transfer, due to fouling from particulate and biological material for heat exchangers within the scope of the program, and will manage cracking of aluminum and copper components that are subject to condensation. In addition, the applicant stated that this program consists of inspections, surveillances, and testing to detect aging effects, while combining this with chemical treatment and cleaning activities to mitigate aging concerns. Finally, the applicant stated that the program is a combination of condition monitoring and mitigation that implements the recommendations of NRC GL 89-13.

Staff Evaluation. During its audit, the staff reviewed the applicant’s claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine whether it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared Elements one through six of the applicant’s program to the corresponding elements of GALL Report AMP XI.M20. As discussed in the audit report, the staff confirmed that each element of the applicant’s program is consistent with the corresponding element of GALL Report AMP XI.M20, with the exception of the “scope of program” program element. For this element, the staff determined the need for additional clarification, which resulted in the issuance of an RAI.

The GALL Report AMP XI.M20 states that this program addresses aging effects of material loss and fouling, but it does not include cracking. However, the applicant’s Open-Cycle Cooling Water Program states that this program manages cracking for copper alloy and aluminum components in several open-cycle systems. By letter dated August 6, 2010, the staff issued RAI B.2.42-1 requesting that the applicant provide additional information explaining the basis for how cracking will be managed in the Open-Cycle Cooling Water Program.

In its response dated September 24, 2010, the applicant stated that Amendment 1 to the LRA, dated July 16, 2010, removed cracking of aluminum and copper alloy components as an aging effect being managed by the Open-Cycle Cooling Water Program. The applicant stated that the associated aluminum components were the fins on cooling coils in various systems exposed to condensation that had been conservatively considered susceptible to cracking. After further evaluation, the applicant concluded the fins were not susceptible to cracking because of the alloy content. The applicant also stated that the associated copper alloy components will now be managed for cracking by the Monitoring and Collection Systems Inspection Program instead of the Open-Cycle Cooling Water Program. The staff finds the response acceptable because, with the changes provided by the applicant, the scope of the Open-Cycle Cooling Water Program is consistent with the “scope of program” program element in GALL Report AMP XI.M20. The staff’s concern described in RAI B.2.42-1 is resolved.

The staff also reviewed the portions of the “scope of program,” “preventive actions,” and “monitoring and trending” program elements associated with exceptions and enhancements to determine whether the program will be adequate to manage the aging effects for which it is credited. The staff’s evaluation of these exceptions and enhancements follows.

Exception 1. LRA Section B.2.42 states an exception to the “preventive actions” program element. The applicant stated that the program does not use coatings on the inner walls in the SW system that are within the scope of license renewal.

The staff reviewed this exception to the GALL Report and noted that the applicant took the exception because the components are not coated or lined on the inner walls. However, the staff noted that the applicant did not describe what actions are taken to ensure that the lack of protective coatings would be managed during the period of extended operation so that loss of intended function would not occur. By letter dated August 6, 2010, the staff issued RAI B.2.42-2 requesting that the applicant provide additional information explaining how the lack of coatings in the open-cycle system is acceptable to maintain the system’s integrity and functionality.

In its response dated September 24, 2010, the applicant stated that other preventive measures of the program include chemical treatments of water to inhibit corrosion and to control biological infestations and deposits; periodic cleaning of heat exchanger components; and mechanical cleaning of SW piping at specific locations. The applicant also stated that these elements, in addition to its operating experience, ensure that the program will maintain the integrity and functionality of systems and components within the scope of the program.

The staff finds both the applicant’s response to the RAI and the program exception acceptable because the preventive measures taken by the applicant, in lieu of the use of coatings, have demonstrated that it will continue to maintain the system’s integrity and functionality during the period of extended operation, as supported by the lack of plant-specific operating experience that might indicate otherwise. The staff’s concern described in RAI B.2.42-2 is resolved.

Exception 2. LRA Section B.2.42 states an exception to the “monitoring and trending” program element. The applicant stated that instead of performing tests and inspections annually and during RFOs, the inspection frequencies are based on operating conditions, past history, flow rates, water quality, lay-up, and heat exchanger design.

The staff reviewed this exception to the GALL Report and noted that the applicant is using engineering evaluations to determine the frequency of inspections for this program. In addition, the staff noted this program element for GALL Report AMP XI.M20 states that testing frequencies comply with the utility’s commitments under GL 89-13. In that regard, the NRC’s most recent heat sink inspection (NRC Report 05000397/2010002), which reviews the GL 89-13 program, did not identify any findings in the applicant’s CLB program. The staff noted this inspection verified performance tests and inspections and verified that significant heat exchanger and heat sink performance problems were identified and that corrective actions were appropriate.

The staff finds the program exception acceptable because, as noted in the applicant's response dated February 5, 1990, to GL 89-13, the applicant demonstrated that the current testing intervals, established using engineering evaluations, are acceptable and that testing intervals will be adjusted in the event that adverse trends are identified.

Enhancement 1. LRA Section B.2.42 states an enhancement to the "scope of program" program element. The applicant stated that it will address loss of material due to cavitation erosion with activities such as opportunistic inspections of portions of the systems that have had indications of cavitation erosion in the past.

The staff reviewed this enhancement against the corresponding program element. The staff finds the enhancement to the "scope of program" acceptable because the applicant's plant-specific operating experience demonstrates that loss of material due to cavitation erosion should be included in this program. However, further details regarding additional aspects of this enhancement are discussed below in the "Operating Experience" section of this AMP.

Enhancement 2. LRA Section B.2.42 states an enhancement to the "scope of program" program element. The applicant stated that it will include nonsafety-related components within the license renewal scope in the SSW, circulating water, TSW, and TMU systems. The applicant also stated that it will include nonsafety-related components served by or connected to the TSW system in the process sampling (PS), process sampling radioactive (PSR), radwaste building mixed air, radwaste building return air, reactor building return air, and RCC systems.

The staff reviewed this enhancement against the corresponding program element. The staff finds this program enhancement acceptable because nonsafety-related components in open-cycle cooling water systems, that are attached to or located near safety-related SSCs, are being included in the program, as required by 10 CFR 54.4(a)(2).

Based on its audit and review of the applicant's responses to RAIs B.2.42-1 and B.2.42-2, the staff finds that Elements one through six of the applicant's Open-Cycle Cooling Water Program, with acceptable exceptions and enhancements, are consistent with the corresponding program elements of GALL Report AMP XI.M20 and, therefore, are acceptable.

<u>Operating Experience</u>. LRA Section B.2.42 summarizes operating experience related to the Open Cycle Cooling Water Program. The applicant stated that the health of the program and corresponding systems are periodically reported, including chemistry trends and material conditions. The applicant's plant-specific operating experience identified instances of damage due to cavitation erosion, which resulted in repeated instances of leaks and failures in the SSW system. The applicant stated that design and operational adjustments have corrected the issue sufficiently to support continued operation of the plant but have not fully eliminated the occurrence of cavitation erosion in the SSW or attached systems.

The staff reviewed operating experience information, in the application and during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant and are evaluated in the GALL Report. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant had adequately incorporated and evaluated operating experience related to this program. During its review, the staff identified operating experience, which could indicate that the applicant's program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of an RAI.

The GALL Report AMP XI.M20 specifies erosion as a cause of aging effects to be managed, but neither the GALL Report nor the SRP-LR specifically address erosion due to cavitation. The applicant stated that erosion, designated as cavitation erosion, has occurred and that corrective actions have not fully eliminated this aging issue. As discussed above in Enhancement 1, the applicant stated that components susceptible to this aging effect will be opportunistically inspected. During its audit, the staff reviewed plant-specific operating experience from 2002, which indicated that the extent of condition corrective actions would not need to apply to systems managed by the applicant's Flow-Accelerated Corrosion Program. The staff noted, however, the applicant's Flow-Accelerated Corrosion Program uses the predictive software, CHECWORKS™, which does not account for damage due to cavitation. In addition, the applicant indicated that previous susceptible locations have been mitigated by replacing carbon steel piping with stainless steel and that some of these areas are no longer inspected for cavitation erosion. The staff noted that, although stainless steel is less susceptible to cavitation damage, its susceptibility will depend on the severity and duration of the cavitation.

By letter dated August 3, 2010, the staff issued RAI B.2.42-3 requesting that the applicant explain how the extent of condition was determined for systems susceptible to erosion by cavitation, including systems managed by the Flow-Accelerated Corrosion Program. Also, the staff requested that the applicant provide the basis for not inspecting, during the period of extended operation, susceptible locations that were replaced with stainless steel.

In its response dated September 27, 2010, the applicant described its extent of condition review by stating that a piping system cavitation guide had been developed based on several industry documents and that the guide was used to predict locations with the potential for sustaining cavitation damage. The applicant also stated that once potential locations were identified, vibration or acoustic measurements and piping wall thickness measurements were taken to identify cavitation damage. The applicant further stated that the cavitation guide is now an appendix to its pipe sizing guide. In addition, the applicant stated that its assumption in 2002, with regard to the Flow-Accelerated Corrosion Program managing cavitation in high energy systems, was incorrect and acknowledged that the 2002 review was not complete. The applicant also stated that this issue has been entered into its Corrective Action Program to properly screen systems that were not evaluated for cavitation after the 2002 event and that the CR resolution would include an extent of condition review. Also, the applicant acknowledged that inspections should not have been discontinued at locations where stainless steel piping had been installed to resolve previously identified cavitation erosion issues. The applicant stated that this issue has also been entered into its Corrective Action Program to reinstate an appropriate inspection frequency, and the CR resolution would include an extent of condition review.

In its review of the applicant's response, the staff noted that it could not evaluate whether the AERMs had been identified for all of the components susceptible to loss of material due to cavitation erosion because the extent of condition performed in 2002 was incomplete. In addition, the applicant had not provided the criteria for predicting locations with a potential for cavitation erosion.

By letter dated December 27, 2010, the staff issued RAI B.2.42-4 requesting a complete list of AMR items susceptible to loss of material due to cavitation erosion, and the criteria used in the extent of condition evaluation to predict cavitation locations.

In its response dated January 28, 2011, the applicant provided a complete list of AMR line items that are known to be susceptible to loss of material due to cavitation erosion. In addition, the applicant added Commitment No. 68 to LRA Table A-1, to ensure that the two systems that had not been screened for cavitation during the 2002 extent of condition review (condensate and RFW systems) will be evaluated prior to the period of extended operation. Also in its response, the applicant discussed the criteria it used to predict the potential locations for cavitation erosion and compared the criteria to that included in the NRC-approved EPRI TR-112675, Revision B-A, "Revised Risk-Informed Inservice Inspection Evaluation Procedure." The applicant stated that the acceptance criteria in its piping system cavitation guide were based on minimizing the lowest and non-damaging levels of cavitation, while the criteria in the EPRI document allows these non-damaging levels but does not allow damaging cavitation. The applicant further stated that its cavitation guide provides more margin to actual damaging cavitation than the EPRI document and compared the equations in each of the documents. The staff finds the response acceptable because the applicant's new commitment will ensure that all components susceptible to loss of material due to cavitation erosion will be identified prior to the period of extended operation, and the criteria being used by the applicant is sufficiently conservative to identify potential locations susceptible to cavitation erosion. The concerns described in RAIs B.2.42-3 and B.2.42-4 are resolved.

Based on its audit, review of the application, and review of the applicant's responses to RAIs B.2.42-3 and B.2.42-4, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criteria in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.42 provides the UFSAR supplement for the Open-Cycle Cooling Water Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.1-2, 3.2-2, 3.3-2, and 3.4-2. The staff also notes that the applicant committed (Commitment No. 42) to ongoing implementation of the existing Open-Cycle Cooling Water Program and to enhance the program to address loss of material due to cavitation erosion and to include nonsafety-related components related to many specified systems prior to the period of extended operation. In addition, the staff notes that the applicant committed (Commitment No. 68) to screen and evaluate the condensate and RFW systems for cavitation prior to the period of extended operation. The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant's Open-Cycle Cooling Water Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. In addition, the staff reviewed the exceptions and its justifications and determines that the AMP, with the exceptions, is adequate to manage the aging effects for which the LRA credits it. Also, the staff reviewed the enhancements and confirmed that its implementation through Commitment No. 42, prior to the period of extended operation, would make the existing AMP consistent with the GALL Report AMP to which it was compared. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.2.18 Structures Monitoring Program

Summary of Technical Information in the Application. LRA Section B.2.50 describes the existing Structures Monitoring Program as being consistent, after enhancements, with GALL Report AMP XI.S6, “Structures Monitoring Program.” In the LRA, the applicant stated that the Structures Monitoring Program encompasses and implements the Masonry Wall Program and the Water Control Structures Inspection Program, and these are existing programs that are consistent with the program elements in GALL Report AMP, XI.S5, “Masonry Wall Program,” and GALL Report AMP XI.S7, “RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants,” respectively, with enhancements. The Structures Monitoring Program includes the performance of visual inspections of external surfaces to ensure that the effects of aging are adequately managed to assure that plant structures and structural components-intended functions will be performed, consistent with the CLB for the period of extended operation. The Structures Monitoring Program includes provisions of the Maintenance Rule, 10 CFR 50.65, that relate to the structures, masonry walls, and water-control structures. The Structures Monitoring Program conforms to guidance contained in RG 1.160 and Nuclear Management and Resources Council (NUMARC) 93-01. Protective coatings monitoring and maintenance are not addressed because it is not relied upon to manage effects of aging for structural components in the Structures Monitoring Program.

Staff Evaluation. During its audit, the staff reviewed the applicant’s claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine if it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant’s program to the corresponding elements of GALL Report AMP XI.S6. As discussed in the audit report, the staff confirmed that each element of the applicant’s program is consistent with the corresponding element of GALL Report AMP XI.S6, with the exception of “parameters monitored or inspected," “detection of aging effects,” and “acceptance criteria.” For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs.

While reviewing the “parameters monitored or inspected” program element, the staff noted that the LRA basis documents state that, in the Structures Monitoring Program, it is recommended to list ACI 349.3R-96 and ANSI/ASCE 11-90 as references to indicate that it provides guidance for selection of parameters monitored or inspected. The listing of these documents is provided as a recommended enhancement. The staff believes recommended enhancements provided in the LRA should be included in the scope of the program. It is not clear to the staff if the recommended enhancements such as these are required to meet GALL criteria or if the applicant will commit to the recommended enhancements prior to the period of extended operation.

By letter dated July 7, 2010, the staff issued RAI B.2.50-1, asking the applicant to do the following:

- provide information to clarify the distinction between the recommended enhancements and, in particular, describe the criteria that will be used to determine if recommendations will be implemented
- specify whether the recommended enhancements are required to meet or exceed GALL provisions (e.g., adoption of ACI 349.3R-96 acceptance criteria)

- identify whether Columbia will commit to the recommended enhancements prior to the period of extended operation or, if a commitment will not be made to all recommended enhancements, identify which recommended enhancements will be adopted in each of the applicable AMPs

In its response dated September 3, 2010, the applicant stated that the following:

- The required enhancements for the Structures Monitoring Program are commitments under license renewal and, as such, are listed in Appendix A of the application.
- The recommended enhancements are to facilitate the performance or documentation of activities related to the Structures Monitoring Program but are not necessary for the program to be effective or consistent with GALL.
- Recommended enhancements are not addressed in the LRA, and the applicant is not making a commitment to implement the recommended enhancements, but some recommended enhancements will be implemented as part of the LRA project prior to the period of extended operation.

Although the applicant provided information that addressed RAI B.2.50-1, the staff was still unclear which enhancements would actually be implemented and for which programs. Therefore, a teleconference was held with the applicant on September 22, 2010, to clarify the response. Based on discussions during the conference call, the staff issued followup RAI B.2.50-1, by letter dated November 19, 2010. The RAI addressed implementation of the enhancements and covered all the enhancements discussed in the original responses to RAIs B.2.50-1, B.2.50-2, and B.2.50-3.

By letter dated January 20, 2011, the applicant responded and explained that it was implementing the enhancements that were included in revised Commitment No. 50 in response to the original RAI. The applicant also stated that a baseline inspection, plus one additional inspection, would be completed using the quantitative acceptance criteria prior to entering the period of extended operation.

The staff reviewed the revised commitments and found them acceptable because the commitments include aligning the implementation procedures with industry codes, including ACI 349.3R-96, and revising the procedures to included additional quantitative degradation limits. This issue is discussed further in response to RAI B.2.50-3. Since the applicant clarified which enhancements were going to be implemented prior to the period of extended operation, and since the required enhancements are consistent with the GALL Report recommendations, the staff finds the response acceptable. The staff's concern described in followup RAI B.2.50-1 is resolved.

While reviewing the "acceptance criteria" program element, the staff noted that the LRA basis documents state that, in the Masonry Wall Program, Structures Monitoring Program, and Water Control Structures Inspection Program, the inspection criteria used to assess the condition of structures and structural components is found in the structures inspection checklist. A review of referenced program basis documents indicated that these documents provide only a listing of conditions to inspect related to the concrete, masonry walls, structural steel, liner plate, roof systems, siding, windows and doors, earthen structures and dams, settlement, structure and seismic gap, interfaces, equipment supports, piping, tanks, cable trays and conduits, outside structures, and general structures. Inspection criteria used to assess the condition of structures and structural components were not identified. The staff is unclear as to what criteria are used to provide a basis for acceptance of the condition of the structures.

By letter dated July 7, 2010, the staff issued RAI B.2.50-2, asking the applicant to provide the acceptance criteria used for the Masonry Wall, Structures Monitoring, and Inspection of Water Control Structures Programs to establish whether or not corrective actions are required prior to loss of function and provide justification that the acceptance criteria used for the structures or structural components meet or exceed the criteria provided in ACI 349.3R-96.

In its response dated September 3, 2010, the applicant stated the following:

- The Masonry Wall Program is implemented under the Structures Monitoring Program and requires an enhancement to acceptance criteria prior to the period of extended operation requiring that the extent of observed masonry cracking or degradation of steel edge supports and bracing to be evaluated is sufficient to ensure that the current evaluation basis is still valid, and quantitative acceptance criteria from the Structures Monitoring Program will be used during the inspections.
- The Structures Monitoring Program will include the recommendation from NUREG-1801, Revision 1, Chapter XI.S6 acceptance criteria element as a commitment prior to the period of extended operation, and the implementing procedure will be revised to include additional acceptance criteria details developed from Chapter 5 of ACI 349.3R-96.
- The inspection of the Water Control Structures Program is implemented under the Structures Monitoring Program and will use quantitative acceptance criteria from the Structures Monitoring Program during the inspections.

Based on its review of the applicant's responses to RAI B.2.50-2, the staff finds that the acceptance criteria related to the Masonry Wall, Structures Monitoring, and Inspection of Water Control Structures Programs are acceptable because, prior to the period of extended operation, the applicant committed to revise the Structures Monitoring Program to develop and add to the inspection procedure sufficient acceptance criteria and critical parameters to trigger levels of inspection and initiation of corrective actions based on plant-specific quantitative degradation limits similar to the three-tier hierarchy acceptance criteria from Chapter 5 of ACI 349.3R-96. The staff's concern described in RAI B.2.50-2 is resolved.

While reviewing the "detection of aging effects" program element, the staff noted that the LRA basis documents state that, in the Masonry Wall Program, Structures Monitoring Program, and Water Control Structures Inspection Program, inspections are performed by individuals normally assigned to maintenance rule activities or if individuals are used that are not normally assigned to maintenance rule activities it is briefed prior to conduct of inspections or accompanied by a maintenance rule staff engineer. A review of referenced program basis documents did not identify information related to qualifications of inspection personnel. The staff is unclear how the qualifications of the inspection personnel are commensurate with those identified in industry codes, standards, and guidelines.

By letter dated July 7, 2010, the staff issued RAI B.2.50-3, asking the applicant to provide qualification criteria of the personnel performing the inspections and demonstrate that it meets or exceed the criteria identified in industry codes, standards, and guidelines.

In its response dated September 3, 2010, the applicant stated that the implementing program documents will be revised prior to the period of extended operation to establish minimum qualifications for the individual performing the inspections to be a civil or structural engineer with an engineering degree and at least 4 years experience associated with nuclear power plant structures.

Based on its review of the applicant's responses to RAI B.2.50-3, the staff finds that the qualifications of the personnel performing the inspections are commensurate with those provided in ACI 349.3R-96 and ANSI/ASCE 11-90. The staff's concern described in RAI B.2.50-3 is resolved.

While reviewing the "parameters monitored or inspected" program element, the staff noted that the LRA basis documents state that the Structures Monitoring Program and excavation procedures will be enhanced to specify that if a below-grade structural wall or structural component becomes accessible through excavation, a followup action is initiated for the responsible engineer to inspect the exposed surfaces for age-related degradation. A review of referenced program basis documents did not identify information related to conduct of planned or opportunistic inspections to address inaccessible areas. Also the program basis documents did not contain provisions to notify the responsible engineer when a below-grade structural wall or structural component is exposed so that an inspection may be performed. The staff is unclear how aging of inaccessible areas will be managed so that the intended functions of the structures and structural components below-grade will be maintained during the period of extended operation.

By letter dated July 7, 2010, the staff issued RAI B.2.50-4, asking the applicant to describe how Columbia will address aging of inaccessible areas of below-grade structures and structural components during the period of extended operation consistent with industry standards for inspection, as recommended in the GALL Report.

In its response dated September 3, 2010, the applicant stated that under the Structures Monitoring Program element "parameters monitored or inspected," the applicant will revise the implementing procedures prior to the period of extended operation to include the following enhancements:

- It will specify that, if a below-grade structural wall or component becomes accessible through excavation, a followup action is initiated for the responsible (civil or structural) engineer to inspect the concrete surfaces for age-related degradation prior to backfilling
- The responsible engineer will review the site groundwater and raw water testing results to validate that the below-grade and raw water environments remain non-aggressive during the period of extended operation.

Based on its review of the applicant's responses to RAI B.2.50-4, the staff finds that the proposed revisions to the implementing procedures prior to the period of extended operation are acceptable because it is in agreement with recommendations in the GALL Report for aging management of inaccessible areas of below-grade structures and structural components. The staff's concern described in RAI B.2.50-4 is resolved.

The staff also reviewed the portions of the "scope," "parameters monitored or inspected," and "acceptance criteria" program elements associated with enhancements to determine if the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of the enhancements follows.

Enhancement 1. LRA Section B.2.50 states an enhancement to "scope" that expands the scope of the Structures Monitoring Program to include and list the structures within the scope of license renewal that credit this program for aging management. The enhancement also expands the scope of the Water Control Structures Inspection Program (LRA Section B.2.53) to include and list water control structures within the scope of license renewal and include RG 1.127, Revision 1, inspection elements for water control structures.

The staff finds this enhancement acceptable because, when implemented, the Structures Monitoring Program will address the structures included within the scope of license renewal. The Water Control Structures Inspection Program will include a list water control structures within the scope of license renewal and incorporate inspection elements of GALL Report AMP XI.S7, RG 1.127 for water control structures, including submerged surfaces. These enhancements make the “scope” of the Structures Monitoring Program and Water Control Structures Inspection Program consistent with “scope of program” elements provided in GALL Report AMP XI.S6, “Structures Monitoring Program,” and GALL Report AMP XI.S7, “RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants.”

Enhancement 2. LRA Section B.2.50 states an enhancement to “parameters monitored or inspected” that expands the Structures Monitoring Program procedure and the excavation procedure to specify that, if a below-grade structural wall or structural component becomes accessible through excavation, a followup action is initiated for the responsible engineer to inspect the exposed surfaces for age-related degradation of this area.

The staff finds this enhancement acceptable because, when implemented, the Structures Monitoring Program will address inspection of inaccessible areas of below-grade structures and structural components during the period of extended operation. However, documentation on how the aging of inaccessible areas of below-grade structures and structural components will be addressed during the period of extended operation was not provided in the LRA. This was addressed previously in response to RAI B.2.50-4.

Enhancement 3. LRA Section B.2.50 states an enhancement to “parameters monitored or inspected” that expands the Structures Monitoring Program to identify that the term “structural component” for inspection includes component types that credit the Structures Monitoring Program for aging management.

The staff finds this enhancement acceptable because this enhancement will add clarification to the component types to be monitored during the period of extended operation.

Enhancement 4. LRA Section B.2.50 states an enhancement to “parameters monitored or inspected” that expands the Structures Monitoring Program to include a potential degradation mechanism checklist as an attachment to the procedure and include aging effect terminology (e.g., loss of material, cracking, change in material properties, and loss of form).

The staff finds this enhancement acceptable because, by providing a checklist to identify facilities (e.g., auxiliary building, turbine building, and intake screenhouse), structural components (e.g., concrete, masonry walls, and structural steel), and potential types of degradation to look for in the structural components (e.g., spalling, cracks in joints, and corrosion), guidance is provided that improves the periodic inspection procedure.

Enhancement 5. LRA Section B.2.50 states an enhancement to “parameters monitored or inspected” that expands the Structures Monitoring Program to specify that the responsible engineer shall review site groundwater and raw water testing results for pH, chlorides, and sulfates prior to inspection to validate that the below-grade or raw water environments remain non-aggressive during the period of extended operation and groundwater chemistry data shall be collected at least once every 4 years and account for seasonal variations.

During discussions with the applicant's staff, documentation was provided demonstrating that historical data from monitoring of the groundwater are available. The sampling wells provide results representative of the safety-related and important-to-safety embedded concrete walls and foundations, and samples will be obtained at a frequency of 4 years and address seasonal variations.

The staff finds this enhancement acceptable because monitoring of groundwater and raw water chemistry will meet recommendations provided in the GALL Report.

Based on its onsite audit, and review of the applicant's response to the RAIs, the staff finds that elements one through six of the applicant's Structures Monitoring Program, with acceptable enhancements, are consistent with the corresponding program elements of GALL Report AMP XI.S6 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.50 summarizes operating experience related to the Structures Monitoring Program. The applicant stated that visual examinations have found general corrosion on steel components and concrete cracking, flaking, and scaling. Many of the concrete surface conditions noted (e.g., shrinkage cracks, construction joint voids, and surface irregularities) have been present since original construction and determined to not require further evaluation. The applicant further stated that the inspected structures were considered to be in good condition and capable of performing its design functions. Minor degradation has been identified in the following locations:

- circulating water pump house (e.g., minor leaching of concrete, cracks in walls along joints, and corrosion of lower section of door frames)
- turbine generator building (e.g., degraded roof membrane and minor water leakage)
- radwaste control building (e.g., concrete spalling and delaminated floor coatings)
- wetwell (e.g., support steel corrosion)
- main steam tunnel (e.g., flaking of coating)

The staff reviewed the operating experience information, in the application and during the onsite audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program.

During its review, the staff identified operating experience that could indicate that the applicant's program may not be effective in adequately managing the aging effects during the period of extended operation. The staff determined the need for additional clarification that resulted in the issuance of two RAIs discussed below.

In program basis documentation, it was noted that when the NRC asked the question of how often leakage from the spent fuel pool liner is checked, the applicant could not find any surveillances, PMs, or operator logs that note checking for this leakage. The staff is uncertain if leakage of the spent fuel pool is occurring and, if leakage is present, that it is being confined to the tell-tale drains.

By letter dated July 7, 2010, the staff issued RAI B.2.50-5 requesting that the applicant provide historical data on fuel pool leakage obtained by checking the tell-tale drains and note whether or not the leakage is confined to the tell-tale drains. If the leakage is not confined to the tell-tale drains, the staff asked the applicant to identify any structures or structural components potentially impacted and describe plans to assess the condition and continued functionality of potentially impacted structures and structural components, in particular when entering the renewed license operating term.

In its response dated September 3, 2010, the applicant stated that the tell-tale drains are checked once per shift (during 12-hour shifts), and any flow identified by the operator is entered into the Corrective Action Program. As of August 2010, no leakage has occurred since there have been no entries of leakage under the Corrective Action Program, and if liner leakage were to occur, it would be directed to the drainage monitoring channels and then to the tell-tale drains, and it would not impact other structures or structural components. Although the applicant provided information that addressed RAI B.2.50-5, the staff needed further assurance that the tell-tale drains are open and not blocked. This issue was discussed with the applicant during a conference call on September 22, 2010, and, as a result of the discussion, the staff issued followup RAI B.2.50-5, by letter dated November 19, 2010. The RAI requested that the applicant provide information that demonstrates the tell-tale drains are not blocked.

By letter dated January 20, 2011, the applicant explained that the spent fuel pool is completely contained within the reactor building (i.e., no walls exposed to soil or groundwater) and the layout of the spent fuel pool allows visual inspections to be conducted of two of the pool walls, as well as the floor. The applicant further explained that past inspections of the accessible walls, and areas of the reactor building in proximity to the spent fuel pool, have not revealed leakage attributable to the spent fuel pool. The applicant also stated that it is unlikely the drain lines would become clogged since boric acid is not used in the spent fuel pool. However, the applicant committed to a one-time internal inspection of the tell-tale drain lines prior to the period of extended operation.

The staff reviewed the information provided in the response, as well as the clarification provided during the conference call, and finds it acceptable, because the applicant has no history of spent fuel pool leakage, either through the tell-tale drains or the surrounding concrete. The applicant will continue to monitor the tell-tale drains and visually inspect the accessible portions of the spent fuel pool, and any leakage will be entered into the Corrective Action Program. The internal inspection of the drain lines will verify that the lines are free from obstruction prior to entering the period of extended operation. These inspections will ensure that any leakage is detected and addressed before it causes degradation to the spent fuel pool concrete. The staff's concern described in RAI B.2.50-5 is resolved.

In the program basis documentation wet well (i.e., the concrete floor of the suppression chamber) coating repair issues were identified that include observed cracks in the concrete estimated as being between 1/16 and 1/32 in. wide. During the subsequent coating inspections, the program basis documentation noted that the cracks had grown in width, but not length, and the coating appears to be peeling away from the concrete creating a wider crack. It was noted that the cracks were about 1/16 in. wide and were not considered to be a concern unless the width increased to 1/8 in. or greater. The staff is unclear about what criteria were used to evaluate these cracks and if there are any plans to repair the cracks in the concrete.

By letter dated July 7, 2010, the staff issued RAI B.2.50-7, asking the applicant to provide the following:

- the acceptance criteria used to evaluate these cracks
- results of any further investigations conducted to evaluate the concrete cracks described in Columbia document A/R Number 00031540
- a description of any monitoring or trending of these cracks to ensure timely remediation of such conditions identified by the Structures Monitoring Program

In its response dated September 3, 2010, the applicant stated the following:

- Acceptance criterion for the cracks was 1/8th in. width based on engineering judgment and plant-specific experience of the responsible engineer.
- During the RFO in 2005, the coating in the area of the crack was repaired and then reinspected during the R18 outage with the result that the coating inspectors could not find or distinguish the crack or repaired coating from coatings in surrounding areas.
- Columbia has a Service Level I Coatings Program that performs inspections, evaluations, and repairs (as necessary) of the wetwell coatings every 2 years that would monitor and trend conditions such as additional cracking that become evident through the discovery of damaged coatings and would also effect remediation or repair and document it in the Corrective Action Program.

The staff reviewed the applicant's response and found it acceptable. The applicant repaired the crack and the area is being monitored, with no further indications of degradation. As discussed in response to RAI B.2.50-2, and revised Commitment No. 50, the applicant will implement more rigorous quantitative acceptance criteria aligned with guidance in ACI 349.3R-96. Since the degraded area is being monitored, and the applicant will implement quantitative inspection criteria prior to the period of extended operation, the staff's concern described in RAI B.2.50-7 is resolved.

Based on its audit and review of the application, and review of the applicant's response to RAIs B.2.50-5, and B.2.50-7, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

<u>UFSAR Supplement</u>. LRA Section A.1.2.50 provides the UFSAR supplement for the Structures Monitoring Program.

The staff reviewed the UFSAR supplement section and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.5-2. The staff also notes that the applicant committed (Commitment No. 50) to enhance the Structures Monitoring Program prior to entering the period of extended operation. Specifically, the applicant committed to do the following:

- It will include and list the structures within the scope of license renewal that credit the Structures Monitoring Program for aging management.
- It will specify that if a below-grade structural wall or structural component becomes accessible through excavation, a followup action is initiated for the responsible engineer to inspect the exposed surfaces for age-related degradation prior to backfilling.

- It will identify that the term “structural component” for inspection includes component types that credit the Structures Monitoring Program for aging management.
- It will include the potential degradation mechanism checklist in the procedural documents. The checklist also requires enhancement to include aging effect terminology (e.g., loss of material, cracking, change in material properties, and loss of form).
- It will specify that the responsible engineer shall review site groundwater and raw water testing results for pH, chlorides, and sulfates prior to inspection to validate that the below-grade or raw water environments remain non-aggressive during the period of extended operation. Chemistry data shall be obtained from Columbia’s chemistry and environmental departments. Groundwater chemistry data shall be collected at least once every 4 years. The time of data collection shall be staggered from year to year (summer-winter-summer) to account for seasonal variations in the environment.

By letter dated September 3, 2010, the applicant revised Commitment No. 50 to also do the following:

- specify additional direction for quantifying, monitoring and trending of inspection results
- provide better alignment with referenced Industry codes, standards and guidelines regarding terminology and evaluation
- revise to add sufficient acceptance criteria and critical parameters to trigger level of inspection and initiation of corrective action (ACI 349.3R-96 provides an acceptable basis for developing acceptance criteria for concrete structural elements, steel liners, joints, coatings, and waterproofing membranes. Plant-specific quantitative degradation limits, similar to the three-tier hierarchy acceptance criteria from Chapter 5 of ACI 349.3R-96, will be developed and added to the inspection procedure.)

The staff determined that the information in the UFSAR supplement is an adequate summary description of the programs, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its audit and review of the applicant’s Structures Monitoring Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent, based on the resolution of the RAIs as discussed above. Also, the staff reviewed the enhancements and confirmed that its implementation through Commitment No. 50 prior to the period of extended operation would make the existing AMP consistent with the GALL Report AMPs to which it was compared. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for these AMPs and concludes that it provides an adequate summary description of the programs, as required by 10 CFR 54.21(d).

3.0.3.2.19 Water Control Structures Inspection

Summary of Technical Information in the Application. LRA Section B.2.53 describes the existing Water Control Structures Inspection Program as being consistent, after enhancements, with GALL Report AMP XI.S7, “RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants.” In the LRA, the applicant stated that the Water Control Structures Inspection Program is an existing program that is consistent with the program elements in GALL

Report AMP XI.S7, "RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," with enhancements. The applicant further stated that the program is implemented by the Structures Monitoring Program. The Water Control Structures Inspection Program includes visual examination of the spray ponds, SSW pump houses, circulating water pump house (including circulating water basin), makeup water pump house, and cooling tower basins for loss of material and cracking aging effects.

Staff Evaluation. During its audit, the staff reviewed the applicant's claim of consistency with the GALL Report. The staff also reviewed the plant conditions to determine if it is bounded by the conditions for which the GALL Report was evaluated.

The staff compared elements one through six of the applicant's program to the corresponding elements of GALL Report AMP XI.S7. As discussed in the audit report, the staff confirmed that each element of the applicant's program is consistent with the corresponding element of GALL Report AMP XI.S7 with the exception of "parameters monitored or inspected," "detection of aging effects," and "acceptance criteria." For these elements, the staff determined the need for additional clarification, which resulted in the issuance of RAIs, as discussed below.

While reviewing the "parameters monitored or inspected" program element, the staff noted that the LRA states that, in the Structures Monitoring Program, it is recommended to list ACI 349.3R-96 and ANSI/ASCE 11-90 as references to indicate that it provides guidance for selection of parameters monitored or inspected. The listing of these documents is provided as a recommended enhancement. The staff believes that the recommended enhancements provided in the LRA should be included in the scope of the program. It is not clear to the staff if the recommended enhancements such as these are required to meet GALL criteria or if the applicant will commit to the recommended enhancements prior to the period of extended operation.

By letter dated July 7, 2010, the staff issued RAI B.2.50-1, asking the applicant to do the following:

- provide information to clarify the distinction between the recommended enhancements and in particular describe the criteria that will be used to determine if the recommendations will be implemented
- specify whether the recommended enhancements are required to meet or exceed GALL provisions (e.g., adoption of ACI 349.3R-96 acceptance criteria)
- identify whether Columbia will commit to the recommended enhancements prior to the period of extended operation or, if a commitment will not be made to implement all recommended enhancements, identify which recommended enhancements will be adopted in each of the AMPs

A summary of the applicant's response and the staff's review and resolution of this issue can be found in the Structures Monitoring Program review in SER Section 3.0.3.2.18.

While reviewing the "acceptance criteria" program element, the staff noted that the LRA basis documents state that, in the Water Control Structures Inspection Program, the inspection criteria used to assess the condition of structures and structural components is found in the structures inspection checklist. A review of the referenced program basis documents indicated that these documents provide only a listing of conditions to inspect related to the concrete, masonry walls, structural steel, liner plate, roof systems, siding, windows and doors, earthen structures and dams, settlement, structure and seismic gap, interfaces, equipment supports, piping, tanks, cable trays and conduits, outside structures, and general structures. No inspection criteria used to assess the condition of structures and structural components were identified. The staff is unclear what criteria are used to provide a basis for acceptance of the condition of the structures.

By letter dated July 7, 2010, the staff issued RAI B.2.50-2, asking the applicant to provide the acceptance criteria used for the Masonry Wall, Structures Monitoring, and Inspection of Water Control Structures Programs to establish whether or not corrective actions are required prior to loss of function and provide justification that the acceptance criteria used for the structures or structural components meet or exceed the criteria provided in ACI 349.3R-96.

In its response dated September 3, 2010, the applicant stated that the Structures Monitoring Program will include the recommendation from NUREG-1801, Revision 1, Chapter XI.S6 acceptance criteria element as a commitment prior to the period of extended operation and the implementing procedure will be revised to include additional acceptance criteria details developed from Chapter 5 of ACI 349.3R-96; and the inspection of Water Control Structures Program is implemented under the Structures Monitoring Program and will use quantitative acceptance criteria from the Structures Monitoring Program during the inspections.

Based on its review of the applicant's responses to RAI B.2.50-2, the staff finds that the acceptance criteria related to the Masonry Wall, Structures Monitoring, and Inspection of Water Control Structures Programs are acceptable because prior to the period of extended operation the applicant has committed to revise the Structures Monitoring Program to develop and add to the inspection procedure sufficient acceptance criteria and critical parameters to trigger levels of inspection and initiation of corrective actions based on plant-specific quantitative degradation limits similar to the three-tier hierarchy acceptance criteria from Chapter 5 of ACI 349.3R-96. The staff's concern described in RAI B.2.50-2 is resolved.

While reviewing the "detection of aging effects" program element, the staff noted that the LRA basis documents state that, in the Masonry Wall Program, Structures Monitoring Program, and Water Control Structures Inspection Program, inspections are performed by individuals normally assigned to maintenance rule activities or if individuals are used that are not normally assigned to maintenance rule activities it is briefed prior to conduct of inspections or accompanied by a maintenance rule staff engineer. A review of referenced program basis documents did not identify information related to qualifications of inspection personnel. The staff is unclear how the qualifications of the inspection personnel are commensurate with those identified in industry codes, standards, and guidelines.

By letter dated July 7, 2010, the staff issued RAI B.2.50-3, asking the applicant to provide qualification criteria of the personnel performing the inspections and demonstrate that it meets or exceed the criteria identified in industry codes, standards, and guidelines.

In its response dated September 3, 2010, the applicant stated that the implementing program documents will be revised prior to the period of extended operation to establish minimum qualifications for the individual performing the inspections to be a civil or structural engineer with an engineering degree and at least 4 years experience associated with nuclear power plant structures.

Based on its review of the applicant's responses to RAI B.2.50-3, the staff finds that the qualifications of the personnel performing the inspections are commensurate with those provided in ACI 349.3R-96 and ANSI/ASCE 11-90. The staff's concern described in RAI B.2.50-3 is resolved.

The staff also reviewed the portions of the "scope" and "parameters monitored or inspected" program elements associated with enhancements to determine if the program will be adequate to manage the aging effects for which it is credited. The staff's evaluation of the enhancements follows.

Enhancement 1. LRA Section B.2.53 states an enhancement to "scope" that expands the scope of the Water Control Structures Program to include and list the water control structures within the scope of license renewal that credit this program for aging management, including submerged portions.

The staff finds this enhancement acceptable because, when implemented, the Water Control Structures Inspection Program will include and list water control structures within the scope of license renewal and incorporate inspection elements of GALL Report AMP XI.S7, RG 1.127 for water control structures, including submerged surfaces. These enhancements make the scope of the Water Control Structures Inspection Program consistent with "scope of program" elements provided in GALL Report AMP XI.S7, "RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants."

Enhancement 2. LRA Section B.2.53 states an enhancement to "parameters monitored or inspected" that ensures the descriptions of concrete conditions conform to ACI 201, "Guide for Making a Condition Survey of Concrete in Service."

The staff reviewed this enhancement and did not find it adequate because it does not align the applicant's program with the recommended GALL Report guidance documents (i.e., ACI 349.3R). This was addressed above by RAI B.2.50-1, and a detailed summary of the issue as well as the staff's review and the resolution can be found in SER Section 3.0.3.2.18. In response to the RAI, the applicant committed to align the parameters monitored or inspected with the guidance in ACI 349.3R; therefore, the staff finds this enhancement acceptable.

Based on its audit, and review of the applicant's response to the RAIs, the staff finds that elements one through six of the applicant's Water Control Structures Inspection Program, with acceptable enhancements, are consistent with the corresponding program elements of GALL Report AMP XI.S7 and, therefore, are acceptable.

Operating Experience. LRA Section B.2.53, summarizes operating experience related to the Water Control Structures Inspection Program. Visual examinations have found general corrosion on steel components and concrete cracking, flaking, and scaling. Many of the concrete surface conditions noted (e.g., shrinkage cracks, construction joint voids, and surface irregularities) have been present since original construction and determined to not require further evaluation. Inspected structures were considered to be in good condition and capable of performing its design functions. Minor degradation has been identified in the circulating water pump house (e.g., minor leaching of concrete, cracks in wall along joints, and corrosion of lower sections of door frames).

The staff reviewed operating experience information, in the application and during the onsite audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant. As discussed in the audit report, the staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program.

During its review, the staff identified operating experience that could indicate that the applicant's program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification that resulted in the issuance of an RAI, as discussed below.

During the field walkdown of the spray ponds, the staff noted that there were numerous narrow cracks visible at the top of the reinforced concrete walls that went through the entire thickness of the wall. The cracks appeared to be shrinkage cracks, and there was no evidence of corrosion. The staff is unclear of how conditions like this that may be identified during the renewed license operating period will be identified, evaluated, and repaired, as necessary.

By letter dated July 7, 2010, the staff issued RAI B.2.50-6, asking the applicant to do the following:

- clarify if the condition been identified by the Structures Monitoring Program and, if so, what date it was identified
- explain if this condition is a potentially adverse condition that could impact spray pond functionality and, hence, would be subject to aging management during the renewed license period
- explain if this condition was identified by the Columbia Structures Monitoring Program and, if so, describe the results of the condition assessment and any plans to implement repairs
- describe any extent of condition concerns that may have led to more focused inspection of structures that could be similarly affected

In its response dated September 3, 2010, the applicant stated the following:

- SW pump houses and its associated spray ponds have been walked down and inspected above water level under the Maintenance Rule since 1996, initially every 2 years and every 4 years since 2006, and cracks identified were considered to be inactive and cosmetic in nature and not impacting the intended function of the spray ponds to provide an ultimate heat sink.
- The condition is not considered to adversely impact the spray pond functionality, and the walls will be managed for potential aging effects, including monitoring and trending of the walls, under the Inspection of Water Control Structures Program that is implemented under the Structures Monitoring Program.
- Based on results of the walkdowns and engineering judgment, the cracks were considered to be cosmetic shrinkage cracks that do not affect the structural integrity of the spray ponds; however, if cracks develop requiring additional further evaluation based on criteria developed from ACI 349.3R-96, Columbia will use the Corrective Action Program to document the additional review and evaluation and any potential corrective actions.
- Since potential cracking and other aging effects of concrete structures within the scope of license renewal will be monitored under the Structures Monitoring Program during the period of extended operation, the extent of condition would be applicable to any concrete structure.

Although the applicant provided information that addressed RAI B.2.50-6, the inspection criteria used are very subjective and do not provide a baseline for use in aging management. Since through-wall cracks were identified in the inspection reports, the staff needs more information, and the applicant is asked to provide more quantitative information on the inspection criteria that will be used to evaluate the significance of the spray pond cracking (e.g., criteria based on ACI 349.3R-96) and to use these inspection criteria to perform a baseline inspection for aging management. By letter dated October 14, 2010, the staff issued followup RAI B.2.50-6 to address this issue.

By letter dated January 18, 2011, the applicant responded and committed to conduct a baseline inspection of the spray ponds prior to the period of extended operation. The applicant stated that the inspections would use quantitative criteria in accordance with ACI 349.3R (Commitment No. 53). The staff reviewed the applicant's response and found it acceptable because the applicant committed to conduct a baseline inspection using quantitative acceptance criteria. This matches the guidance in the GALL Report and ensures that the degradation will be properly identified and addressed. The staff's concern described in RAI B.2.50-6 is resolved.

Based on its audit and review of the application, including RAI B.2.50-6, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.10; therefore, the staff finds it acceptable.

<u>UFSAR Supplement</u>. LRA Section A.1.2.53 provides the UFSAR supplement for the Water Control Structures Inspection Program.

The staff reviewed this UFSAR supplement section and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.5-2. The staff also notes that the applicant committed (Commitment No. 53) to enhance the Water Control Structures Inspection Program prior to entering the period of extended operation. Specifically, the applicant committed to the following:

> Include and list the water control structures within the scope of license renewal. Include the RG 1.127 Revision 1 inspection elements for the water control structures, including submerged surfaces. Ensure descriptions of concrete conditions conform with the appendix to the American Concrete Institute (ACI) publication, ACI 201, "Guide for Making a Condition Survey of Concrete in Service." Add a recommendation to use photographs for comparison of previous and present conditions. Add a requirement for the documentation of new or progressive problems as a part of the inspection program.

By letter dated September 3, 2010, the applicant revised Commitment No. 53 to also do the following:

- specify additional direction for quantifying, monitoring, and trending of inspection results
- provide better alignment with referenced Industry codes, standards, and guidelines regarding terminology and evaluation
- revise to add sufficient acceptance criteria and critical parameters to trigger level of inspection and initiation of corrective action (ACI 349.3R-96 provides an acceptable

basis for developing acceptance criteria for concrete structural elements, steel liners, joints, coatings, and waterproofing membranes. Plant-specific quantitative degradation limits, similar to the three-tier hierarchy acceptance criteria from Chapter 5 of ACI 349.3R-96, will be developed and added to the inspection procedure.)

By letter dated January 18, 2011, the applicant revised Commitment No. 53 to also include a baseline inspection of the spray ponds prior the period of extended operation. The inspection will use quantitative acceptance criteria in accordance with ACI 349.3R.

The staff determined that the information in the UFSAR supplement is an adequate summary description of the programs, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its onsite audit and review of the applicant's Water Control Structures Inspection Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent, based on the resolution of the RAIs as discussed above. Also, the staff reviewed the enhancements and confirmed that its implementation through Commitment No. 53 prior to the period of extended operation would make the existing AMP consistent with the GALL Report AMPs to which it was compared. The staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3 AMPs that are Not Consistent with or Not Addressed in the GALL Report

In LRA Appendix B, the applicant identified the following AMPs that were not consistent with, or not addressed by, the GALL Report:

- Air Quality Sampling Program
- B_4C Monitoring Program
- Cooling Units Inspection Program
- Diesel-Driven Fire Pumps Inspection Program
- Diesel Systems Inspection Program
- Flexible Connection Inspection Program
- High-Voltage Porcelain Insulators Program
- Monitoring and Collection Systems Inspection Program
- Potable Water Monitoring Program
- Preventative Maintenance-RCIC Turbine Casing Program
- Service Air System Inspection Program
- Service Level 1 Protective Coatings Program
- Small Bore Class 1 Piping Program

For the AMPs that are not consistent with or not addressed by the GALL Report, the staff performed a complete review of the AMPs to determine whether it was adequate to monitor or manage aging. The staff's review of these plant-specific AMPs is documented in the following sections of this SER.

3.0.3.3.1 Air Quality Sampling

Summary of Technical Information in the Application. LRA Section B.2.2 describes the existing Air Quality Sampling Program as plant-specific. The applicant stated that this program mitigates degradation due to loss of material for carbon steel components in the diesel starting air system that contain compressed air. The applicant also stated that this program ensures that the CAS remains dry and free of contaminants, thereby ensuring that no aging effects require management for the system. The applicant further stated that this program is a combination of prevention and condition monitoring programs comprised of periodic air quality sampling and corresponding actions to remove moisture or contaminants from the control air and diesel starting air systems as well as periodic ultrasonic inspections of the air receivers in the diesel starting air system to ensure that the aging effects are adequately managed. The applicant further stated that, although NUREG-1801 includes the XI.M24 Compressed Air Monitoring Program, which like the Air Quality Sampling Program is based on the results of responses to GL 88-14, the Columbia program is comprised of periodic sampling for air quality, and other portions of the NUREG-1801, XI.M24 Program are not applicable to Columbia.

Staff Evaluation. The staff reviewed Program Elements one through six of the applicant's program against the acceptance criteria for the corresponding elements, as stated in SRP-LR Section A.1.2.3. The staff's review focused on how the applicant's program manages aging effects through the effective incorporation of these program elements. The staff's evaluation of each of these elements follows.

Scope of the Program. LRA Section B.2.2 states that the Air Quality Sampling Program is credited for managing the loss of material for carbon steel components in the diesel starting air system and the air quality in the control air and diesel starting air systems. The applicant stated that this program includes periodic air quality sampling and corresponding actions to remove moisture and particulates from the control air and diesel starting air systems. The applicant also stated that this program performs periodic ultrasonic inspections of the air receivers in the diesel starting air system to ensure that its pressure boundary integrity is maintained.

The staff reviewed the applicant's "scope of the program" program element against the criteria in SRP-LR Section A.1.2.3.1, which states that the program should include the specific SCs of which the program manages the effects of aging.

The staff reviewed the applicant's program basis document and noted that it identifies the type of material, components, and aging effect within the scope of the program. The applicant's scoping program element is appropriate for the Air Quality Sampling Program because it clearly defines the aging effects, materials, and applicable components.

The staff confirmed that the "scope of the program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1; therefore, the staff finds it acceptable.

Preventive Actions. LRA Section B.2.2 states that the Air Quality Sampling Program includes periodic air quality sampling of the control air and diesel starting air systems to ensure acceptable air quality and corresponding actions if the results are outside the limits. The applicant stated that this program involves desiccant inspection and replenishment, air receiver dewpoint reduction, and air receiver blowdown activities, which are conducted as necessary to minimize the accumulation of moisture in the diesel starting air system and any resulting corrosion to system components.

The staff reviewed the applicant's "preventive actions" program element against the criteria in SRP-LR Section A.1.2.3.2, which states that the activities for the prevention and mitigation program should be described. The SRP-LR also states that for condition or performance monitoring programs, no preventive actions are required.

The staff reviewed the applicant's program basis document and noted that the program conducts air quality sampling and corrective actions in accordance with the applicant's implementing procedures. The applicant's preventive actions program element is appropriate for the Air Quality Sampling Program because it clearly defines the prevention and mitigation activities.

The staff confirmed that the "preventive actions" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.2; therefore, the staff finds it acceptable.

Parameters Monitored or Inspected. LRA Section B.2.2 states that the Air Quality Sampling Program includes periodic air quality sampling of the control air and diesel starting air systems for particulates, hydrocarbons, and dewpoint, and conducts ultrasonic inspections of the air receivers in the diesel starting air system to determine wall thickness.

The staff reviewed the applicant's "parameters monitored or inspected" program element against the criteria in SRP-LR Section A.1.2.3.3, which states that parameters to be monitored or inspected should be identified and linked to the degradation of the particular structure and component intended function. The SRP-LR also states that, for condition monitoring programs, the parameters monitored or inspected should detect the presence and extent of aging effects. The SRP-LR further states that, for performance monitoring programs, a link should be established between the degradation of the particular structure and component intended function and the parameter being monitored. Additionally, the SRP-LR states that, for prevention and mitigation programs, the parameters monitored should be the specific parameters being controlled to prevent or mitigate aging effects.

The staff reviewed the applicant's program basis document and noted that the program includes the performance of periodic sampling of air quality for particulates, hydrocarbons, and dewpoint, and wall-thickness measurements through ultrasonic inspections. The applicant stated that the air-quality parameters monitored by the program are detailed in its implementing procedures and include particulates, hydrocarbons, and dewpoint, which could lead to corrosion of system components. The applicant also stated that for wall-thickness measurements, the ultrasonic inspections are performed using established nondestructive techniques, and the ASME code is used to identify code design requirements associated with minimum wall thickness. The applicant's parameters monitored or inspected program element is appropriate for the Air Quality Sampling Program because it clearly defines parameters to be monitored and inspected.

The staff confirmed that the "parameters monitored or inspected" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.3; therefore, the staff finds it acceptable.

Detection of Aging Effects. LRA Section B.2.2 states that the Air Quality Sampling Program detects the presence of moisture, as a critical environmental condition that could lead to corrosion of system components, and performs ultrasonic inspections to measure wall thickness of the air receivers in the diesel starting air system.

The staff reviewed the applicant's "detection of aging effects" program element against the criteria in SRP-LR Section A.1.2.3.4, which states that detection of aging effects should occur before there is a loss of the component or structure intended function. The SRP-LR also states that parameters to be monitored should be appropriate to ensure that the structure and component intended function will be adequately maintained for license renewal. The SRP-LR further states that a program based solely on detecting structure and component failure should not be considered as an effective AMP for license renewal. Additionally, the SRP-LR states that the program element describes when, where, and how program data are collected. The SRP-LR also suggests that the method or technique and frequency may be linked to plant-specific or industry-wide operating experience. Finally, the SRP-LR states that when sampling is used to inspect a group of SCs, the basis for the inspection population and size should be provided.

The staff reviewed the applicant's program basis document and noted that the presence of moisture is detected through dewpoint testing of air samples, in accordance with applicant's implementing procedure. The applicant stated that the air quality testing is based on existing commitments to NRC GL 88-14. The applicant also stated that its plant-specific operating experience has confirmed that the quarterly sampling of air quality of the control air and diesel starting air systems is effective to maintain dry and contaminant-free air. The applicant further stated that the performance of biennial ultrasonic inspections and the inspection location is based on its past work orders. The applicant's detection of aging effects program element is appropriate for the Air Quality Sampling Program because it does the following:

- uses appropriate techniques for detecting aging effects.
- explains when, where, and how the data are collected
- uses operating experience to determine the frequency for detecting aging

The staff confirmed that the "detection of aging effects" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.4; therefore, the staff finds it acceptable.

Monitoring and Trending. LRA Section B.2.2 states that the Air Quality Sampling Program is a combination of prevention and condition monitoring program comprised of periodic air quality sampling of the control air and diesel starting air systems and ultrasonic inspections of the air receivers in the diesel starting air system. The applicant stated that recurring instances of the diesel starting air system air quality outside acceptable limits and decrease in wall thickness of the air receivers in the diesel starting air system have been trended and evaluated through the Corrective Action Program.

The staff reviewed the applicant's "monitoring and trending" program element against the criteria in SRP-LR Section A.1.2.3.5, which states that monitoring and trending activities should be described, including ability to predict the extent of degradation. The SRP-LR also states that operating or industry experience may be used to determine the appropriateness of the technique and frequencies. The SRP-LR further states that the program element describes how the data collected are evaluated against the acceptance criteria.

The staff reviewed the applicant's program basis document and noted that the inspection results are kept in permanent plant files and are available for trending analysis. The applicant stated that periodic sampling of the air quality and evaluation of dewpoint levels outside acceptable limits ensures timely diagnosis of any unfavorable trends and prompt corrective actions to restore the air quality to design standards. The applicant also stated that the wall-thickness measurements for the air receivers in the diesel starting air system are evaluated to estimate the end-of-life of the components. The staff also reviewed the applicant's claim that the other portions of GALL Report AMP XI.M24 are not applicable. The "monitoring and trending" program element of GALL Report AMP XI.M24 recommends visual inspection and leak testing to verify proper operation of the compressed air system and to ensure timely detection of loss of material due to corrosion. In addition, LRA Table 3.3.2-10 indicates that steel piping and valve bodies in the CAS internally exposed to dried air are not subject to aging effects that require management. The LRA attributes the AMR results to the AMP B.2.2, Air Quality Sampling Program. However, it is unclear to the staff how AMP B.2.2 will adequately maintain a dried air environment free of contaminants and corrosion in the compressed air system in the event that the air driers were isolated or bypassed.

By letter dated September 21, 2010, the staff issued RAI B.2.2-3, which requested that the applicant describe how its Air Quality Sampling Program will maintain a dried air environment, free of contaminants and corrosion in the compressed air system, in the event that the air driers were isolated or bypassed due to a system perturbation, to support maintenance activities, or during an outage. In its response dated December 7, 2010, the applicant stated that its Air Quality Sampling Program comprises periodic air quality sampling and corresponding actions to remove moisture and particulates from the CAS. The applicant also stated that the CAS incorporates two air dryer skids arranged in parallel to facilitate on-line maintenance or dryer outages, both of which can individually support 100 percent of the system load. Additionally, a moisture detection device is located immediately downstream of the air dryers to provide local indication of instrument air dew point and provide an alarm to the main control room if moisture levels rise above a predetermined value. The applicant further stated that in the event the CAS acceptance criteria are not met, station operating procedures direct the failure be entered into the Corrective Action Program, and actions are taken to reduce the dewpoint as well as to implement a focused inspection and monitoring plan similar to the visual and ultrasonic exams performed for the diesel starting air system (discussed above). Based on its review, the staff finds the applicant’s responses acceptable because the applicant’s Air Quality Sampling Program includes both prevention and condition monitoring measures to ensure that the CAS remains dry and free of contaminants and corrosion. The staff’s concern described in RAI B.2.2-3 is resolved.

The applicant’s “monitoring and trending” program element is appropriate for the Air Quality Sampling Program because it clearly defines the monitoring and trending activities for managing the aging effects.

The staff confirmed that the “monitoring and trending” program element satisfies the criterion defined in SRP-LR Section A.1.2.3.5; therefore, the staff finds it acceptable.

Acceptance Criteria. LRA Section B.2.2 states that the Air Quality Sampling Program specifies the acceptance criteria for the air quality of the control air and diesel starting air systems in terms of the limits for particulates, hydrocarbons, and dewpoint and specifies a minimum wall thickness acceptance criterion for ultrasonic inspections of the diesel starting air system air receivers.

The staff reviewed the applicant’s “acceptance criteria” program element against the criteria in SRP-LR Section A.1.2.3.6, which states that the acceptance criteria of the program and its basis should be described. The SRP-LR also states that the acceptance criteria could be specific numerical values or could consist of a discussion of the process for calculating specific values. The SRP-LR further states that it is not necessary to justify any acceptance criteria taken directly from the design basis information that is included in the UFSAR. Additionally, the SRP-LR states that qualitative inspections should be performed to the same predetermined criteria as quantitative inspections.

The staff reviewed the applicant's program basis document and noted that the acceptance criteria for air quality sampling are specified for particulates, hydrocarbons, and dewpoint in the surveillance procedures for the control air and diesel starting air systems. However, it is unclear to the staff the basis for establishing the acceptance criteria for particulates, hydrocarbons, and dewpoint. By letter dated June 30, 2010, the staff issued RAI B.2.2-1, which requested that the applicant provide the basis for establishing the particulates, hydrocarbons, and dew point criteria for air quality sampling of the control air and diesel starting air systems.

By letter dated August 26, 2010, the applicant responded to the RAI by stating that the basis for the acceptance criteria for air quality sampling was provided in its response to GL 88-14, dated July 28, 1989. Further, the staff noted that the applicant's response has fulfilled the requirements of GL 88-14. Based on its review, the staff finds the applicant's response to RAI B.2.2-1 acceptable because the applicant provided the basis for establishing the particulates, hydrocarbons, and dew point criteria for air quality sampling of the control air and diesel starting air systems that makes the applicant's program consistent with the criteria in SRP-LR Section A.1.2.3.6. The staff's concern described in RAI B.2.2-1 is resolved.

The staff reviewed the applicant's program basis document and noted that an operating minimum wall thickness of 0.236 in. was determined based on ASME code for the air receiver tanks of the diesel starting air system. However, it is unclear to the staff the basis for the wall-thickness criteria established for the air receiver tanks. By letter dated June 30, 2010, the staff issued RAI B.2.2-2, which requested that the applicant provide the basis for establishing the tank wall thickness criteria for ultrasonic inspections of the diesel starting air system.

By letter dated August 26, 2010, the applicant responded to the RAI by stating that the operating minimum wall thickness of 0.236 in. was determined following the provisions in the 1974 Edition of ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, UG-32(d). Further, the staff noted that the methodology the applicant used for calculating the minimum design wall thickness is appropriate. Based on its review, the staff finds the applicant's response to RAI B.2.2-2 acceptable because the applicant provided the basis for establishing the tank wall thickness criteria for ultrasonic inspections of the diesel starting air system that makes the applicant's program consistent with the criteria in SRP-LR Section A.1.2.3.6. The staff's concern described in RAI B.2.2-2 is resolved.

The staff confirmed that the "acceptance criteria" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.6; therefore, the staff finds it acceptable.

Operating Experience. LRA Section B.2.2 summarizes operating experience related to the Air Quality Sampling Program. The applicant stated that the quarterly sampling of the CAS air quality is effective in maintaining dry and contaminant-free air. The applicant also stated that the diesel starting air system has experienced recurring dewpoint problems, and, as a result, degradation has been identified on the diesel starting air system components due to excessive moisture content. The applicant further stated that additional corrective actions are necessary to reduce dewpoint, replenish desiccant, and blowdown the air receivers to effectively maintain the diesel starting air system air quality. During the audit, the staff reviewed the applicant's program basis document and CRs. The staff noted that ultrasonic inspections of the diesel starting air system air receivers, conducted in 2002, revealed that the remaining wall thickness of the bottom heads had dropped below the ASME code required thickness value. The applicant stated that an engineering evaluation was performed to determine the operating minimum wall thickness for the bottom heads, and the end-of-life limits for the components were estimated. The applicant also stated that corrosion on the diesel starting air system air receiver tanks has been periodically monitored because repair or replacement may be needed prior to entering the period of extended operation.

The staff reviewed this information against the acceptance criteria in SRP-LR Section A.1.2.3.10, which states that operating experience with existing programs should be discussed including past corrective actions resulting in program enhancements.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.2 provides the UFSAR supplement for the Air Quality Sampling Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.3-2. The staff also notes that the applicant committed (Commitment No. 2) to ongoing implementation of the Air Quality Sampling Program for managing aging of applicable components during the period of extended operation.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its technical review of the applicant's Air Quality Sampling Program, the staff concludes the applicant demonstrated that the effects of aging will be adequately managed so that the intended function will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.2 B_4C Monitoring Program

Summary of Technical Information in the Application. LRA Section B.2.54 describes the existing B_4C Monitoring Program as plant-specific. The applicant stated that the program ensures that potentially detrimental aging effects will be adequately detected such that the neutron absorber material in the spent fuel pool (SFP) racks continue to function, consistent with the CLB, for the period of extended operation.

Staff Evaluation. The staff reviewed Program Elements one through six of the applicant's program against the acceptance criteria for the corresponding elements, as stated in SRP-LR Section A.1.2.3. The staff's review focused on how the applicant's program manages aging effects through the effective incorporation of these program elements. The staff's evaluation of each of these elements follows.

Scope of Program. LRA Section B.2.54 states that the scope of the program includes detection of degradation of B_4C neutron absorbers in the spent fuel storage racks by monitoring of the fuel racks for potential off-gassing and B_4C inspection. The applicant further states that the data collected from monitoring will be used to assess the stability and integrity of the B_4C material in the storage cells. The applicant states that adverse conditions will be documented in the Corrective Action Program. The applicant states that the neutron absorber plates in the SFP were manufactured in West Germany by Electroschmelzwerk-Kempen. The applicant further stated that the absorber plates are composed of B_4C granule material that is mixed with a phenolic resin and catalyst, are seal welded in a stainless steel cavity to prevent water intrusion, and are vented at the pool curb through sampling valves.

The staff reviewed the applicant's "scope of program" program element against the criteria in SRP-LR Section A.1.2.3.1, which states that the scope of the program should include the specific SCs of which the program manages the effects of aging.

The staff confirmed that the "scope of the program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1; therefore, the staff finds it acceptable.

Preventative Actions. LRA Section B.2.54 states that the program is a Condition Monitoring Program, and no actions are taken to prevent or mitigate aging degradation.

The staff reviewed the applicant's "preventative actions" program element against the criteria in SRP-LR Section A.1.2.3.2, which states that for condition or performance monitoring programs, it does not rely on preventative actions; thus, this information need not be provided.

The staff confirmed that the "preventative actions" program element satisfies the criterion defined by SRP-LR Section A.1.2.3.2; therefore, the staff finds it acceptable.

Parameters Monitored or Inspected. LRA Section B.2.54 states B_4C sample coupons will be monitored for signs of physical or chemical degradation or both. The applicant stated that by monitoring for degradation in B_4C sample coupons, the degradation in the neutron-absorbing material can be identified and corrected so that the spent fuel storage racks will be capable of performing its intended functions during the period of extended operation.

The applicant stated that visual examination of the B_4C sample coupons is performed on a 4-year frequency. It was further stated that there are 14 sample coupons and 1 coupon is examined during each inspection. The parameters being evaluated are surface appearance, size, shape, and color. In a letter dated January 14, 2011, the applicant indicated that neutron attenuation testing of B_4C sample coupons will be conducted on a 4-year frequency as well. In addition, Boron-10 Areal Density Gage for Evaluating Racks (BADGER), or comparable in situ testing, will be performed prior to the period of extended operation and at intervals not to exceed 10 years during the period of extended operation.

The applicant stated that the parameters include the physical, mechanical, and chemical conditions of the B_4C coupons and swelling of the spent fuel racks. The applicant stated that the spent fuel racks are vented periodically for monitoring of potential off-gassing based on industry operating experience. The applicant performs a visual inspection of the B_4C coupons to evaluate surface appearance, size, shape, and color. The applicant further stated that mechanical and chemical testing will be conducted on a periodic basis to determine if physical degradation is occurring in the plate material and if leaching of the boron content is occurring.

The staff reviewed the applicant's "parameters monitored or inspected" program element against the criteria in SRP-LR Section A.1.2.3.3, which states that the parameters to be monitored or inspected should be identified and linked to the degradation of the particular structure and component intended function(s).

After reviewing the “parameters monitored or inspected” program element, the staff determined that the applicant adequately addressed the criterion defined in SRP-LR Section A.1.2.3.3. Inspection of the B_4C coupons, which are indicative of the B_4C plates in the SFP, is an acceptable means to monitor for the aging effects of loss of material and reduction of neutron absorber capacity. Furthermore, the performance of visual inspections and BADGER testing, or comparable in situ testing, makes this element of the program consistent with LR-ISG-2009-01, “Aging Management of Spent Fuel Pool Neutron-Absorbing Materials other than Boraflex.” Therefore, the staff finds the “parameters monitored or inspected” program element acceptable. Subsequently, LR-ISG-2009-01 has been incorporated to the GALL Report, Revision 2.

Detection of Aging Effects. LRA Section B.2.54 states that the amount of boron loss from the B_4C panels is determined through measurement of the boron areal density in the coupons. The applicant also stated that visual inspections and measurements are used to determine and assess the extent of degradation in the B_4C before there is a loss of intended function. The applicant further stated that supplemental verification of boron loss can be obtained through areal density measurement techniques such as the BADGER testing.

The staff reviewed the applicant’s “detection of aging effects” program element against the criteria in SRP-LR Section A.1.2.3.4, which states that detection of aging effects should occur before there is loss of the structure and component intended function(s). The parameters to be monitored or inspected should be appropriate to ensure that the structure and component intended function(s) will be adequately maintained for license renewal under all CLB design conditions. 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. The applicant should provide information that links the parameters to be monitored or inspected to the aging effects being managed.

After reviewing the applicant’s “detection of aging effects” program element against the criteria, the staff determined that more information was needed. In an RAI dated November 1, 2010, the staff requested that the applicant provide additional details on the location and neutron flux exposure of the B_4C sample coupons, relative to the neutron absorber plates in the spent fuel racks. The staff also requested that the applicant discuss additional measures used to ensure that the material condition of the racks is adequately assessed.

In its response dated January 14, 2011, the applicant stated that the sample coupons are mounted on the outside of the racks at the middle height of the bundles and are in a location of low neutron flux, relative to the fuel assemblies. In addition, the applicant stated that in situ testing on the neutron absorbing material will be performed prior to the period of extended operation. The applicant also stated that additional in situ testing of the neutron absorber material will be based on the results of this initial test, but at an interval not to exceed 10 years within the period of extended operation.

After reviewing the applicant’s response dated January 14, 2011, the staff finds that the low level neutron flux exposure, relative to the spent fuel assemblies, of the sample coupons may not yield test results that bound the B_4C material in the SFP racks. In effect, the staff finds that the sample coupon program may be non-conservative in indicating the boron loss in B_4C panels. Although the staff finds the coupon program as being non-conservative, the performance of BADGER testing, or comparable in situ testing, is an acceptable means in monitoring the aging effects on the neutron absorber material (e.g., boron loss).

The staff confirmed that the “detection of aging effects” program element satisfies the criterion defined in SRP-LR Section A.1.2.3.4. The staff finds the performance of BAGDER testing, or other comparable in situ testing methods, as acceptable means to monitor and trend neutron absorber degradation; therefore, the staff finds this program element acceptable.

Monitoring and Trending. LRA Section B.2.54 states that periodic inspection measurements and analysis are to be compared to values of previous measurements and analysis to provide data for trend analysis. The applicant also stated that the studies from other utilities using similar B_4C material for high density spent fuel racks will be monitored for information.

The staff reviewed the applicant's "monitoring and trending program" program element against the criteria in SRP-LR Section A.1.2.3.5, which states that monitoring and trending activities should be described, and it should provide predictability of the extent of degradation and thus affect timely corrective or mitigative actions. Plant-specific or industry-wide operating experience, or both, may be considered in evaluating the appropriateness of the technique and frequency.

The staff confirmed that the "monitoring and trending" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.5; therefore, the staff finds it acceptable.

Acceptance Criteria. LRA Section B.2.54 states that the 5 percent subcriticality margin of the spent fuel racks is to be maintained for the period of extended operation. The applicant stated that corrective actions will be initiated if test results find that the 5 percent subcriticality margin cannot be maintained because of the current or projected future degradation. It was further stated that BADGER testing may be performed on the racks as a result of corrective action performed.

The staff reviewed the applicant's "acceptance criteria" program element against the criteria in SRP-LR Section A.1.2.3.6, which states that the acceptance criteria of the program and its basis should be described. The acceptance criteria, against which the need for corrective actions will be evaluated, should ensure that the structure and component intended function(s) are maintained under all CLB design conditions during the period of extended operation. The program should include a methodology for analyzing the results against applicable acceptance criteria.

The staff confirmed that the "acceptance criteria" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.6; therefore, the staff finds it acceptable.

<u>Operating Experience</u>. LRA Section B.2.54 summarizes operating experience related to the B_4C Monitoring Program. The applicant stated that the B_4C Monitoring Program is an existing AMP proposed for the period of extended operation. The applicant further stated that there has been no indication of B_4C deterioration or loss of boron at Columbia.

The applicant stated that the operating experience included the following:

- In 1980, LER 50-305/80-039 indicated that another operating plant had problems with off-gassing of the binder material in its B_4C SFP racks. During surveillance of SFP rack samples, two sealed specimens exhibited swelling. This swelling was likewise found to be occurring in the fuel racks. The swelling in the spent fuel canister walls reduces the separation (water gap) between canisters. It appears that the bulging of the SFP canisters and specimen is the result of a gaseous product of radiolysis of materials used in the B_4C plate. This LER indicated that this swelling of sealed B_4C canisters happened at another facility. Maximum k_{eff} allowed for the spent fuel pool has not been exceeded.

To prevent distortion of the spent fuel pool rack cavities and binding of spent fuel pool assemblies due to pressure buildup, the Spent Fuel Rack enclosures at Columbia are vented through an arrangement of tubing and sampling valves to above storage pool water surface at the pool curb. Monitoring of gas pressure and venting to relieve pressure are provided for in the plant's work management system.

- In 1999, a CR documented that water was noticed flowing in the vent line while venting the spent fuel racks. The valve was immediately closed and Reactor Engineering was notified. The Tech noted that less than ¼ cup of water was ejected from the line then the rest of the venting was as normal. Although the racks are designed to be sealed and vented, the presence of water indicates that the rack or the vent line is not water tight. The presence of water in the rack will not affect the neutron absorption characteristics of the B_4C plates. There are coupons in the pool that have vented (to the water) plates and one of the coupons was delivered to a testing lab in 1995 and it was determined that there was no depletion of the wetted coupons with respect to the control coupons.

The staff reviewed this information against the acceptance criteria in SRP-LR Section A.1.2.3.10, which states that the operating experience of AMPs, 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 operating experience should have resulted in appropriate program enhancements or new programs. This information can show where an existing program has succeeded and where it has failed (if at all) 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 structure and component intended function(s) will be maintained during the period of extended operation.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

The staff confirmed that the applicant addressed operating experience identified after issuance of the GALL Report. Based on its review, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on systems SCs within the scope of the program and that implementation of this program has resulted in the applicant taking appropriate corrective actions. Therefore, the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10, and the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.54 provides the UFSAR supplement for the B_4C Monitoring Program.

The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in LR-ISG-2009-01 and the GALL Report, Revision 2. The staff also notes that the applicant committed (Commitment No. 61) to continue the existing B_4C Monitoring Program during the period of extended operation for managing aging of applicable components. The applicant also committed to performing an initial in situ testing of the spent fuel rack neutron absorbing material prior to the period of extended operation. It was stated that additional in situ testing will be based on the results of this initial testing, but at an interval not to exceed 10 years.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review of the applicant's B_4C Monitoring Program, the staff determines that those program elements for which the applicant claimed consistency with the GALL Report are consistent. The staff concludes that the applicant has determined that the effects of aging will be adequately managed so that the intended function will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.3 Cooling Units Inspection Program

Summary of Technical Information in the Application. LRA Section B.2.14, as amended by letter dated January 28, 2011, describes the new Cooling Units Inspection Program as a plant-specific Condition Monitoring Program. The applicant stated that the program will consist of inspections of aluminum, steel, copper alloy, and stainless steel cooling unit components that are exposed to a condensation (internal or external) environment to manage the effects of loss of material due to crevice, galvanic, general, pitting, or microbiologically-influenced corrosion, a reduction in heat transfer due to fouling of heat exchanger tubes and fins, or cracking of aluminum components. The applicant also stated that the program includes baseline inspections of a sample population performed within the 10-year period prior to the period of extended operation, followed by opportunistic inspections when components are opened for maintenance, repair, or surveillances.

Staff Evaluation. The staff reviewed Program Elements one through six of the applicant's program against the acceptance criteria for the corresponding elements, as stated in SRP-LR Section A.1.2.3. The staff's review focused on how the applicant's program manages aging effects through the effective incorporation of these program elements. The staff's evaluation of each of these elements follows.

Scope of the Program. LRA Section B.2.14, as amended by letter dated January 28, 2011, states that the program includes baseline inspections of a sample population followed by opportunistic inspections of the aluminum, steel, copper alloy, and stainless steel cooling unit components that are exposed to condensation (internal or external). The plant systems and components in the scope of the program include:

- diesel building mixed air - drain pan and drain piping,
- pumphouse mixed air and pumphouse return air - drain pan and drain piping,
- radwaste building mixed air - unit housing, drain pan, heat exchanger (fins), heat exchanger (tubes), and piping
- reactor building return air - drain pan, piping, and valve body.

The staff reviewed the applicant's "scope of the program" program element against the criteria in SRP-LR Section A.1.2.3.1, which states that the scope of the program should include the specific SCs of which the program manages the effects of aging. The staff finds the applicant's "scope of program" program element acceptable because it includes specific information regarding the components and materials that will be managed by the program.

The staff confirmed that the "scope of the program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1; therefore, the staff finds it acceptable.

Preventive Actions. LRA Section B.2.14, as amended by letter dated January 28, 2011, states the program is a Condition Monitoring Program and does not include an action to prevent or mitigate aging effects.

The staff reviewed the applicant's "preventive actions" program element against the criteria in SRP-LR Section A.1.2.3.2, which states that, for condition monitoring programs, it does not rely on preventive actions; thus, this information need not be provided. The staff finds the applicant's "preventive actions" program element acceptable because the program is a Condition Monitoring Program and does not require any preventive actions.

The staff confirmed that the "preventive actions" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.2; therefore, the staff finds it acceptable.

Parameters Monitored or Inspected. LRA Section B.2.14, as amended by letter dated January 28, 2011, states that the program will monitor wall thickness or evidence of degradation, as measures of loss of material and cracking, and visual evidence of fouling as a measure of reduction in heat transfer. The applicant also stated that the inspections will be performed by qualified personnel using established NDE techniques, primarily visual, with enhanced visual, surface, or volumetric techniques used depending on the aging effect.

The staff reviewed the applicant's "parameters monitored or inspected" program element against the criteria in SRP-LR Section A.1.2.3.3, which states that the parameters monitored or inspected should be identified, should be linked to the degradation of the particular structure and component intended function(s), and should detect the presence and extent of aging effects. The staff finds the applicant's "parameters monitored or inspected" program element acceptable because the applicant's chosen inspection parameters (i.e., wall thickness and evidence of internal surface degradation) are appropriate to detect the aging effects managed by the program (i.e., cracking, loss of material, and reduction of heat transfer).

The staff confirmed that the "parameters monitored or inspected" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.3; therefore, the staff finds it acceptable.

Detection of Aging Effects. LRA Section B.2.14, as amended by letter dated January 28, 2011, states that baseline inspections of 20 percent of each material, environment, and aging effect group, with a maximum of 25 inspections per group, will be performed within the 10-year period prior to the period of extended operation, focusing on the components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margins, where practical. The applicant also stated that opportunistic inspections will be performed thereafter when components are opened for maintenance, repair, or surveillance and surfaces are made available for inspection. The applicant further stated that inspections will be performed by qualified personnel using established NDE techniques, primarily visual, with enhanced visual, surface, or volumetric techniques used depending on the aging effects.

The staff reviewed the applicant's "detection of aging effects" program element against the criteria in SRP-LR Section A.1.2.3.4, which states the following:

- The detection of aging effects should occur before there is a loss of the structure and component intended function(s).
- The effects of aging on a structure or component should be managed to ensure its availability to perform its intended function(s) as designed when called upon.
- The program element describes “when,” “where,” and “how” program data are collected.
- The method or technique and frequency may be linked to plant-specific or industry-wide operating experience.
- When sampling is used to inspect a group of SCs, the basis for the inspection population and sample size is provided.

The SRP-LR also states that a program based solely on detecting structure and component failure should not be considered as an effective AMP for license renewal. The staff finds the applicant’s “detection of aging effects” program element acceptable for the following reasons:

- The applicant’s chosen inspection techniques (i.e., visual, enhanced visual, surface, and volumetric NDE techniques) are capable of detecting the aging effects managed by the program (i.e., cracking, loss of material, and reduction of heat transfer) prior to loss of component intended function.
- The applicant will collect data during baseline and opportunistic inspections.
- The sampling methodology ensures that a representative sample of material and environment combinations is considered, ensures sample locations will focus on the most susceptible components, and includes an appropriate sample size.

The staff confirmed that the “detection of aging effects” program element satisfies the criterion defined in SRP-LR Section A.1.2.3.4; therefore, the staff finds it acceptable.

Monitoring and Trending. LRA Section B.2.14, as amended by letter dated January 28, 2011, states that the program includes inspections performed prior to the period of extend operation and opportunistic inspections performed when components are opened for maintenance, repair, and surveillance thereafter. The applicant also stated that baseline inspections are used to characterize material conditions and include provisions for increasing the sample size and locations if degradation is detected. The applicant further stated that inspection findings will be reviewed to ensure that each material exposed to a condensation (internal or external) environment has been examined by opportunistic inspection within the initial 5-year period and that appropriate actions will be taken to ensure an inspection is performed if opportunistic inspections have not occurred. The staff noted that, in the applicant’s commitment (Commitment No. 14) to implement the program, the applicant stated that the initial interval for review of inspection findings is 5 years and may be adjusted based on operating experience.

The staff reviewed the applicant’s “monitoring and trending” program element against the criteria in SRP-LR Section A.1.2.3.5, which states that monitoring and trending activities should be described and should provide predictability of the extent of degradation to ensure timely corrective or mitigative actions. The SRP-LR also states that this program element describes “how” the data collected are evaluated and may also include trending for a forward look. SRP-LR further states that plant-specific or industry-wide operating experience may be considered in evaluating the appropriateness of the technique and frequency of inspections. The staff finds the “monitoring and trending” program element acceptable because the program includes baseline inspections performed prior to the period of extended operation to characterize the material condition of the components, increased inspections if degradation is identified, and review of inspection findings to ensure each material and environment combination has been inspected to ensure that degradation is identified prior to loss of component intended function.

The staff confirmed that the “monitoring and trending” program element satisfies the criterion defined in SRP-LR Section A.1.2.3.5; therefore, the staff finds it acceptable.

Acceptance Criteria. LRA Section B.2.14, as amended by letter dated January 28, 2011, states that indications or relevant conditions of degradation detected during the inspection will be compared to pre-determined acceptance criteria established by engineering evaluation of the pertinent design standard. The applicant also stated that unacceptable inspection findings include visual evidence of a loss of material, reduction of heat transfer due to fouling, reduction in wall thickness, or evidence of cracking of aluminum as obtained by enhanced visual, surface, or volumetric examination. The applicant further stated that, if the acceptance criteria are not met, the condition will be entered into the Corrective Action Program for evaluation of whether the degradation could result in a loss of component intended function during the period of extended operation or prior to the next opportunity for inspection.

The staff reviewed the applicant’s “acceptance criteria” program element against the criteria in SRP-LR Section A.1.2.3.6, which states that the acceptance criteria for the program and its basis should be described, and the program should include a methodology for analyzing the results against applicable acceptance criteria. The SRP-LR also states that the acceptance criteria could be specific numerical values or should consist of a discussion of the process for calculating specific values. The SRP-LR further states that qualitative inspections should be performed to the same predetermined criteria as quantitative inspections. The staff finds the “acceptance criteria” program element acceptable because the program includes appropriate acceptance criteria and any acceptance criteria not met will be evaluated under the corrective action program.

The staff confirmed that the “acceptance criteria” program element satisfies the criterion defined in SRP-LR Section A.1.2.3.6; therefore, the staff finds it acceptable.

<u>Operating Experience</u>. LRA Section B.2.14, as amended by letter dated January 28, 2011, summarizes operating experience related to the Cooling Units Inspection Program. The applicant stated that the Cooling Units Inspection Program is a new program for which plant operating experience has not shown the occurrence of aging effects. The applicant also stated that its review of plant operating experience did not identify any age-related deficiencies with the components associated with the system or any deficiencies involving the specific components and the aforementioned aging effects.

The staff reviewed this information against the acceptance criteria in SRP-LR Section A.1.2.3.10, which states that operating experience of AMPs, including past corrective actions resulting in program enhancements or additional programs, should be considered.

During its review, the staff found no operating experience to indicate that the applicant’s program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its review of the application, the staff finds that operating experience related to the applicant’s program demonstrates that it can adequately manage the detrimental effects of aging on SSCs within the scope of the program. The staff confirmed that the “operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.14, as amended by letter dated January 28, 2011, provides the UFSAR supplement for the Cooling Units Inspection Program.

The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.2-2, 3.3-2, and 3.4-2. The staff also notes that the applicant committed (Commitment No. 14) to implement the Cooling Units Inspection Program prior to entering the period of extended operation for managing aging of applicable components and to perform the baseline inspections within the 10-year period prior to entering the period of extended operation. The applicant also committed (Commitment No. 14) that inspections will be periodically reviewed to ensure that each material and environment combination has been examined via opportunistic inspections or actions are taken to ensure inspections are performed and that the initial interval for review of inspection findings will be 5 years and may be adjusted based on operating experience.

The staff determines that the information in the UFSAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its technical review of the applicant's Cooling Units Inspection Program, the staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement, as amended, for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.4 Diesel-Driven Fire Pumps Inspection Program

Summary of Technical Information in the Application. LRA Section B.2.18, as amended by letter dated January 28, 2011, describes the new Diesel-Driven Fire Pumps Inspection Program as a plant-specific Condition Monitoring Program. The applicant stated that the program will consist of inspections of the interior of the fire protection system diesel engine exhaust piping and heat exchangers exposed to raw water (antifreeze or fire water) to manage loss of material, reduction of heat transfer, and cracking due to SCC. The applicant also stated that the program includes baseline inspections of a sample population performed within the 10-year period prior to the period of extended operation, followed by opportunistic inspections when components are opened for maintenance, repair, or surveillances.

Staff Evaluation. The staff reviewed Program Elements one through six of the applicant's program against the acceptance criteria for the corresponding elements, as stated in SRP-LR Section A.1.2.3. The staff's review focused on how the applicant's program manages aging effects through the effective incorporation of these program elements. The staff's evaluation of each of these elements follows.

Scope of the Program. LRA Section B.2.18, as amended by letter dated January 28, 2011, states that the program includes baseline inspections of a sample population followed by opportunistic inspections of the steel exhaust line exposed to outdoor air and the copper alloy, copper alloy with greater than 15 percent Zn, gray cast iron, and stainless steel heat exchanger components exposed to raw water (antifreeze or fire water) for diesels FP-ENG-1 and FP-ENG-100.

The staff reviewed the applicant's "scope of the program" program element against the criteria in SRP-LR Section A.1.2.3.1, which states that the scope of the program should include the specific SCs of which the program manages the effects of aging. The staff finds the applicant's "scope of program" program element acceptable because it includes specific information regarding the components and materials that will be managed by the program.

The staff confirmed that the "scope of the program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1; therefore, the staff finds it acceptable.

Preventive Actions. LRA Section B.2.18, as amended by letter dated January 28, 2011, states the program is a Condition Monitoring Program and does not include an action to prevent or mitigate aging effects.

The staff reviewed the applicant's "preventive actions" program element against the criteria in SRP-LR Section A.1.2.3.2, which states that, for condition monitoring programs, it does not rely on preventive actions; thus, this information need not be provided. The staff finds the applicant's "preventive actions" program element acceptable because the program is a Condition Monitoring Program and does not require any preventive actions.

The staff confirmed that the "preventive actions" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.2; therefore, the staff finds it acceptable.

Parameters Monitored or Inspected. LRA Section B.2.18, as amended by letter dated January 28, 2011, states that the program will monitor wall thickness or visual evidence of degradation of the internal surfaces of the diesel exhaust piping and heat exchangers for cracking, loss of material, and reduction of heat transfer. The applicant also stated that the inspections will be performed by qualified personnel using established NDE techniques including visual, with enhanced visual, surface and volumetric techniques, depending on the aging effect.

The staff reviewed the applicant's "parameters monitored or inspected" program element against the criteria in SRP-LR Section A.1.2.3.3, which states that the parameters monitored or inspected should be identified, should be linked to the degradation of the particular structure and component intended function(s), and should detect the presence and extent of aging effects. The staff finds the applicant's "parameters monitored or inspected" program element acceptable because the applicant's chosen inspection parameters (i.e., wall thickness and evidence of internal surface degradation) are appropriate to detect the aging effects managed by the program (i.e., cracking, loss of material, and reduction of heat transfer).

The staff confirmed that the "parameters monitored or inspected" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.3; therefore, the staff finds it acceptable.

Detection of Aging Effects. LRA Section B.2.18, as amended by letter dated January 28, 2011, states that baseline inspections of 20 percent of each material, environment, and aging effect group, with a maximum of 25 inspections per group, will be performed within the 10-year period prior to the period of extended operation, focusing on the components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margins, where practical. The applicant also stated that opportunistic inspections will be performed thereafter, when components are opened for maintenance, repair, or surveillance and surfaces are made available for inspection. The applicant further stated that inspections will be performed by qualified personnel using established NDE techniques including visual or enhanced visual, surface, and volumetric techniques.

The staff reviewed the applicant's "detection of aging effects" program element against the criteria in SRP-LR Section A.1.2.3.4, which states the following:

- The detection of aging effects should occur before there is a loss of the structure and component intended function(s).
- The effects of aging on a structure or component should be managed to ensure its availability to perform its intended function(s) as designed when called upon.
- The program element describes "when," "where," and "how" program data are collected.
- The method or technique and frequency may be linked to plant-specific or industry-wide operating experience.
- When sampling is used to inspect a group of SCs, the basis for the inspection population and sample size should be provided.

The SRP-LR also states that a program based solely on detecting structure and component failure should not be considered as an effective AMP for license renewal. The staff finds the applicant's "detection of aging effects" program element acceptable for the following reasons:

- The applicant's chosen inspection techniques (i.e., visual, enhanced visual, surface, and volumetric NDE techniques) are capable of detecting the aging effects managed by the program (i.e., cracking, loss of material, and reduction of heat transfer) prior to loss of component intended function.
- The applicant will collect data during baseline and opportunistic inspections.
- The sampling methodology ensures that a representative sample of material and environment combinations is considered, ensures sample locations will focus on the most susceptible components, and includes an appropriate sample size.

The staff confirmed that the "detection of aging effects" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.4; therefore, the staff finds it acceptable.

Monitoring and Trending. LRA Section B.2.18, as amended by letter dated January 28, 2011, states that the program includes inspections performed prior to the period of extend operation and opportunistic inspections performed when components are opened for maintenance, repair, and surveillance thereafter. The applicant also stated that baseline inspections are used to characterize material conditions and include provisions for increasing the sample size and locations if degradation is detected. The applicant further stated that inspection findings will be reviewed to ensure that each material exposed to either outdoor air or raw water has been examined by opportunistic inspection in a 5-year period, and appropriate actions will be taken to ensure an inspection is performed if opportunistic inspections have not occurred. The staff noted that, in the applicant's commitment (Commitment No. 18) to implement the program, the applicant stated that the initial interval for review of inspection findings is 5 years and may be adjusted based on operating experience.

The staff reviewed the applicant's "monitoring and trending" program element against the criteria in SRP-LR Section A.1.2.3.5, which states that monitoring and trending activities should be described and should provide predictability of the extent of degradation to ensure timely corrective or mitigative actions. The SRP-LR also states that this program element describes "how" the data collected are evaluated and may also include trending for a forward look. The SRP-LR further states that plant-specific or industry-wide operating experience may be considered in evaluating the appropriateness of the technique and frequency of inspections. The staff finds the "monitoring and trending" program element acceptable because the program includes baseline inspections performed prior to the period of extended operation to characterize the material condition of the components, increased inspections if degradation is identified, and review of inspection findings to ensure each material and environment combination has been inspected to ensure that degradation is identified prior to loss of component intended function.

The staff confirmed that the "monitoring and trending" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.5; therefore, the staff finds it acceptable.

Acceptance Criteria. LRA Section B.2.18, as amended by letter dated January 28, 2011, states that indications or relevant conditions of degradation detected during the inspection will be compared to pre-determined acceptance criteria established by engineering evaluation of the pertinent design standard. The applicant also stated that unacceptable inspection findings include visual evidence of cracking, loss of material, reduction of heat transfer due to fouling, or a reduction in wall thickness, as obtained by enhanced visual, surface, or volumetric examination. The applicant further stated that if the acceptance criteria are not met, the condition will be entered into the Corrective Action Program for evaluation of whether the degradation could result in a loss of component intended function during the period of extended operation or prior to the next opportunity for inspection.

The staff reviewed the applicant's "acceptance criteria" program element against the criteria in SRP-LR Section A.1.2.3.6, which states that the acceptance criteria for the program and its basis should be described, and the program should include a methodology for analyzing the results against applicable acceptance criteria. The SRP-LR also states that the acceptance criteria could be specific numerical values or should consist of a discussion of the process for calculating specific values. The SRP-LR further states that qualitative inspections should be performed to the same predetermined criteria as quantitative inspections. The staff finds the "acceptance criteria" program element acceptable because the program includes appropriate acceptance criteria and any acceptance criteria not met will be evaluated under the Corrective Action Program.

The staff confirmed that the "acceptance criteria" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.6; therefore, the staff finds it acceptable.

<u>Operating Experience</u>. LRA Section B.2.18, as amended by letter dated January 28, 2011, summarizes operating experience related to the Diesel-Driven Fire Pumps Inspection Program. The applicant stated that the Diesel-Driven Fire Pumps Inspection Program is a new program for which plant operating experience has not shown the occurrence of aging effects. The applicant also stated that its review of plant operating experience did not identify any age-related deficiencies with the components associated with the system or any deficiencies involving the specific components that will be managed by the program.

The staff reviewed this information against the acceptance criteria in SRP-LR Section A.1.2.3.10, which states that operating experience of AMPs, including past corrective actions resulting in program enhancements or additional programs, should be considered.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program will result in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.18, as amended by letter dated January 28, 2011, provides the UFSAR supplement for the Diesel-Driven Fire Pumps Inspection Program.

The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.1-2, 3.2-2, 3.3-2, 3.4-2, 3.5-2, and 3.6-2. The staff also notes that the applicant committed (Commitment No. 18) to implement the Diesel-Driven Fire Pumps Inspection Program prior to entering the period of extended operation for managing aging of applicable components and to perform the baseline inspections within the 10-year period prior to entering the period of extended operation. The applicant also committed (Commitment No. 18) that inspections will be periodically reviewed to ensure that each material and environment combination has been examined via opportunistic inspections or actions are taken to ensure inspections are performed, and the initial interval for review of inspection findings will be 5 years and may be adjusted based on operating experience.

The staff determines that the information in the UFSAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its technical review of the applicant's Diesel-Driven Fire Pumps Inspection Program, the staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement, as amended, for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.5 Diesel Systems Inspection Program

Summary of Technical Information in the Application. LRA Section B.2.17, as amended by letter dated January 28, 2011, describes the new Diesel Systems Inspection Program as a plant-specific Condition Monitoring Program. The applicant stated that the program will consist of inspections of the interior of the exhaust piping for the Division 1, 2, and 3 diesels in the diesel engine exhaust system, including the loop seal drains from the exhaust piping. The applicant also stated that the program includes baseline inspections of a sample population performed within the 10-year period prior to the period of extended operation, followed by opportunistic inspections when components are opened for maintenance, repair, or surveillances.

Staff Evaluation. The staff reviewed Program Elements one through six of the applicant's program against the acceptance criteria for the corresponding elements, as stated in SRP-LR Section A.1.2.3. The staff's review focused on how the applicant's program manages aging effects through the effective incorporation of these program elements. The staff's evaluation of each of these elements follows.

Scope of the Program. LRA Section B.2.17, as amended by letter dated January 28, 2011, states that the program includes baseline inspections of a sample population followed by opportunistic inspections of the steel and stainless steel exhaust piping exposed to outdoor air and raw water (in the form of precipitation) for Division 1, 2, and 3 diesels.

The staff reviewed the applicant's "scope of the program" program element against the criteria in SRP-LR Section A.1.2.3.1, which states that the scope of the program should include the specific SCs of which the program manages the effects of aging. The staff finds the applicant's "scope of program" program element acceptable because it includes specific information regarding the components and materials that will be managed by the program.

The staff confirmed that the "scope of the program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1; therefore, the staff finds it acceptable.

Preventive Actions. LRA Section B.2.17, as amended by letter dated January 28, 2011, states the program is a Condition Monitoring Program and does not include an action to prevent or mitigate aging effects.

The staff reviewed the applicant's "preventive actions" program element against the criteria in SRP-LR Section A.1.2.3.2, which states that, for condition monitoring programs, it does not rely on preventive actions; thus, this information need not be provided. The staff finds the applicant's "preventive actions" program element acceptable because the program is a Condition Monitoring Program and does not require any preventive actions.

The staff confirmed that the "preventive actions" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.2; therefore, the staff finds it acceptable.

Parameters Monitored or Inspected. LRA Section B.2.17, as amended by letter dated January 28, 2011, states that the program will monitor wall thickness or visual evidence of internal surface degradation of the diesel exhaust piping as measures of loss of material. The applicant also stated that the inspections will be performed by qualified personnel using established NDE techniques including visual, with enhanced visual, surface and volumetric techniques, depending on the aging effect.

The staff reviewed the applicant's "parameters monitored or inspected" program element against the criteria in SRP-LR Section A.1.2.3.3, which states that the parameters monitored or inspected should be identified, should be linked to the degradation of the particular structure and component intended function(s), and should detect the presence and extent of aging effects. The staff finds the applicant's "parameters monitored or inspected" program element acceptable because the applicant's chosen inspection parameters (i.e., wall thickness and evidence of internal surface degradation) are appropriate to detect the aging effects managed by the program (i.e., cracking, and loss of material).

The staff confirmed that the "parameters monitored or inspected" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.3; therefore, the staff finds it acceptable.

Detection of Aging Effects. LRA Section B.2.17, as amended by letter dated January 28, 2011, states that baseline inspections of 20 percent of each material, environment, and aging effect group, with a maximum of 25 inspections per group, will be performed within the 10-year period prior to the period of extended operation. These inspections will focus on the components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margins, where practical. The applicant also stated that opportunistic inspections will be performed thereafter when components are opened for maintenance, repair, or surveillance and surfaces are made available for inspection. The applicant further stated that inspections will be performed by qualified personnel using established NDE techniques including visual or enhanced visual, surface, and volumetric techniques.

The staff reviewed the applicant's "detection of aging effects" program element against the criteria in SRP-LR Section A.1.2.3.4, which states the following:

- Detection of aging effects should occur before there is a loss of the structure and component intended function(s).
- The effects of aging on a structure or component should be managed to ensure its availability to perform its intended function(s) as designed when called upon.
- The program element describes "when," "where," and "how" program data are collected.
- The method or technique and frequency may be linked to plant-specific or industry-wide operating experience.
- When sampling is used to inspect a group of SCs, the basis for the inspection population and sample size should be provided.

The SRP-LR also states that a program based solely on detecting structure and component failure should not be considered as an effective AMP for license renewal. The staff finds the applicant's "detection of aging effects" program element acceptable for the following reasons:

- The applicant's chosen inspection techniques (i.e., visual, enhanced visual, surface, and volumetric NDE techniques) are capable to detecting the aging effects managed by the program (i.e., cracking and loss of material) prior to loss of component intended function.
- The applicant will collect data during baseline and opportunistic inspections.
- The sampling methodology ensures that a representative sample of material and environment combinations is considered, ensures sample locations will focus on the most susceptible components, and includes an appropriate sample size.

The staff confirmed that the "detection of aging effects" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.4; therefore, the staff finds it acceptable.

Monitoring and Trending. LRA Section B.2.17, as amended by letter dated January 28, 2011, states that the program includes inspection performed prior to the period of extend operation and opportunistic inspections performed when components are opened for maintenance, repair, and surveillance thereafter. The applicant also stated that baseline inspections are used to characterize material conditions and include provisions for increasing the sample size and locations if degradation is detected. The applicant further stated that inspection findings will be reviewed to ensure that each material exposed to either outdoor air or raw water has been examined by opportunistic inspection in a 5-year period and that appropriate actions will be taken to ensure an inspection is performed if opportunistic inspections have not occurred. The staff noted that, in the applicant's commitment (Commitment No. 17) to implement the program, the applicant stated that the initial interval for review of inspection findings is 5 years and may be adjusted based on operating experience.

The staff reviewed the applicant's "monitoring and trending" program element against the criteria in SRP-LR Section A.1.2.3.5, which states that monitoring and trending activities should be described and should provide predictability of the extent of degradation to ensure timely corrective or mitigative actions. The SRP-LR also states that this program element describes "how" the data collected are evaluated and may also include trending for a forward look. The SRP-LR further states that plant-specific or industry-wide operating experience may be considered in evaluating the appropriateness of the technique and frequency of inspections. The staff finds the "monitoring and trending" program element acceptable because the program includes baseline inspections performed prior to the period of extended operation to characterize the material condition of the components, increased inspections if degradation is identified, and review of inspection findings to ensure each material and environment combination has been inspected to ensure that degradation is identified prior to loss of component intended function.

The staff confirmed that the "monitoring and trending" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.5; therefore, the staff finds it acceptable.

Acceptance Criteria. LRA Section B.2.17, as amended by letter dated January 28, 2011, states that indications or relevant conditions of degradation detected during the inspection will be compared to pre-determined acceptance criteria established by engineering evaluation of the pertinent design standard. The applicant also stated that unacceptable inspection findings include visual evidence of cracking and loss of material or a reduction in wall thickness, as obtained by enhanced visual, surface, or volumetric examination. The applicant further stated that, if the acceptance criteria are not met, the condition will be entered into the corrective action program for evaluation of whether the degradation could result in a loss of component intended function during the period of extended operation or prior to the next opportunity for inspection.

The staff reviewed the applicant's "acceptance criteria" program element against the criteria in SRP-LR Section A.1.2.3.6, which states that the acceptance criteria for the program and its basis should be described, and the program should include a methodology for analyzing the results against applicable acceptance criteria. The SRP-LR also states that the acceptance criteria could be specific numerical values or should consist of a discussion of the process for calculating specific values. The SRP-LR further states that qualitative inspections should be performed to the same predetermined criteria as quantitative inspections. The staff finds the "acceptance criteria" program element acceptable because the program includes appropriate acceptance criteria, and any acceptance criteria not met will be evaluated under the Corrective Action Program.

The staff confirmed that the "acceptance criteria" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.6; therefore, the staff finds it acceptable.

Operating Experience. LRA Section B.2.17, as amended by letter dated January 28, 2011, summarizes operating experience related to the Diesel Systems Inspection Program. The applicant stated that the Diesel Systems Inspection Program is a new program for which plant operating experience has not shown the occurrence of aging effects. The applicant also stated that its review of plant operating experience did not identify any age-related deficiencies with the components associated with the system or any deficiencies involving the specific components that will be managed by the program.

The staff reviewed this information against the acceptance criteria in SRP-LR Section A.1.2.3.10, which states that operating experience of AMPs, including past corrective actions resulting in program enhancements or additional programs, should be considered.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program will result in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.17, as amended by letter dated January 28, 2011, provides the UFSAR supplement for the Diesel Systems Inspection Program.

The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.1-2, 3.2-2, 3.3-2, 3.4-2, 3.5-2, and 3.6-2. The staff also notes that the applicant committed (Commitment No. 17) to implement the Diesel Systems Inspection Program prior to entering the period of extended operation for managing aging of applicable components and to perform the baseline inspections within the 10-year period prior to entering the period of extended operation. The applicant also committed (Commitment No. 17) that inspections will be periodically reviewed to ensure that each material and environment combination has been examined via opportunistic inspections or actions are taken to ensure inspections are performed, and the initial interval for review of inspection findings will be 5 years and may be adjusted based on operating experience.

The staff determines that the information in the UFSAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its technical review of the applicant's Diesel Systems Inspection Program, the staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement, as amended, for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.6 Flexible Connection Inspection Program

Summary of Technical Information in the Application. LRA Section B.2.27, as amended by letter dated January 28, 2011, describes the new Flexible Connection Inspection Program as a plant-specific Condition Monitoring Program. The applicant stated that the program will consist of inspections of elastomeric components that are exposed to treated water, dried air, gas, and indoor air environments. The applicant also stated that the program will manage degradation of elastomeric components, including the effects of loss of material due to wear and hardening and loss of strength due to thermal exposure and ionizing radiation. The applicant further stated that the program includes baseline inspections of a sample population performed 10 years prior to the period of extended operation, followed by opportunistic inspections when components are opened for maintenance, repair, or surveillances.

Staff Evaluation. The staff reviewed Program Elements one through six of the applicant's program against the acceptance criteria for the corresponding elements as stated in SRP-LR Section A.1.2.3. The staff's review focused on how the applicant's program manages aging effects through the effective incorporation of these program elements. The staff's evaluation of each of these elements follows.

Scope of the Program. LRA Section B.2.27, as amended by letter dated January 28, 2011, states that the scope of the Flexible Connection Inspection Program includes the surfaces of elastomeric flexible connections exposed to treated water, dried air, gas, and indoor air environments and lists the 10 applicable systems.

The staff reviewed the applicant's "scope of the program" program element against the criteria in SRP-LR Section A.1.2.3.1, which states that the scope of the program should include the specific SCs of which the program manages the effects of aging. The staff finds the applicant's "scope of program" program element acceptable because it includes specific information regarding the components and materials that will be managed by the program.

The staff confirmed that the "scope of the program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1; therefore, the staff finds it acceptable.

Preventive Actions. LRA Section B.2.27, as amended by letter dated January 28, 2011, states the program is a Condition Monitoring Program and does not include an action to prevent or mitigate aging effects.

The staff reviewed the applicant's "preventive actions" program element against the criteria in SRP-LR Section A.1.2.3.2, which states that, for condition monitoring programs that do not rely on preventive actions, this information need not be provided. The staff finds the applicant's "preventive actions" program element acceptable because the program is a Condition Monitoring Program and does not require any preventive actions.

The staff confirmed that the "preventive actions" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.2; therefore, the staff finds it acceptable.

Parameters Monitored or Inspected. LRA Section B.2.27, as amended by letter dated January 28, 2011, states that the program will include visual inspections for evidence of surface degradation such as cracking or discoloration, as well as physical manipulation and prodding to detect hardening and loss of strength. The applicant also stated that the inspections will be performed by qualified personnel using established NDE techniques.

The staff reviewed the applicant's "parameters monitored or inspected" program element against the criteria in SRP-LR Section A.1.2.3.3, which states that the parameters monitored or inspected should be identified, should be linked to the degradation of the particular structure and component intended function(s), and should detect the presence and extent of aging effects. The staff finds the applicant's "parameters monitored or inspected" program element acceptable because the applicant's chosen inspection parameters consisting of visual detection of surface defects and physical manipulation of the elastomeric material is capable of detecting all aging effects associated with loss of material due to wear, loss of strength, and hardening in elastomeric components.

The staff confirmed that the "parameters monitored or inspected" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.3; therefore, the staff finds it acceptable.

Detection of Aging Effects. LRA Section B.2.27, as amended by letter dated January 28, 2011, states that baseline visual and physical manipulation of the elastomeric material inspections of 20 percent of each material, environment, and aging effect group, with a maximum of 25 inspections per group, will be performed within the 10 year period prior to the period of extended operation. These inspections will focus on the components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margins, where practical.

The applicant also stated that opportunistic inspections will be performed thereafter when components are opened for maintenance, repair, or surveillance and surfaces are made available for inspection. The applicant further stated that the inspections conducted in the 10-year period prior to the period of extended operation will serve as the baseline for future inspections.

The staff reviewed the applicant's "detection of aging effects" program element against the criteria in SRP-LR Section A.1.2.3.4, which states the following:

- The detection of aging effects should occur before there is a loss of the structure and component intended function(s).
- The effects of aging on a structure or component should be managed to ensure its availability to perform its intended function(s) as designed when called upon.
- The program element describes "when," "where," and "how" program data are collected.
- The method or technique and frequency may be linked to plant-specific or industry-wide operating experience.
- When sampling is used to inspect a group of components, the basis for the inspection population and sample size should be provided.

The SRP-LR also states that a program based solely on detecting structure and component failure should not be considered as an effective AMP for license renewal. The staff finds the applicant's "detection of aging effects" program element acceptable for the following reasons:

- The applicant's chosen inspection techniques (i.e., visual inspection accompanied by physical manipulation of the material) are capable of detecting the aging effects managed by the program (i.e., hardening, loss of material due to wear, and loss of strength) prior to loss of component intended function.
- The applicant will collect data during baseline and opportunistic inspections.
- The sampling methodology ensures that a representative sample of material and environment combinations is considered, ensures sample locations will focus on the most susceptible components, and includes an appropriate sample size.
- Plant-specific operating experience will be used to adjust inspection intervals.

The staff confirmed that the "detection of aging effects" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.4; therefore, the staff finds it acceptable.

Monitoring and Trending. LRA Section B.2.27, as amended by letter dated January 28, 2011, states that the program includes inspection performed prior to the period of extend operation and opportunistic inspections performed when components are opened for maintenance, repair, and surveillance thereafter. The applicant also stated that baseline inspections are used to characterize material conditions and include provisions for increasing the sample size and locations if degradation is detected. The applicant further stated that inspection findings will be reviewed to ensure that each material exposed to either outdoor air or raw water has been examined by opportunistic inspection in each 5-year period and that appropriate actions will be taken to ensure an inspection is performed if opportunistic inspections have not occurred. The staff noted that Commitment No. 27 states that the 5-year interval may be adjusted based on operating experience.

The staff reviewed the applicant's "monitoring and trending" program element against the criteria in SRP-LR Section A.1.2.3.5, which states that monitoring and trending activities should be described and should provide predictability of the extent of degradation to ensure timely corrective or mitigative actions. The SRP-LR also states that this program element describes "how" the data collected are evaluated and may also include trending for a forward look. The SRP-LR further states that plant-specific or industry-wide operating experience may be considered in evaluating the appropriateness of the technique and frequency of inspections. The staff finds the "monitoring and trending" program element acceptable because the program includes baseline inspections performed prior to the period of extended operation to characterize the material condition of the components and increased inspections if degradation is identified. It also includes a review of inspection findings to ensure each material and environment combination has been inspected in the 5-year period subsequent to the baseline inspections to ensure that degradation is identified prior to loss of component intended function and plant-specific operating experience will be used in any subsequent adjustments of the 5-year review of findings interval.

The staff confirmed that the "monitoring and trending" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.5; therefore, the staff finds it acceptable.

Acceptance Criteria. LRA Section B.2.27, as amended by letter dated January 28, 2011, states that indications or relevant conditions of degradation detected during the inspection will be compared to pre-determined acceptance criteria established by engineering evaluation of the pertinent design standard. The applicant also stated that unacceptable inspection findings include visual evidence of surface degradation such as cracking or discoloration, as well as physical manipulation evidence of hardening or loss of strength. The applicant further stated that if the acceptance criteria are not met, the condition will be entered into the Corrective Action Program for evaluation of whether the degradation could result in a loss of component intended function during the period of extended operation or prior to the next opportunity for inspection.

The staff reviewed the applicant's "acceptance criteria" program element against the criteria in SRP-LR Section A.1.2.3.6, which states that the acceptance criteria for the program and its basis should be described, and the program should include a methodology for analyzing the results against applicable acceptance criteria. The SRP-LR further states that qualitative inspections should be performed to the same predetermined criteria as quantitative inspections. The staff finds the "acceptance criteria" program element acceptable because the program includes appropriate acceptance criteria established by engineering evaluation, and any acceptance criteria not met will be evaluated under the Corrective Action Program.

The staff confirmed that the "acceptance criteria" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.6; therefore, the staff finds it acceptable.

<u>Operating Experience</u>. LRA Section B.2.27, as amended by letter dated January 28, 2011, summarizes operating experience related to the Flexible Connection Inspection Program. The applicant stated that the Flexible Connection Inspection Program is a new program for which plant operating experience has not shown the occurrence of aging effects. The applicant described an example where tears were found in HVAC boots for which it adjusted its program to include the aging effect of loss of material due to wear.

The staff reviewed this information against the acceptance criteria in SRP-LR Section A.1.2.3.10, which states that operating experience of AMPs, including past corrective actions resulting in program enhancements or additional programs, should be considered.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.27, as amended by letter dated January 28, 2011, provides the UFSAR supplement for the Flexible Connection Inspection Program.

The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.2-2 and 3.3-2. The staff notes that the applicant committed (Commitment No. 27) to implement the Flexible Connection Inspection Program prior to entering the period of extended operation for managing aging of applicable components.

The staff determines that the information in the UFSAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its technical review of the applicant's Flexible Connection Inspection Program, the staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement, as amended, for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.7 High-Voltage Porcelain Insulators

Summary of Technical Information in the Application. LRA Section B.2.31 describes the existing High-Voltage Porcelain Insulators AMP as plant-specific. The applicant states that build-up of contamination (hard water residue) is deposited on the in-scope high-voltage insulators in the transformer yard by the vapor plume from the circulating water system cooling towers. This residue, in conjunction with unfavorable weather conditions (moisture from the plume and freezing temperatures), has caused electrical flashovers on the 500-kV bus pedestal insulators in the transformer yard. The applicant also stated that the High-Voltage Porcelain Insulators AMP is a PM Program consisting of activities to mitigate potential degradation of the insulation functions due to hard water deposits.

Staff Evaluation. The staff reviewed Program Elements one through six of the applicant's program against the acceptance criteria for the corresponding elements, as stated in SRP-LR Section A.1.2.3. The staff's review focused on how the program manages aging effects through the effective incorporation of these program elements. The staff's evaluation of each of these elements follows.

Scope of the Program. LRA Section B.2.31 states the High-Voltage Porcelain Insulators AMP is credited for managing the build-up of hard water residue on the in-scope high-voltage insulators (located in the transformer yard) deposited by the vapor plume from the circulating water system cooling towers. Specifically, the applicant stated the High-Voltage Porcelain Insulators AMP includes the in-scope high-voltage station post insulators between the 115-kV backup transformer (E-TR-B) and circuit breaker E-CB-TRB.

The staff reviewed the applicant's "scope of program" program element against the criteria in SRP-LR Section A.1.2.3.1, which states that the scope of program should include the specific SCs of which the program manages the effects of aging. The specific commodity groups for which the program manages aging effects are identified (high-voltage station post insulators between the 115 kV backup transformer (E-TR-B) and circuit breaker (E-CB-TRB)), which satisfies the criterion defined in SRP-LR Appendix A.1.2.3.1.

Yet, during the Columbia License Renewal Inspection that was conducted October 18, 2010, through November 4, 2010, the staff noted an issue that was documented in the License Renewal Inspection Report dated December 17, 2010. In the report, the staff noted that the applicant appropriately included the in-scope 115 kV station post insulators into the High-Voltage Porcelain Insulators AMP because it provided power required during a station blackout and would be subject to hard water deposits caused by spray drift from the cooling towers.

However, the applicant did not include the in-scope high-voltage station post insulators at the 230 kV Ashe A809 Breaker located in the Ashe Substation in the High-Voltage Porcelain Insulators AMP, even though this breaker provided an alternate path of power during a station blackout. The applicant stated that it did not include these station post insulators because it concluded that the hard water deposits spray drift phenomenon would not occur due to the significant distance between the circulating water system cooling towers and Ashe Substation.

The applicant could not provide any other information to support its conclusions and issued Action Requests 228661 and 228673 to resolve the concern. The applicant indicated that it would either establish appropriate coating or cleaning tasks or develop information that would demonstrate why the phenomenon would not affect the 230 kV switchyard station post insulators.

The inspection team concluded that, with the exceptions noted above, the applicant performed appropriate evaluations and considered pertinent plant operating experience to determine the effects of aging from the hard water deposits on the high-voltage porcelain insulators. The inspection team concluded that, with the possible exception noted, if implemented as described, the applicant developed guidance to appropriately identify and address aging effects during the period of extended operation.

By letter dated July 19, 2011, the staff issued RAI B.2.31-1 requesting the applicant explain why the high-voltage post insulators at the 230kV Ashe A809 Breaker located in the Ashe Substation are not subject to circulating water system cooling tower spray drift and do not require a coating or cleaning aging management program.

This issue was open item OI 3.0.3.3.7 in the SER with open items.

In its response dated August 18, 2011, the applicant stated that the root cause analysis performed after the first 500 kV insulator flashover in the Columbia transformer yard concluded that the immediate cause for the failure of the 500 kV insulators was a buildup of conductive film on the surface of the insulator. Chemical analyses showed the film was composed of chemical residue deposited by spray drift from the circulating water system cooling tower. The major constituents of the residue were river water minerals and sulfate compounds generated by sulfuric acid additions (which is used to control the pH of circulating water). The applicant also stated that the reason for not including the 230 kV high-voltage insulators, located in Ashe Substation, in the High-Voltage Porcelain Insulators AMP is that the environment required to coat the insulators was not present at the Ashe Substation based on the fact that:

- flashover has not been recorded at the Ashe Substation
- discussion with plant personnel (system engineer and others) who evaluated the corrective action resolution indicated that the drift studies did not show an adverse effect on the Ashe Substation
- the Ashe Substation remains largely unaffected since it is about a quarter mile away from the plant.

The applicant also stated that because the configuration and location of the plant, prevailing winds from the south carry contaminant-laden drift droplets from the plant's cooling tower towards the station's transformer yard. The Ashe Substation remains largely unaffected since it is about a quarter of mile north of the plant. To substantiate its claim that the Ashe Substation is unaffected by the spray drift from the plant's cooling towers, the applicant requested Bonneville Power Administration (BPA), which owns and operates the Ashe Substation, to conduct an equivalent salt deposit density (ESDD) test on a sample of the in-scope 230 kV station post insulators located in the Ashe Substation. The ESDD is an industry standard technique of swiping the surface of an insulator and measuring the amount of contamination found in order to determine its density. The results of the testing indicated that the contamination levels were well within the acceptance levels established. The applicant also stated that data shows that with current BPA maintenance tests, the highest ESDD value was 0.0383 mg/cm² and was taken from a sample on the underside of the bottom skirt of the A-phase of the line drop station post insulator. The highest value for the top surfaces was 0.0086 mg/cm². The applicant further stated that BPA and the applicant have established the action level to be 0.05 mg/cm². An industry standard established 4 contamination site severity levels. It is very light (0 - 0.03 mg/cm²), light (0.03 - 0.06 mg/cm²), average/moderate (0.06 - 0.10 mg/cm²), and heavy (greater than 0.10 mg/cm²). Selecting the light severity level as the acceptance criteria is considered conservative by the applicant. The applicant is revising the High-Voltage Porcelain Insulators AMP to require ESDD testing every 8 years and cleaning (if test results indicate the need) of the in-scope 230 kV station post insulators located at Ashe Substation. The applicant stated that an 8-year interval is considered acceptable because: (a) current BPA maintenance practice is to visually inspect every 7 to 10 years and clean if necessary, (b) there have not been any recorded flashovers at the Ashe Substation, and (c) ESDD test results showed that contamination levels are acceptable for any exposure to circulating water system cooling tower drift. The applicant also revised LRA Sections 3.6.2.2.2, plant-specific note 680, LRA Section A.1.2.31, LRA Table A-1 line item 31, and LRA Section B.2.31 to reflect the proposed changes to the in-scope 230 kV Ashe Substation insulators.

The staff finds the applicant response acceptable. EPRI 1003057 (License Renewal Handbook) states that various airborne materials such as dust, salt and industrial effluent can contaminate insulator surfaces. The buildup of surface contamination is gradual and in most areas such contamination is washed away by rain; the glazed insulator surface aids this contamination removal. A large buildup of contamination could enable the conductor voltage to track along the surface more easily and can lead to insulator flashover. Surface contamination can be a problem in areas where there is greater concentration of airborne particles such as near facilities that discharge soot or near the sea coast where salt spray is prevalent. The Standard Review Plan for license renewal (SRP-LR) Section 3.6.2.2.2 recommends a plant-specific AMP for management of reduced insulation resistance due to presence of salt deposits and surface contamination for plants located in areas where the potential exists for salt deposit or surface contamination (e.g., in the vicinity of salt water bodies or industrial pollution). The 230 kV insulators in Ashe Substation are not located near facilities that discharge soot or near the sea coast where salt spray is a potential problem. The applicant proposed to include the in-scope 230 kV insulators in-scope of the High-Voltage Porcelain Insulators AMP although these insulators are not adversely affected by the spray drift from the circulating water system cooling towers. The staff also finds that the proposed 8-year testing and cleaning frequency is acceptable because the results of the previous tests performed by the owner of the Ashe Substation indicated that the contamination levels of the 230 kV insulators are acceptable, and there have not been any recorded flashover events at the Ashe Substation. The staff's concern in OI 3.0.3.3.7 is closed.

The staff confirmed that the "scope of the program" program element satisfies the criterion defined in SRP-LR Appendix A.1.2.3.1 and, therefore, the staff finds it acceptable.

Preventive Actions. LRA Section B.2.31 states that actions of the High-Voltage Porcelain Insulators AMP are a PM activity that mitigates (retards) degradation of the insulation function. The applicant also states that the High-Voltage Porcelain Insulators AMP provides for either the periodic coating or cleaning of the applicable high-voltage insulators. The applicant further stated that cleaning every 2 years is performed to prevent the build-up of hard water residue on the insulator surface to a point that could cause an electrical flashover. In addition, the applicant indicated that coating the high-voltage porcelain insulators every 10 years prevents the harmful effect of a hard water residue build-up on the insulators and that cleaning is not required if the insulator is coated. In response to the staff OI 3.0.3.3.7, the applicant revised this program element to require testing and cleaning of in-scope 230 kV high-voltage insulators located in the Ashe Substation.

The staff reviewed the applicant's "preventive actions" program element against the criteria in SRP-LR Appendix A.1.2.3.2, which states that the activities for prevention and mitigation programs should be described. And the actions should mitigate or prevent aging degradation.

The applicant described the actions that should mitigate or prevent aging degradation of high-voltage insulators (i.e., periodic coating or cleaning of the in-scope high-voltage insulators should prevent the buildup of contamination that can cause an electrical flashover).

The staff confirms that the "preventive actions" program element satisfies the criterion defined in SRP-LR Appendix A.1.2.3.2; therefore, the staff finds it acceptable.

Parameters Monitored or Inspected. LRA Section B.2.31 states that the High-Voltage Porcelain Insulators AMP visually inspects coated insulators every 2 years for damage. The applicant also stated that uncoated insulators are also inspected every 2 years for any unusual conditions. In response to staff OI 3.0.3.3.7, the applicant revised this program element to test the uncoated insulators located in the Ashe Substation for contamination every 8 years.

The staff reviewed the applicant's "parameters monitored or inspected" program element against the criteria in SRP-LR Appendix A.1.2.3.3, which states that the parameters to be monitored or inspected should be identified and linked to the degradation of the particular structure and component intended function(s). The parameter monitored or inspected should detect the presence and extent of aging effects.

Surface contamination is the potential aging effect for high-voltage porcelain insulators. A buildup of contamination could enable the conductor voltage to track along the surface and cause insulator flashover. The "parameters monitored or inspected" program element visually inspects the insulators for evidence of coating damage or unusual conditions due to contamination. Visual inspection detects the high-voltage porcelain insulator aging effects due to hard water residue buildup and will ensure the component intended function during the period of extended operation. The staff also finds the 8-year testing frequency and cleaning, if required, for in-scope 230 kV insulators located in the Ashe Substation acceptable because Ashe Substation is largely unaffected by the water residue buildup from the circulating water cooling tower and previous tests indicated that the contamination levels of 230 kV insulators are acceptable. In addition, there have not been any recorded flashover events at the Ashe Substation.

The staff confirmed that the "parameters monitored or inspected" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.3; therefore, the staff finds it acceptable.

Detection of Aging Effects. LRA Section B.2.31 states that the High-Voltage Porcelain Insulators AMP is a PM Program that does not have any specific steps to detect hard water residue on the insulators leading to flashover. The program assumes that the residue exists and takes steps to limit its effect (via coating) or to remove it (via cleaning). The applicant also stated that a visual inspection of the insulator is specified to note any excessive degradation or excessive surface contamination. The in-scope insulators are inspected and cleaned every 2 years. The applicant further stated that cleaning is not required if the insulators are coated. If insulators are coated, the coating is performed every 10 years. In addition, in response to the OI 3.0.3.3.7, the applicant committed to test in-scope 230 kV insulators located in the Ashe Substation for contamination every 8 years.

The staff reviewed the applicant's "detection of aging effects" program element against the criteria in SRP-LR Appendix A.1.2.3.4, which states that the parameters to be monitored or inspected should be appropriate to ensure that the SCs intended function(s) will be adequately maintained for license renewal under all CLB design conditions. This includes aspects such as method or technique (e.g., visual, volumetric, surface inspection), frequency, and timing of inspection to ensure timely detection of aging effects.

The staff determined that visual inspection of the insulator is an acceptable method to detect surface contamination. Coating or cleaning will limit the aging effects of contamination. The staff determined that inspection every 2 years is acceptable because the buildup of surface contamination is gradual and in most areas such contamination is washed away by rain; the glazed insulator surface aids this contamination removal. The staff also determined that testing every 8 years for insulators in the Ashe Substation is acceptable because the 230 kV insulators in the Ashe Substation is a quarter mile away from the plant and contamination residue from the cooling towers is not expected. Furthermore, testing results indicated that contamination levels of the in-scope 230 kV high-voltage insulators are acceptable.

The staff confirmed that the "detection of aging effects" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.4; therefore, the staff finds it acceptable.

Monitoring and Trending. LRA Section B.2.31 states that the High-Voltage Porcelain Insulators AMP does not include trending actions. The applicant stated that the High-Voltage Porcelain Insulators AMP is a PM Program that is performed at established intervals to coat or clean the in-scope insulators. The applicant also stated that if during the inspection of the coating or in preparation for cleaning uncoated high-voltage porcelain insulators, significant or unusual or unexpected hard water residue build-up is noted (i.e., excessive deposits), the inspection results will be evaluated through the Corrective Action Program. The applicant further stated that the corrective action evaluation may result in analysis or further inspection, and a disposition is generated. This disposition may result in a change in the frequency of inspection. The applicant stated, in response to OI 3.0.3.3.7, that the High-Voltage Porcelain Insulators AMP does include trending actions for those insulators located in the Ashe Substation. Test results will be trended to determine if cleaning of the insulators is needed to ensure that contamination levels do not exceed acceptance criteria during the next test period, and the trending data will also be used to adjust the testing frequency.

The “monitoring and trending” program element criteria in SRP-LR Appendix A.1.2.3.5 are that monitoring and trending activities should be described, and it should provide predictability of the extent of degradation and affect timely corrective or mitigative actions. This program element describes how the data collected are evaluated and may also include trending for a forward look. The parameter or indicator trended should be described.

The staff determined that absence of trending is acceptable for insulators located in the transformer yard because this is a PM Program that is periodically performed to coat or clean the in-scope insulators. For insulators located in the Ashe Substation, trending will provide predictability of the contamination levels and also be used to adjust the testing frequency. On this basis, the staff finds the applicant’s “monitoring and trending” program element acceptable.

Acceptance Criteria. LRA Section B.2.31 states that the High-Voltage Porcelain Insulators AMP is a PM activity that is periodically performed on specific in-scope equipment. The applicant stated that there are no defined acceptance criteria; hard water deposits are assumed to occur and the activity is designed to limit its impact on the insulators. The applicant stated that for the visual inspection of the insulators, excessive surface contamination that does not wash off (i.e., obvious degradation on the insulator) is unacceptable. Further, the applicant stated that such degradation is not expected to be seen on the porcelain material. In response to OI 3.0.3.3.7, the applicant stated that the High-Voltage Porcelain Insulators AMP uses industry-recognized ESDD acceptance criteria of not greater than 0.05 mg/cm^2 (within the light contamination level per industry standard). The applicant stated that if another industry recognized test is used, then the acceptance criteria will provide reasonable assurance that contamination levels will be maintained at levels that will prevent flashovers due to contamination.

The staff reviewed the applicant’s “acceptance criteria” program element against the criteria in SRP-LR Appendix A.1.2.3.6, which states that the acceptance criteria of the program and its basis should be described. The acceptance criteria, against which the need for corrective actions will be evaluated, should ensure that the structure and component intended function(s) are maintained under all CLB design conditions during the period of extended operation.

The staff determined that for in-scope insulators located in the transformer yard, verifying the high-voltage porcelain insulator coating is not degraded and there is no accumulation of contamination or other airborne deposits are adequate acceptance criteria for a visual inspection. For in-scope 230 kV insulators in the Ashe Substation, ESDD testing is an acceptable method to detect contamination levels because it is the industry standard for testing of contamination for high-voltage insulators.

The staff confirmed that the “acceptance criteria” program element satisfies the criterion defined in SRP-LR Section A.1.2.3.6; therefore, the staff finds it acceptable.

<u>Operating Experience</u>. LRA Section B.2.31 summarizes operating experience related to the High-Voltage Porcelain Insulators AMP. The applicant states that the elements that comprise the High-Voltage Porcelain Insulators AMP are consistent with industry practice and have

proven effective in maintaining the high-voltage porcelain insulators free from the adverse effects of hard water residue build-up. The applicant also stated that its review of the most recent operating experience for the high-voltage porcelain insulator inspections reveals that the inspections are performed in accordance with procedure, the results are documented and retrievable, and, if any abnormalities are identified during inspection, corrective actions are taken. The applicant further stated that a review of plant-specific operating experience for the most recent 5-year period, through a search of CRs, revealed that no 115-kV or 230-kV output breakers tripped as a result of high currents created when a porcelain insulator in the transformer yard shorted to ground. The applicant stated that the incidents that alerted the plant to the hard water deposition on the 500-kV insulators are described in LERs 89-002-00 and 90-031. The applicant noted that these events occurred almost 20 years ago. The applicant further noted that there is industry operating experience of similar flashover events occurring at plants on the ocean affected by salt spray and also plants affected by heavy fog and contamination deposits on high-voltage insulators.

The staff reviewed this information against the “operating experience” program element criterion in SRP-LR Appendix A.1.2.3.10, which states that operating experience with existing programs should be discussed. The operating experience should provide objective evidence to support the conclusion that the effect of aging will be managed adequately so that the structure and component intended function(s) will be maintained during the period of extended operation.

The staff reviewed the operating experience, in the application during the audit, to determine if the applicable aging effects and industry and plant-specific operating experience were reviewed by the applicant. The staff conducted an independent search of the plant operating experience information to determine if the applicant adequately incorporated and evaluated operating experience related to this program. Further, the staff performed a search of regulatory operating experience for at least the past 10-year period through March 2010. Databases were searched using various key word searches and then reviewed by technical auditor staff.

During its review, the staff found no operating experience to indicate that the applicant’s program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its review of the application, the staff finds that operating experience related to the applicant’s program demonstrates that it can adequately manage the detrimental effects of aging on SCCs within the scope of the program and that implementation of the program has resulted in the applicant taking corrective actions. The staff confirms that the “operating experience” program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.31 provides the UFSAR supplement for the High-Voltage Porcelain Insulators AMP. In response to OI 3.0.3.3.7, the applicant revised Commitment No. 31 through Amendment 42 to add testing for contamination and cleaning if required, every 8 years for the in-scope station post insulators located at the Ashe Substation.

The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.6-2.

The staff notes that the applicant committed (Commitment No. 31) to ongoing implementation of the existing High-Voltage Porcelain Insulators AMP for managing aging of applicable components during the period of extended operation. The applicant enhanced the existing program to require testing for contamination, and cleaning if required, every 8 years, for the in-scope station post insulators located at the Ashe Substation.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its technical review of the applicant's High-Voltage Porcelain Insulators AMP and closure of open item OI 3.0.3.3.7, the staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.8 Monitoring and Collection Systems Inspection

Summary of Technical Information in the Application. LRA Section B.2.41, as amended by letter dated January 28, 2011, describes the new Monitoring and Collection Systems Program as a plant-specific Condition Monitoring Program. The applicant stated that the program will consist of inspections of mechanical components that are exposed to equipment and area drainage water and other potential contaminants and fluids to manage the effects of loss of material due to crevice, galvanic, general, or pitting corrosion, erosion, MIC, and SCC. The applicant also stated that the program includes baseline inspections of a sample population performed within the 10-year period prior to the period of extended operation, followed by opportunistic inspections when components are opened for maintenance, repair, or surveillances.

Staff Evaluation. The staff reviewed Program Elements one through six of the applicant's program against the acceptance criteria for the corresponding elements, as stated in SRP-LR Section A.1.2.3. The staff's review focused on how the applicant's program manages aging effects through the effective incorporation of these program elements. The staff's evaluation of each of these elements follows.

Scope of the Program. LRA Section B.2.41, as amended by letter dated January 28, 2011, states that the program includes baseline inspections of a sample population followed by opportunistic inspections of the internal surface of mechanical components, including containment isolation piping and valve bodies, in the following plant systems: equipment drain radioactive (EDR), floor drains (FDs), floor drains radioactive (FDRs), fuel pool cooling (FPC), miscellaneous waste radioactive (MWR), plant sanitary drains (PSDs), process sampling (PS), process sampling radioactive (PSR), and reactor closed cooling water (RCC) systems.

The staff reviewed the applicant's "scope of the program" program element against the criteria in SRP-LR Section A.1.2.3.1, which states that the scope of the program should include the specific SCs of which the program manages the effects of aging. The staff finds the applicant's "scope of program" program element acceptable because it includes specific information regarding the components that will be managed by the program.

The staff confirmed that the "scope of the program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1; therefore, the staff finds it acceptable.

Preventive Actions. LRA Section B.2.41, as amended by letter dated January 28, 2011, states the program is a Condition Monitoring Program and does not include any actions to prevent or mitigate aging effects.

The staff reviewed the applicant's "preventive actions" program element against the criteria in SRP-LR Section A.1.2.3.2, which states that, for Condition Monitoring Programs, it does not rely on preventive actions; thus, this information need not be provided. The staff finds the applicant's "preventive actions" program element acceptable because the program is a Condition Monitoring Program and does not require any preventive actions.

The staff confirmed that the "preventive actions" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.2; therefore, the staff finds it acceptable.

Parameters Monitored or Inspected. LRA Section B.2.41, as amended by letter dated January 28, 2011, states that the program will monitor wall thickness or evidence of internal surface degradation as measures of loss of material or cracking. The applicant also stated that the inspections will be performed by qualified personnel using established NDE techniques including visual, with enhanced visual, surface, and volumetric techniques, depending on the aging effect.

The staff reviewed the applicant's "parameters monitored or inspected" program element against the criteria in SRP-LR Section A.1.2.3.3, which states that the parameters monitored or inspected should be identified, should be linked to the degradation of the particular structure and component intended function(s), and should detect the presence and extent of aging effects. The staff finds the applicant's "parameters monitored or inspected" program element acceptable because the applicant's chosen inspection parameters (wall thickness and evidence of internal surface degradation) are appropriate to detect the aging effects of loss of material and cracking.

The staff confirmed that the "parameters monitored or inspected" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.3; therefore, the staff finds it acceptable.

Detection of Aging Effects. LRA Section B.2.41, as amended by letter dated January 28, 2011, states that baseline inspections of 20 percent of each material, environment, and aging effect group, with a maximum of 25 inspections per group, will be performed within the 10-year period prior to the period of extended operation. These inspections will focus on the components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margins, where practical. The applicant also stated that opportunistic inspections will be performed thereafter when components are opened for maintenance, repair, or surveillance and surfaces are made available for inspection. The applicant further stated that inspections will be performed by qualified personnel using established NDE techniques including visual or enhanced visual, surface, and volumetric techniques.

The staff reviewed the applicant's "detection of aging effects" program element against the criteria in SRP-LR Section A.1.2.3.4, which states the following:

- Detection of aging effects should occur before there is a loss of the structure and component intended function(s).
- The effects of aging on a structure or component should be managed to ensure its availability to perform its intended function(s) as designed when called upon.
- The program element describes "when," "where," and "how" program data are collected.

- The method or technique and frequency may be linked to plant-specific or industry-wide operating experience.
- When sampling is used to inspect a group of SCs, the basis for the inspection population and sample size should be provided.

The SRP-LR also states that a program based solely on detecting structure and component failure should not be considered as an effective AMP for license renewal. The staff finds the applicant's "detection of aging effects" program element acceptable for the following reasons:

- The applicant's chosen inspection techniques (visual, enhanced visual, surface, and volumetric NDE techniques) are capable to detecting the aging effects of loss of material and cracking prior to loss of component intended function.
- The applicant will collect data during baseline and opportunistic inspections.
- The sampling methodology ensures that a representative sample of material and environment combinations is considered, ensures sample locations will focus on the most susceptible components, and includes an appropriate sample size.

The staff confirmed that the "detection of aging effects" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.4; therefore, the staff finds it acceptable.

Monitoring and Trending. LRA Section B.2.41, as amended by letter dated January 28, 2011, states that the program includes inspection performed prior to the period of extend operation and opportunistic inspections performed when components are opened for maintenance, repair, and surveillance thereafter. The applicant also stated that baseline inspections are used to characterize material conditions and include provisions for increasing the sample size and locations if degradation is detected. The applicant further stated that inspection findings will be reviewed to ensure that each material and environment combination has been examined by opportunistic inspection in a 5-year period and that appropriate actions will be taken to ensure an inspection is performed if opportunistic inspections have not occurred. The staff noted that in the applicant's commitment (Commitment No. 41) to implement the program, the applicant stated that the initial interval for review of inspection findings is 5 years and may be adjusted based on operating experience.

The staff reviewed the applicant's "monitoring and trending" program element against the criteria in SRP-LR Section A.1.2.3.5, which states that monitoring and trending activities should be described and should provide predictability of the extent of degradation to ensure timely corrective or mitigative actions. The SRP-LR also states that this program element describes "how" the data collected are evaluated and may also include trending for a forward look. The SRP-LR further states that plant-specific or industry-wide operating experience may be considered in evaluating the appropriateness of the technique and frequency of inspections. The staff finds the "monitoring and trending" program element acceptable because the program includes baseline inspections performed prior to the period of extended operation to characterize the material condition of the components, increased inspections if degradation is identified, and review of inspection findings to ensure each material and environment combination has been inspected to ensure that degradation is identified prior to loss of component intended function.

The staff confirmed that the "monitoring and trending" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.5; therefore, the staff finds it acceptable.

Acceptance Criteria. LRA Section B.2.41, as amended by letter dated January 28, 2011, states that indications or relevant conditions of degradation detected during the inspection will be compared to pre-determined acceptance criteria established by engineering evaluation of the pertinent design standard. The applicant also stated that unacceptable inspection findings include visual evidence of loss of material, a reduction in wall thickness, and evidence of cracking obtained by enhanced visual, surface, or volumetric examination. The applicant further stated that if the acceptance criteria are not met, the condition will be entered into the Corrective Action Program for evaluation of whether the degradation could result in a loss of component intended function during the period of extended operation or prior to the next opportunity for inspection.

The staff reviewed the applicant's "acceptance criteria" program element against the criteria in SRP-LR Section A.1.2.3.6, which states that the acceptance criteria for the program and its basis should be described, and the program should include a methodology for analyzing the results against applicable acceptance criteria. The SRP-LR also states that the acceptance criteria could be specific numerical values or should consist of a discussion of the process for calculating specific values. The SRP-LR further states that qualitative inspections should be performed to the same predetermined criteria as quantitative inspections. The staff finds the "acceptance criteria" program element acceptable because the program includes appropriate acceptance criteria and any acceptance criteria not met will be evaluated under the Corrective Action Program.

The staff confirmed that the "acceptance criteria" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.6; therefore, the staff finds it acceptable.

Operating Experience. LRA Section B.2.41, as amended by letter dated January 28, 2011, summarizes operating experience related to the Monitoring and Collection Systems Inspection Program. The applicant stated there was loss of material due to corrosion within the FDR system in 2003. The applicant also stated that, in 2005, it redesigned the susceptible piping and valves to eliminate standing water in the system and replaced the material with a corrosion resistant stainless steel. The applicant further stated that a flexitallic gasket on an FDR pipe flange was found severely corroded and was replaced in 2006. The applicant stated that no additional instances of corrosion have occurred in the FDR system since then. The applicant also stated that it will use its Corrective Action Program and ongoing industry operating experience to ensure this program is effective in managing the identified aging effects in components within the scope of the program.

The staff reviewed this information against the acceptance criteria in SRP-LR Section A.1.2.3.10, which states that operating experience of AMPs, including past corrective actions resulting in program enhancements or additional programs, should be considered.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.41, as amended by letter dated January 28, 2011, provides the UFSAR supplement for the Monitoring and Collection Systems Inspection Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.2-2, 3.3-2, and 3.4-2. The staff also notes that the applicant committed (Commitment No. 41) to implement the new Monitoring and Collection Systems Inspection Program within 10 years prior to entering the period of extended operation for managing aging of applicable components. The applicant also committed (Commitment No. 41) that inspections will be periodically reviewed to ensure that each material and environment combination has been examined via opportunistic inspections or actions are taken to ensure inspections are performed, and the initial interval for review of inspection findings will be 5 years and may be adjusted based on operating experience.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its technical review of the applicant's Monitoring and Collection Systems Inspection Program, the staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement, as amended, for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.9 Potable Water Monitoring

Summary of Technical Information in the Application. LRA Section B.2.43 describes the existing Potable Water Monitoring Program as plant-specific. The applicant stated that this program mitigates loss of material due to corrosion and erosion for components that contain potable water and are within the scope of license renewal. The applicant stated that this is a mitigation program that includes water treatment activities including flocculation, sedimentation, filtration, and chemical addition. The applicant further stated that this program is also a Condition Monitoring Program, with at least one inspection to be conducted within the 10-year period prior to the period of extended operation.

Staff Evaluation. The staff reviewed Program Elements one through six of the applicant's program against the acceptance criteria for the corresponding elements, as stated in SRP-LR Section A.1.2.3. The staff's review focused on how the applicant's program manages aging effects through the effective incorporation of these program elements. The staff's evaluation of each of these elements follows.

Scope of the Program. LRA Section B.2.43 states that the Potable Water Monitoring Program will manage loss of material for aluminum, copper alloy, copper alloy with greater than 15 percent Zn, gray cast iron, and steel components exposed to potable water in the reactor building outside air, potable cold water (PWC), and potable hot water systems.

The staff reviewed the applicant's "scope of the program" program element against the criteria in SRP-LR Section A.1.2.3.1, which states that the program should include specific SCs of which the program manages the effects of aging.

The staff reviewed the information provided in LRA Section B.2.43, and Tables 3.3.2-29, 3.3.2-30, and 3.3.2-37, and noted that it contains the types of materials, and specific components within the systems that this program will manage. This scope of program is appropriate for the Potable Water Monitoring Program because it clearly defines the aging effects, materials, specific components, and applicable systems.

The staff confirmed that the "scope of the program" program element satisfies the criteria defined in SRP-LR Section A.1.2.3.1; therefore, the staff finds it acceptable.

Preventive Actions. LRA Section B.2.43 states that the Potable Water Monitoring Program is a mitigation program comprised of water treatment activities, including flocculation, sedimentation, filtration, and chemical addition.

The staff reviewed the applicant's "preventive actions" program element against the criteria in SRP-LR Section A.1.2.3.2, which states that the activities for prevention and mitigation program should be described and that these actions should mitigate or prevent aging degradation. The SRP-LR also states that preventive actions are not required for condition or performance monitoring programs.

The staff reviewed the information provided in the LRA and noted that the water treatment activities used to manage aging was clearly defined. The applicant's preventive action is appropriate for the Potable Water Monitoring Program because the specified water treatment activities mitigate loss of material.

The staff confirmed that the "preventive actions" program element satisfies the criteria defined in SRP-LR Section A.1.2.3.2; therefore, the staff finds it acceptable.

Parameters Monitored or Inspected. LRA Section B.2.43 states that the Potable Water Monitoring Program monitors the water treatment plant performance and the overall status of the potable water system, including water quality.

The staff reviewed the applicant's "parameters monitored or inspected" program element against the criteria in SRP-LR Section A.1.2.3.3, which states that parameters to be monitored or inspected should be identified and linked to the degradation of the particular structure and component intended function. In addition, the SRP-LR states that, for Condition Monitoring Programs, the parameters monitored or inspected should detect the presence and extent of aging effects. The SRP-LR further states that Prevention And Mitigation Programs should monitor the specific parameters being controlled to prevent or mitigate aging effects.

The staff reviewed the LRA and noted that for the prevention and mitigation aspect, the water quality is being monitored, but the LRA did not discuss parameters relative to the condition monitoring associated with the periodic inspection activities. By letter dated June 30, 2010, the staff issued RAI B.2.43-1, which requested that the applicant provide additional information for the periodic inspection activities in the parameters monitored and inspected element. In its response dated August 26, 2010, the applicant stated that the enhancement discussion in the LRA, regarding the addition of periodic inspection activities, focused on the "detection of aging effects element," which specifies visual and volumetric examinations. In its response, the applicant also modified Commitment No. 43 to specify that the existing program will be enhanced to include periodic inspection activities for loss of material and to adjust inspection frequencies based on engineering evaluations of the inspection results. The staff finds the applicant's response acceptable because the applicant modified the "parameter monitored or inspected" element by including the periodic inspection activities. The staff's concern described in RAI B.2.43-1 is resolved. The parameters being monitored or inspected are appropriate because the loss of material will be mitigated by monitoring the water quality, and performing periodic inspections will detect loss of material.

Based on its review of the application and the applicant's response to RAI B.2.43-1, the staff confirmed that the "parameters monitored or inspected" program element satisfies the criteria defined in SRP-LR Section A.1.2.3.3; therefore, the staff finds it acceptable.

Detection of Aging Effects. LRA Section B.2.43 states that the Potable Water Monitoring Program will be enhanced to use volumetric and visual examination techniques, in locations determined by an engineering evaluation, to identify evidence of loss of material or to confirm lack thereof. The applicant also stated that, based on operating experience, it is necessary for inspections to be conducted at least once every 5 years.

The staff reviewed the applicant's "detection of aging effects" program element against the criteria in SRP-LR Section A.1.2.3.4, which states that detection of aging effects should occur before there is a loss of a component's intended functions and that parameters monitored should ensure that the component's intended functions will be adequately maintained. The SRP-LR also states that this element describes "when," "where," and "how" the program data are collected and that the method or technique and frequency may be linked to plant-specific or industry-wide operating experience.

The staff reviewed the LRA and noted that the applicant's program uses visual and volumetric examination techniques that can detect loss of material prior to compromising the component's intended functions. The adequacy of the 5-year interval for conducting inspections is discussed in the "operating experience" element below. The applicant's detection of aging effects is appropriate for the Potable Water Monitoring Program because it monitors appropriate parameters and uses appropriate techniques for detecting aging effects, specifies when, where, and how data will be collected, and it uses operating experience to determine the frequency and technique for detecting aging effects.

The staff confirmed that the "detection of aging effects" program element satisfies the criteria defined in SRP-LR Section A.1.2.3.4; therefore, the staff finds it acceptable.

Monitoring and Trending. LRA Section B.2.43 states that the Potable Water Monitoring Program will monitor water treatment plant performance and the overall status of the potable water system, including water quality. The LRA also states that these results are recorded and trended.

The staff reviewed the applicant's "monitoring and trending" program element against the criteria in SRP-LR Section A.1.2.3.5, which states that monitoring and trending activities should be described, including the ability to predict the extent of degradation. The SRP-LR also states that operating or industry experience may be used to determine the appropriateness of the techniques and frequencies. Finally, the SRP-LR states that this element describes how the data collected are evaluated and that the results are analyzed against the acceptance criteria.

The staff reviewed the LRA and noted it included details for monitoring water quality, but it did not discuss the periodic inspection activities. By letter dated September 16, 2010, the staff issued RAI B.2.43-3, asking the applicant to provide information regarding monitoring and trending activities associated with the periodic inspection activities. In its response dated December 21, 2010, the applicant stated that the "monitoring and trending" element will include an increase in inspection sample size and location if degradation is detected inside piping and components, and it will include evaluation of inspection results to determine if inspection frequency should be adjusted. The applicant also stated that this modification is documented in LRA Amendment 3, dated August 26, 2010. The staff finds the applicant's response acceptable because the applicant modified the "monitoring and trending" element by including the evaluation of inspection results to determine if sample size, location, or frequency should be adjusted to ensure that degradation is detected. The staff's concern described in RAI B.2.43-3 is resolved.

Based on its review of the application, and review of the applicant's response to RAI B.2.43-3, the staff confirmed that the "monitoring and trending" program element satisfies the criteria defined in SRP-LR Section A.1.2.3.5; therefore, the staff finds it acceptable.

Acceptance Criteria. LRA Section B.2.43 states that the acceptance criteria for the Potable Water Monitoring Program are indications or relevant conditions of degradation detected during the inspection. The applicant also stated that the established acceptance criteria for potable water quality minimizes the presence of impurities that could cause degradation. The applicant further stated that if the acceptance criteria are not met, then the indications and conditions will be evaluated under the Corrective Action Program to determine whether it could result in a loss of component intended function during the period of extended operation.

The staff reviewed the applicant's "acceptance criteria" program element against the criteria in SRP-LR Section A.1.2.3.6, which states that the acceptance criteria of the program and its basis should be described. The SRP-LR also states that the acceptance criteria establish the need for corrective actions and ensure intended functions are maintained. The SRP-LR further states that the acceptance criteria could be specific numerical values, and that information may be cited from available references.

The staff reviewed the applicant's LRA and noted that the applicant's Potable Water Monitoring Program acceptance criteria for water quality parameters did not provide details on the specific values used to determine the acceptance criteria. By letter dated June 30, 2010, the staff issued RAI B.2.43-2, which requested that the applicant provide additional information on the water quality guidelines used as a means to control aging in the potable water system, especially for loss of material.

In its response dated August 26, 2010, the applicant stated that state water quality guidelines are currently followed for the potable water systems. The applicant also stated that, because plant-specific operating experience has not identified any failures of the metallic piping and components within the scope of license renewal, no additional actions for corrosion control are necessary. The applicant further stated that its use of the state water quality guidelines are not the only methods used in this AMP because periodic inspection activities provide additional confirmation that the integrity of piping and components will be maintained during the period of extended operation. The staff finds the applicant's response acceptable because it is not relying singularly on the water quality guidelines and has included periodic inspection activities as a method for detecting aging effects. The staff's concern described in RAI B.2.43-2 is resolved. The applicant's acceptance criteria are appropriate for the Potable Water Monitoring Program because identifying indications of degradation through inspections and maintaining water quality to the specified guideline will mitigate loss of material.

Based on its review of the application, and review of the applicant's response to RAI B.2.43-2, the staff confirmed that the "acceptance criteria" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.6; therefore, the staff finds it acceptable.

Operating Experience. LRA Section B.2.43 summarizes operating experience related to the Potable Water Monitoring Program. The applicant indicated that a review of operating experience showed that corrosion and subsequent system leakage has been a recurring problem. The applicant further stated that these problems have been detected and repaired or replaced in a timely manner. The applicant also stated that none of the system leakage problems have occurred in portions of the systems that are within the reactor building where it could affect safety-related equipment and that the majority of leaks are in the yard loop piping, which is buried.

The staff reviewed this information against the acceptance criteria in SRP-LR Section A.1.2.3.10, which states that operating experience with the existing program should be discussed, including the past corrective actions that resulted in program enhancements.

During its review, the staff identified operating experience, which could indicate that the applicant's program may not be effective in adequately managing aging effects during the period of extended operation. The staff determined the need for additional clarification, which resulted in the issuance of an RAI.

The staff reviewed the applicant's operating experience element, which indicated that corrosion and subsequent system leakage has been a recurring problem in portions of the system that are not within the scope of license renewal, and, as a result, the applicant will enhance the program by performing periodic inspection at least every 5 years. The staff notes that even though these components may not be within the scope of license renewal, it is indicative of degradation in the potable water systems. However, it is not clear to the staff if the operating experience used supports the conclusion that a 5-year periodic inspection is capable of managing aging in the potable water systems. By letter dated September 16, 2010, the staff issued RAI B.2.43-4, asking the applicant to provide the technical basis for conducting periodic inspections at 5-year intervals, including relevant operating experience for components that have material, environment, and aging affects consistent with the in-scope components in the potable water systems.

In its response dated December 21, 2010, the applicant stated the following:

- The 5-year interval is reasonable because it is consistent with inspection intervals in GALL Report AMPs XI.S2 "ASME Section XI, Subsection IWL" and XI.S7 "RG 1.127, Inspection of Water-Controlled Structures Associated with Nuclear Power Plants."
- The program was enhanced to include at least one inspection within the 10 years prior to the period of extended operation.
- Inspection results will be evaluated to determine if the 5-year inspection frequency should adjusted.
- No leaks have occurred in the portions of the system that are part of the reactor and radwaste buildings where it could affect safety-related equipment.
- The majority of leaks in the potable water system have occurred in polyvinyl chloride (PVC) piping that is not in-scope for license renewal, and PVC is not the material present in the in-scope piping in the reactor and radwaste buildings.
- The operating experience for out-of-scope metallic piping in the potable water system has not shown a negative trend that would indicate a need for additional actions in the current licensing period.

The staff finds the applicant's response acceptable because the results of the inspection activities will be evaluated to determine whether the inspection frequency should be increased, plant operating experience does not include any leaks in the in-scope portion of the potable water system, and the majority of leaks in the out-of-scope piping occurred in piping constructed out of PVC, which is not the same material as in-scope piping. The staff's concern described in RAI B.2.43-4 is resolved.

Based on its review of the application, and review of the applicant's response to RAI B.2.43-4, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirms that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.43 provides the UFSAR supplement for the Potable Water Monitoring Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.3-2. The staff also notes that the applicant committed (Commitment No. 43) to ongoing implementation of the Potable Water Monitoring Program for managing aging of applicable components during the period of extended operation. The staff also notes that, in Commitment No 43, as amended in letter dated August 26, 2010, the applicant committed to enhance the program prior to entering the period of extended operation. Specifically, the applicant committed to periodically inspect the potable water system for loss of material and to adjust inspection frequencies based on engineering evaluations of the inspection results.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its technical review of the applicant's Potable Water Monitoring Program, the staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.10 Preventative Maintenance-RCIC Turbine Casing

Summary of Technical Information in the Application. LRA Section B.2.44 describes the existing PM–RCIC Turbine Casing Program as plant-specific. The applicant stated that this program manages loss of material due to corrosion on the internal surfaces of the RCIC turbine casing and associated piping and piping components downstream from the steam admission valve. The applicant also stated that this program is a Condition Monitoring Program comprising periodic inspection and surveillance activities to ensure that the aging effects are adequately managed.

Staff Evaluation. The staff reviewed Program Elements one through six of the applicant's program against the acceptance criteria for the corresponding elements, as stated in SRP-LR Section A.1.2.3. The staff's review focused on how the applicant's program manages aging effects through the effective incorporation of these program elements. The staff's evaluation of each of these elements follows.

Scope of the Program. LRA Section B.2.44 states that the PM–RCIC Turbine Casing Program is credited for managing loss of material on the internal surfaces of the steel RCIC turbine casing and the associated steel piping and piping components.

The staff reviewed the applicant's "scope of the program" program element against the criteria in SRP-LR Section A.1.2.3.1, which states that the program should include specific SCs of which the program manages the effects of aging.

The staff reviewed the applicant's program basis document and noted that it contains a list of in-scope steel components, including the steel turbine casing for the RCIC pump and the steel components associated with steam supply to the turbine that are exposed to steam during RCIC system operation and testing and uncontrolled indoor air during normal plant operation. The applicant's scoping program element is appropriate for the PM–RCIC Turbine Casing Program because it clearly defines the aging effects, materials, and applicable components.

The staff confirmed that the "scope of the program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1; therefore, the staff finds it acceptable.

Preventive Actions. LRA Section B.2.44 states that the PM–RCIC Turbine Casing Program does not include any actions to prevent or mitigate the effects of aging.

The staff reviewed the applicant's "preventive actions" program element against the criteria in SRP-LR Section A.1.2.3.2, which states that the activities for Prevention And Mitigation Program should be described. The SRP-LR also states that for Condition or Performance Monitoring Programs, no preventive actions are required.

The staff reviewed the applicant's program basis document and noted that the program is a Condition Monitoring Program and does not include actions to prevent or mitigate the aging effects. The applicant's "preventive actions" program element is appropriate for the PM–RCIC Turbine Casing Program because it is consistent with the GALL Report guidance that no preventive actions are required for Condition or Performance Monitoring Programs.

The staff confirmed that the "preventive actions" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.2; therefore, the staff finds it acceptable.

Parameters Monitored or Inspected. LRA Section B.2.44 states that the PM–RCIC Turbine Casing Program inspects the internal surfaces of the steel RCIC turbine casing for signs of degradation that may be indicative of loss of material.

The staff reviewed the applicant's "parameters monitored or inspected" program element against the criteria in SRP-LR Section A.1.2.3.3, which states that parameters to be monitored or inspected should be identified and linked to the degradation of the particular structure and component intended function. The SRP-LR also states that, for Condition Monitoring Programs, the parameters monitored or inspected should detect the presence and extent of aging effects.

The staff reviewed the applicant's program basis document and noted that the program includes periodic inspections of the internal surfaces of the steel RCIC turbine casing for visible evidence of corrosion to indicate possible loss of material. The applicant stated that inspection results will be evaluated through the Corrective Action Program if evidence of loss of material is indicated. The applicant also stated that inspections are focused on the turbine casing with the results to be applicable to the other associated components because of the similarities in materials and environment. The applicant's parameters monitored or inspected program element is appropriate for the PM–RCIC Turbine Casing Program because it includes periodic inspection and surveillance activities that are appropriate for detecting the aging effect of loss of material.

The staff confirmed that the “parameters monitored or inspected” program element satisfies the criterion defined in SRP-LR Section A.1.2.3.3; therefore, the staff finds it acceptable.

Detection of Aging Effects. LRA Section B.2.44 states that the PM–RCIC Turbine Casing Program is a Condition Monitoring Program that includes the performance of visual inspection at established intervals to detect loss of material prior to any loss of component intended function.

The staff reviewed the applicant’s “detection of aging effects” program element against the criteria in SRP-LR Section A.1.2.3.4, which states that detection of aging effects should occur before there is a loss of the component or structure intended function. The SRP-LR also states that parameters to be monitored should be appropriate to ensure that the structure and component intended function will be adequately maintained for license renewal. The SRP-LR further states that a program based solely on detecting structure and component failure should not be considered as an effective AMP for license renewal. Additionally, the SRP-LR states that the program element describes when, where, and how program data are collected. The SRP-LR also suggests that the method or technique and frequency may be linked to plant-specific or industry-wide operating experience. Finally, the SRP-LR states that, when sampling is used to inspect a group of SCs, the basis for the inspection population and size should be provided.

The staff reviewed the applicant’s program basis document and noted that the applicant’s performance maintenance activities for the RCIC turbine are performed in accordance with its maintenance procedure. The applicant stated that the internal inspection of the turbine casing is performed on a 10-year frequency based on results of past plant-specific inspections and industrial experience. The applicant also stated that the inspection frequency may be adjusted as future results and experience require. The applicant’s “detection of aging effects” program element is appropriate for the PM–RCIC Turbine Casing Program because it uses appropriate techniques for detecting aging effects; explains when, where, and how the data are collected; and uses operating experience to determine the frequency for detecting aging.

The staff confirmed that the “detection of aging effects” program element satisfies the criterion defined in SRP-LR Section A.1.2.3.4; therefore, the staff finds it acceptable.

Monitoring and Trending. LRA Section B.2.44 states that the PM–RCIC Turbine Casing Program is a condition monitoring activity that identifies evidence of internal degradation of the turbine casing. The applicant stated that inspection results will be evaluated through the Corrective Action Program if unacceptable deterioration is noted during the internal inspection of the turbine casing.

The staff reviewed the applicant’s “monitoring and trending” program element against the criteria in SRP-LR Section A.1.2.3.5, which states that monitoring and trending activities should be described, including ability to predict the extent of degradation. The SRP-LR also states that operating or industry experience may be used to determine the appropriateness of the technique and frequencies. The SRP-LR further states that the program element describes how the data collected are evaluated against the acceptance criteria.

The staff reviewed the applicant’s program basis document and noted that the material condition of the RCIC system components is a performance indicator that is monitored and reported quarterly. The applicant’s “monitoring and trending” program element is appropriate for the PM–RCIC Turbine Casing Program because it includes periodic inspection and surveillance activities for monitoring the material condition and includes performance trending of the RCIC system components, including turbine casing.

The staff confirmed that the "monitoring and trending" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.5; therefore, the staff finds it acceptable.

Acceptance Criteria. LRA Section B.2.44 states that the acceptance criteria for the PM–RCIC Turbine Casing Program are no unacceptable visual indications of loss of material. The applicant stated that unacceptable indications are those that are determined by engineering evaluation to degrade the components such that it may not be capable of performing its intended function until the next scheduled inspection.

The staff reviewed the applicant's "acceptance criteria" program element against the criteria in SRP-LR Section A.1.2.3.6, which states that the acceptance criteria of the program and its basis should be described. The SRP-LR also states that the acceptance criteria could be specific numerical values or should consist of a discussion of the process for calculating specific values. The SRP-LR further states that it is not necessary to justify any acceptance criteria taken directly from the design basis information that is included in the UFSAR. Additionally, the SRP-LR states that qualitative inspections should be performed to the same predetermined criteria as quantitative inspections.

The staff reviewed the applicant's program basis document and noted that the material condition of the RCIC turbine casing is effectively maintained with no unacceptable indications of loss of material. The applicant stated that if evidence of degradation is indicated, the corrective actions are taken to assess the material condition to ensure that no further degradation or loss of intended function occurred. The applicant's "acceptance criteria" program element is appropriate for the PM–RCIC Turbine Casing Program because it clearly defines the acceptance criteria and the need for implementing corrective actions to ensure that the component intended function is maintained.

The staff confirmed that the "acceptance criteria" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.6; therefore, the staff finds it acceptable.

<u>Operating Experience</u>. LRA Section B.2.44 summarizes operating experience related to the PM–RCIC Turbine Casing Program. The applicant stated that a review of plant-specific operating experience revealed that no loss of pressure boundary integrity has occurred due to the aging effects covered by this program. The applicant also stated that some minor leakage was identified that has been corrected, and the material condition of the system has been monitored to ensure that no further degradation occurred. During the audit, the staff reviewed the applicant's CRs and noted that RCIC turbine gland seal steam leakage was identified in 2007, and RCIC valve seat and packing leakage was identified in 2008. The applicant stated that its ongoing material condition monitoring activities have shown no further degradation due to the leakage.

The staff reviewed this information against the acceptance criteria in SRP-LR Section A.1.2.3.10, which states that operating experience with existing programs should be discussed, including the past corrective actions resulting in program enhancements.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.44 provides the UFSAR supplement for the PM–RCIC Turbine Casing Program. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.1-2. The staff also notes that the applicant committed (Commitment No. 44) to ongoing implementation of the PM–RCIC Turbine Casing Program for managing aging of applicable components during the period of extended operation.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its technical review of the applicant's PM-RCIC Turbine Casing Program, the staff concludes that the applicant demonstrated that the effects of aging will be adequately managed, so that the intended function will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.11 Service Air System Inspection Program

Summary of Technical Information in the Application. LRA Section B.2.48, as amended by letter dated January 28, 2011, describes the new Service Air System Inspection Program as a plant-specific Condition Monitoring Program. The applicant stated that the program will consist of inspections of piping and valve bodies that are within the scope of license renewal in the service air system and are exposed to an "air (internal)" environment to manage the effect of loss of material due to general corrosion. The applicant also stated that the program includes baseline inspections of a sample population performed within the 10-year period prior to the period of extended operation, followed by opportunistic inspections when components are opened for maintenance, repair, or surveillances.

Staff Evaluation. The staff reviewed Program Elements one through six of the applicant's program against the acceptance criteria for the corresponding elements, as stated in SRP-LR Section A.1.2.3. The staff's review focused on how the applicant's program manages aging effects through the effective incorporation of these program elements. The staff's evaluation of each of these elements follows.

Scope of the Program. LRA Section B.2.48, as amended by letter dated January 28, 2011, states that the program includes baseline inspections of a sample population followed by opportunistic inspections of the steel piping and valve bodies exposed to an air (internal) environment.

The staff reviewed the applicant's "scope of the program" program element against the criteria in SRP-LR Section A.1.2.3.1, which states that the scope of the program should include the specific SCs of which the program manages the effects of aging. The staff finds the applicant's "scope of program" program element acceptable because it includes specific information regarding the components and materials that will be managed by the program.

The staff confirmed that the "scope of the program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1; therefore, the staff finds it acceptable.

Preventive Actions. LRA Section B.2.48, as amended by letter dated January 28, 2011, states the program is a Condition Monitoring Program and does not include an action to prevent or mitigate aging effects.

The staff reviewed the applicant's "preventive actions" program element against the criteria in SRP-LR Section A.1.2.3.2, which states that, for Condition Monitoring Programs, it does not rely on preventive actions; thus, this information need not be provided. The staff finds the applicant's "preventive actions" program element acceptable because the program is a Condition Monitoring Program and does not require any preventive actions.

The staff confirmed that the "preventive actions" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.2; therefore, the staff finds it acceptable.

Parameters Monitored or Inspected. LRA Section B.2.18, as amended by letter dated January 28, 2011, states that the program will monitor wall thickness or visual evidence of degradation of the internal surfaces of the steel piping and valve bodies exposed to an air (internal) environment in the service air system. The applicant also stated that the inspections will be performed by qualified personnel using established NDE techniques including visual, with enhanced visual, surface and volumetric techniques, depending on the aging effect.

The staff reviewed the applicant's "parameters monitored or inspected" program element against the criteria in SRP-LR Section A.1.2.3.3, which states that the parameters monitored or inspected should be identified, should be linked to the degradation of the particular structure and component intended function(s), and should detect the presence and extent of aging effects. The staff finds the applicant's "parameters monitored or inspected" program element acceptable because the applicant's chosen inspection parameters (i.e., wall thickness and evidence of internal surface degradation) are appropriate to detect the aging effects managed by the program (i.e., loss of material).

The staff confirmed that the "parameters monitored or inspected" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.3; therefore, the staff finds it acceptable.

Detection of Aging Effects. LRA Section B.2.48, as amended by letter dated January 28, 2011, states that baseline inspections of 20 percent of each material, environment, and aging effect group, with a maximum of 25 inspections per group, will be performed within the 10-year period prior to the period of extended operation. These inspections will focus on the components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margins, where practical. The applicant also stated that opportunistic inspections will be performed thereafter when components are opened for maintenance, repair, or surveillance and surfaces are made available for inspection. The applicant further stated that inspections will be performed by qualified personnel using established NDE techniques including visual or enhanced visual, surface, and volumetric techniques.

The staff reviewed the applicant's "detection of aging effects" program element against the criteria in SRP-LR Section A.1.2.3.4, which states the following:

- Detection of aging effects should occur before there is a loss of the structure and component intended function(s).

- The effects of aging on a structure or component should be managed to ensure its availability to perform its intended function(s) as designed when called upon.
- The program element describes “when,” “where,” and “how” program data are collected.
- The method or technique and frequency may be linked to plant-specific or industry-wide operating experience.
- When sampling is used to inspect a group of SCs, the basis for the inspection population and sample size should be provided.

The SRP-LR also states that a program based solely on detecting structure and component failure should not be considered as an effective AMP for license renewal. The staff finds the applicant’s “detection of aging effects” program element acceptable for the following reasons:

- The applicant’s chosen inspection techniques (i.e., visual, enhanced visual, surface, and volumetric NDE techniques) are capable of detecting the aging effects managed by the program (i.e., loss of material) prior to loss of component intended function.
- The applicant will collect data during baseline and opportunistic inspections.
- The sampling methodology ensures that a representative sample of material and environment combinations is considered, ensures sample locations will focus on the most susceptible components, and includes an appropriate sample size.

The staff confirmed that the “detection of aging effects” program element satisfies the criterion defined in SRP-LR Section A.1.2.3.4; therefore, the staff finds it acceptable.

Monitoring and Trending. LRA Section B.2.48, as amended by letter dated January 28, 2011, states that the program includes inspection performed prior to the period of extend operation and opportunistic inspections performed when components are opened for maintenance, repair, and surveillance thereafter. The applicant also stated that baseline inspections are used to characterize material conditions and include provisions for increasing the sample size and locations if degradation is detected. The applicant further stated that inspection findings will be reviewed to ensure that each material has been examined by opportunistic inspection in a 5-year period and that appropriate actions will be taken to ensure an inspection is performed if opportunistic inspections have not occurred. The staff noted that, in the applicant’s commitment (Commitment No. 48) to implement the program, the applicant stated that the initial interval for review of inspection findings is 5 years and may be adjusted based on operating experience.

The staff reviewed the applicant’s “monitoring and trending” program element against the criteria in SRP-LR Section A.1.2.3.5, which states that monitoring and trending activities should be described and should provide predictability of the extent of degradation to ensure timely corrective or mitigative actions. The SRP-LR also states that this program element describes “how” the data collected are evaluated and may also include trending for a forward look. The SRP-LR further states that plant-specific or industry-wide operating experience may be considered in evaluating the appropriateness of the technique and frequency of inspections. The staff finds the “monitoring and trending” program element acceptable because the program includes baseline inspections performed prior to the period of extended operation to characterize the material condition of the components, increased inspections if degradation is identified, and review of inspection findings to ensure each material and environment combination has been inspected to ensure that degradation is identified prior to loss of component intended function.

The staff confirmed that the "monitoring and trending" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.5; therefore, the staff finds it acceptable.

Acceptance Criteria. LRA Section B.2.48, as amended by letter dated January 28, 2011, states that indications or relevant conditions of degradation detected during the inspection will be compared to pre-determined acceptance criteria established by engineering evaluation of the pertinent design standard. The applicant also stated that unacceptable inspection findings include visual evidence of loss of material or a reduction in wall thickness, where appropriate, that could lead to a loss of component intended function. The applicant further stated that if the acceptance criteria are not met, the condition will be entered into the Corrective Action Program for evaluation of whether the degradation could result in a loss of component intended function during the period of extended operation or prior to the next opportunity for inspection.

The staff reviewed the applicant's "acceptance criteria" program element against the criteria in SRP-LR Section A.1.2.3.6, which states that the acceptance criteria for the program and its basis should be described, and the program should include a methodology for analyzing the results against applicable acceptance criteria. The SRP-LR also states that the acceptance criteria could be specific numerical values or should consist of a discussion of the process for calculating specific values. The SRP-LR further states that qualitative inspections should be performed to the same predetermined criteria as quantitative inspections. The staff finds the "acceptance criteria" program element acceptable because the program includes appropriate acceptance criteria, and any acceptance criteria not met will be evaluated under the Corrective Action Program.

The staff confirmed that the "acceptance criteria" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.6; therefore, the staff finds it acceptable.

Operating Experience. LRA Section B.2.48, as amended by letter dated January 28, 2011, summarizes operating experience related to the Service Air System Inspection Program. The applicant stated that the Service Air System Inspection Program is a new program for which plant operating experience has not shown the occurrence of aging effects. The applicant also stated that its review of plant operating experience did not identify any age-related deficiencies with the components associated with the system or any deficiencies involving the specific components that will be managed by the program.

The staff reviewed this information against the acceptance criteria in SRP-LR Section A.1.2.3.10, which states that operating experience of AMPs, including past corrective actions resulting in program enhancements or additional programs, should be considered.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program will result in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.48, as amended by letter dated January 28, 2011, provides the UFSAR supplement for the Service Air System Inspection Program.

The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Tables 3.1-2, 3.2-2, 3.3-2, 3.4-2, 3.5-2, and 3.6-2. The staff also notes that the applicant committed (Commitment No. 48) to implement the Service Air System Inspection Program prior to entering the period of extended operation for managing aging of applicable components and to perform the baseline inspections within the 10-year period prior to entering the period of extended operation. The applicant also committed (Commitment No. 48) that inspections will be periodically reviewed to ensure that each material and environment combination has been examined via opportunistic inspections or actions are taken to ensure inspections are performed, and the initial interval for review of inspection findings will be 5 years and may be adjusted based on operating experience.

The staff determines that the information in the UFSAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its technical review of the applicant's Service Air System Inspection Program, the staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement, as amended, for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.12 Service Level 1 Protective Coatings

Summary of Technical Information in the Application. LRA Section B.2.55 describes the existing Service Level I Protective Coatings Program as plant-specific. The applicant stated that the coatings program is a management program that monitors the performance of coatings inside containment through periodic coating examinations, condition assessments, and remedial actions including repair or testing.

The applicant provided the following program description:

> The program establishes roles, responsibilities, controls and deliverables for the Service Level I Protective Coatings Program. Service Level I coatings are subject to the requirements of ANSI N101.2-1972, ANSI N101.4-1972, applicable sections of ANSI N5.12, and programmatic controls. This program also ensures the Design Basis Accident (DBA) analysis limits with regard to coatings will not be exceeded for the suction strainers. Current UFSAR limits allows for 5,000 square feet of unqualified coating in the drywell and 4,000 square feet of unqualified coating in the suppression pool (wetwell).

Staff Evaluation. The staff reviewed Program Elements one through six of the applicant's program against the acceptance criteria for the corresponding elements, as stated in SRP-LR Section A.1.2.3. The staff's review focused on how the applicant's program manages aging effects through the effective incorporation of these program elements. The staff's evaluation of each of these elements follows.

Scope of the Program. LRA Section B.2.55 states that the scope of the program includes monitoring the performance of Service Level I coatings inside containment through periodic coating examinations, condition assessments, and remedial actions, including repair and testing. The applicant further stated that the program ensures that Columbia does not exceed the licensing limit of 5,000 square feet (ft^2) of unqualified coatings in the drywell and 4,000 ft^2 of unqualified coatings in the wetwell per response to GL 98-04. The applicant stated that the qualification testing of Service Level I coatings inside containment meets the applicable requirements contained in ANSI N101.4, "Quality Assurance for Protective Coatings Applied to Nuclear Power Plants," and RG 1.54, Revision 0, "Quality Assurance Requirements for Protective Coatings Applied to Water-Cooled Nuclear Power Plants." The applicant also stated that the protective coatings have been evaluated to meet the testing standards of ANSI N101.2, "Protective Coatings (Paints) for Light Water Nuclear Reactor Containment Facilities" and ASTM D3911, "Standard Method for Evaluating Coatings used in Light-Water Nuclear Power Plants at Simulated Design Basis Accident (DBA) Conditions."

The staff reviewed the applicant's "scope of program" program element against the criteria in SRP-LR Section A.1.2.3.1, which states that the scope of the program should include the specific SCs of which the program manages the effect of aging.

The staff confirmed that the "scope of the program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1; therefore, the staff finds it acceptable. The staff has also found acceptable the manner in which the programs meet the requirements of ANSI N101.4, ANSI N101.2, and ASTM D3911 since it is consistent with NRC RG 1.54, Revision 0.

Preventative Actions. LRA Section B.2.55 states that the Service Level I Protective Coatings Program is a Condition Monitoring Program that does not include preventative actions. The applicant stated that no actions are taken as part of the Service Level I Protective Coatings Program to prevent aging effects or mitigate age-related degradation.

The staff reviewed the applicant's "preventative actions" program element against the criteria in the SRP-LR Section A.1.2.3.2, which states that for condition or performance monitoring programs, it does not rely on preventative actions; thus, this information need not be provided.

The staff confirmed that the "preventative actions" program element satisfies the criterion defined by SRP-LR Section A.1.2.3.2; therefore, the staff finds it acceptable.

Parameters Monitored or Inspected. LRA Section B.2.55 states that the Service Level I Protective Coatings Program monitors Service Level I coatings in accordance with ASTM D5163, "Standard Guide for Establishing Procedures to Monitor the Performance of Safety Related Coatings in an Operating Nuclear Power Plant," and ASTM D714, "Standard Test Method for Evaluating Degree of Blistering of Paints." The applicant also stated that coating application inspections are verified and documented by quality control, in accordance with ANSI N101.4 commitment and the Columbia Quality Control Inspection Planning Report.

The applicant provided the following information regarding the "parameters monitored or inspection" program element:

> Parameters monitored or inspected by the Service Level I Protective Coatings Program include any visible defects, such as blistering, cracking, flaking, peeling, delamination and rusting. Any area identified as degrading is noted and identified for future inspections. Physically identifying the current area of degradation facilitates evaluation of degradation rate.

The staff reviewed the applicant's "parameters monitored or inspected" program element against the criteria in SRP-LR Section A.1.2.3.3, which states that the parameters to be monitored or inspected should be identified and linked to the degradation of the particular structure and component intended function(s). The staff finds acceptable the use of ASTM

D5163 since it provides guidelines that are acceptable to staff for establishing an inservice Coatings Monitoring Program for Service Level I coating systems.

Detection of Aging Effects. LRA Section B.2.55 states that a visual containment inspection is performed for evidence of degraded qualified coatings during each RFO in accordance with the guidance in ASTM D5163. The applicant stated that the inspection includes a walkdown of the accessible drywell area and a scuba dive examination of the submerged Service Level I coatings for the wetwell. It was further reported that a qualified diver (i.e., Level II coating inspector) is required for the wetwell inspection, with a Level III inspection team leader as the supervisor. At the completion of the inspection, the applicant indicated that the coating inspector and coating engineer will review the inspection evaluation and identify any emergent work areas. After which, the applicant stated that areas of degradation are documented with a CR and work requests are initiated so that repairs are made as necessary, prior to start-up. The applicant also stated that individuals who perform coating inspections maintain a Level II or Level III qualification per ANSI N45.2.6, “Qualifications of Inspection, Examination and Testing Personnel for Nuclear Power Plants.”

The staff reviewed the applicant’s “detection of aging effects” program element against the criteria in SRP-LR Section A.1.2.3.4, which states that detection of aging effects should occur before there is loss of the structure and component intended function(s). The parameters to be monitored or inspected should be appropriate to ensure that the structure and component intended function(s) will be adequately maintained for license renewal under all CLB design conditions. This includes aspects such as method or technique (e.g., visual, volumetric, surface inspection), frequency, sample size, data collection and timing of new and one-time inspections to ensure timely detection of aging effects. The applicant should provide information that links the parameters to be monitored or inspected to the aging effects being managed.

The staff confirmed that the “detection of aging effects” program element satisfies the criterion defined in SRP-LR Section A.1.2.3.4; therefore, the staff finds it acceptable. The qualifications of personnel who perform the inspection are found to be acceptable since the staff has reviewed and confirmed that ANSI N45.2.6 is acceptable. In addition, ASTM D5163 is an acceptable standard per the GALL Report.

Monitoring and Trending. LRA Section B.2.55 states that the qualified coating engineer develops and manages the Service Level I Protective Coatings Program. The applicant also stated that inspection results are reviewed and corrective action is taken, including repair, testing, or evaluation for any identified degradation. It was further stated that the inspection reports permit the applicant to prioritize areas of repair for the current outage and following outage. In addition, the applicant stated that degradation that is not repaired or removed is evaluated in accordance with the plant’s corrective action process, and degraded coating that is left in place in an area is added to the Unqualified Coatings Log and evaluated.

The staff reviewed the applicant’s “monitoring and trending program” program element against the criteria in SRP-LR Section A.1.2.3.5, which states that monitoring and trending activities should be described, and it should provide predictability of the extent of degradation and affect timely corrective or mitigative actions. Plant-specific or industry-wide operating experience, or both, may be considered in evaluating the appropriateness of the technique and frequency.

The staff confirmed that the “monitoring and trending” program element satisfies the criterion defined in SRP-LR Section A.1.2.3.5; therefore, the staff finds it acceptable. The staff finds the method in which the applicant evaluates identified degradation as acceptable since repairs are made as appropriate, and degradation is evaluated in accordance with the plant's corrective action process.

Acceptance Criteria. LRA Section B.2.55 states that any coating that is found to be damaged or degraded is either repaired, replaced, or evaluated to determine whether it can remain in service. The applicant stated that damaged and degraded coating that is left in service is entered into the Unqualified Coatings Log and evaluated against the established acceptance criteria and previous assessment results to ensure the total area of coatings postulated to fail during a LOCA is less than the design limits.

The applicant provided the following information regarding the "acceptance criteria" program element:

> The Service Level I Protective Coatings Program characterizes, documents, and tests defective or deficient coatings in accordance with ASTM D 5163. Coated surfaces are characterized as exhibiting blisters, cracking, flaking, peeling, delamination and rusting. Coating tests are employed for areas where the qualification is in question. Acceptance criteria are specific to the coating remaining in service until the next RFO when further evaluation or repairs or both can be made.

The applicant provided the following as the criteria for evaluating containment inspection:

- Blistering—Signs of an acceptable blister (otherwise unacceptable):
  - Blister is intact
  - Medium density
  - Blister has burst but no signs of corrosion product
  - Blister has burst but coating around blister still adhering to the surface
- Cracking—Signs of acceptable cracking (otherwise unacceptable):
  - No signs of corrosion product around cracking
  - Cracking area does not exceed 10 square feet (per location). The 10 square feet plant-specific acceptance criteria is a 10% limit from a plant calculation that justified 100 square feet as the maximum allowable value of unqualified, cracked or peeling coatings that can be used in the Service Level I Protective Coatings Program
    - Immediate repairs are required if the area at one location exceeds 10 square feet
  - Coating is adhering to the wall
- Flaking, peeling, delamination—All signs of flaking, peeling, or delamination are unacceptable:
  - Schedule these areas for repair during the next outage, unless the area exceeds 10 square feet. An area of this size requires immediate repairs (prior to start-up). The 10 square feet plant-specific acceptance criteria is a 10% limit from a plant calculation that justified 100 square feet as the maximum allowable value of unqualified,

cracked or peeling coatings that can be used in the Service Level I Protective Coatings Program.

- Rusting—Repair all areas of rusting (through a degraded coating) prior to startup or during the next outage.
  - Repair areas of rust exceeding 10 square feet prior to start-up

The applicant stated that coating tests are performed as needed and under the direction of the coating engineer. It was further reported that testing includes adhesion tests performed to determine coating system strength or dry film thickness readings obtained in various locations. The applicant also stated that a failure analysis is performed and included in the inspection report. It was indicated that areas of degradation are documented with a CR and the Unqualified Coatings Log is updated to ensure DBA Limits of 5,000 ft^2 in the drywell and 4,000 ft^2 in the wetwell are not exceeded.

The staff reviewed the applicant's "acceptance criteria" program element against the criteria in SRP-LR Section A.1.2.3.6, which states that the acceptance criteria of the program and its basis should be described. The acceptance criteria, against which the need for corrective actions will be evaluated, should ensure that the structure and component intended function(s) are maintained under all CLB design conditions during the period of extended operation. The program should include a methodology for analyzing the results against applicable acceptance criteria.

The staff does not find blisters or cracks to be acceptable degradation. However, based on the small quantities defined in the acceptance criteria, the margin available in plant calculations, and the short service life allowed before remediation, the staff finds that blisters being evaluated and repaired or remaining in service until the following RFO where repairs can be made are acceptable. The staff finds cracks less than 10 $ft^2$of degradation (i.e., 10 percent of the 100 ft^2 margin of unqualified design calculations) remaining in service until the following RFO for repairs to be performed as acceptable.

The staff confirmed that the "acceptance criteria" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.6; therefore, the staff finds it acceptable.

Operating Experience. LRA Section B.2.55 summarizes operating experience related to the Service Level I Protective Coating Program. The applicant states that the Coatings Program is used in monitoring coatings inside containment by identifying degraded conditions, performing evaluations and corrective actions, ensuring the DBA analysis limits debris loading will not be exceeded for the suction strainers.

The applicant provided the following information as operating experience:

> In 2009, the coating report for Refueling Outage RFO-19 identified several instances of coating defects within the containment. All of the identified defects are slated to be repaired or any loose coating be removed during the next Refueling Outage RFO-20. Conditions reported were as follows:
>
> Primary Containment Sacrificial Shield: The coating condition of the drywell epoxy coated steel vessel appears to be in generally good condition, with no evidence of current or incipient general coating failure. As identified in RFO-18 Inspection Report small localized areas of mechanical damage were identified primarily at the 501' elevation in the workers travel path areas due to impacts and

scrapes from the movements of equipment and wear from foot traffic as identified in earlier outage reports. There is a greenish blue staining on the coating of the containment vessel concentrated in the areas of the spray nozzles starting above the 501' elevation up to approximately the 570' elevation 360 degrees around the coated steel vessel. This staining was identified in earlier outage reports and does not appear to have any evidence of current or incipient general coating failure. These areas were identified and reported in the RFO-18 Inspection Report. Coatings defects identified were:

- One area of localized mud cracking/delaminated epoxy coating (epoxy coating is peeling away from the substrate) was identified at azimuth 195° elevation 501', this area is just below the flange on a 12" to 14" diameter pipe that is penetrating through the down comer missile shield on the outboard side of the catwalk.
- One area of rusting (rust grade 0^F approximately 100% surface rusted per ASTM 0610) was identified on a embed plate attached to the vessel wall at azimuth 265° elevation 501'. The rusting appears to be concentrated to the weld area at the steel vessel/hanger plate interface and the embed plate. It appears that this hanger plate was welded to the steel vessel and not recoated.

Primary Containment Pedestal: The coating condition of the drywell epoxy coated concrete pedestal appears to be in generally good condition, with no evidence of current or incipient general coating failure. There were several areas of localized mud cracking of the epoxy coating to the concrete substrate and mechanical impact damage. These areas are concentrated between elevation 501' and 512' and were identified and reported in the RFO-18 Inspection Report. One area of localized mud cracking/delaminated epoxy coating (epoxy coating is peeling away from the substrate) was identified at azimuth 0° elevation 501'. This area is just above an unused support brace embed on the containment pedestal wall.

Drywell General Coating Condition: The piping systems and component equipment appears to be in generally good condition, with no evidence of current or incipient general coating failure. There were several areas of rusting (rust grade 0^F approximately 100% surface rusted per ASTM 0610) on the chiller piping, flanges, valve handles and flange bolting hardware. One area of rusting was identified on a weld interface area on a 18" diameter epoxy coated carbon steel pipe and 1" diameter stainless steel pipe penetration at azimuth 90° elevation 522'.

The staff reviewed this information against the acceptance criteria in SRP-LR Section A.1.2.3.10, which states that the operating experience of AMPs, 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 operating experience should have resulted in appropriate program enhancements or new programs. This information can show where an existing program has succeeded and where it has failed (if at all) 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 structure and component intended function(s) will be maintained during the period of extended operation.

During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

The staff confirmed that the applicant addressed operating experience identified after issuance of the GALL Report. Based on its review, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging on systems SCs within the scope of the program, and implementation of this program has resulted in the applicant taking appropriate corrective actions. Therefore, the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. LRA Section A.1.2.55 provides the UFSAR supplement for the Service Level I Protective Coatings Program.

The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in the GALL Report. The staff also noted that the applicant committed (Commitment No. 62) to continue the Service Level I Protective Coatings Program during the period of extended of operation.

The staff determines that the information in the UFSAR supplement is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its technical review of the applicant's Service Level I Protective Coatings Program, the staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(2). The staff also reviewed the UFSAR supplement for the AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.13 Small Bore Class 1 Piping Inspection

Summary of Technical Information in the Application. LRA Section B.2.49 describes the new Small Bore Class 1 Piping Program as plant-specific. The applicant stated that the program will detect and characterize cracking of small bore (less than 4 in. NPS) Class 1 piping components that are exposed to reactor coolant. The applicant also stated that this Periodic Inspection Program will provide physical evidence as to whether, and to what extent, cracking due to SCC and other thermal and mechanical loading has occurred in small bore Class 1 piping components. The applicant further stated that the program will verify, by inspections for cracking, that reduction of fracture toughness due to thermal embrittlement requires no additional aging management for small bore Class 1 CASS valve bodies. The applicant additionally stated that the present program will be a Condition Monitoring Program with no actions to prevent or mitigate aging effects.

In its response dated November 11, 2010, to RAI 3.1.2.1-X1, discussed in SER Section 3.1.2.1.2, the applicant stated that it has no small bore CASS Class 1 valves with a weld or weld repair in the valve body. The applicant also stated that all small bore CASS Class 1 valves (and bonnets) are cast as one piece, and the valve bodies and bonnets are bolted together so that there is no need for the surface inspection in the ISI Program.

Staff Evaluation. The staff reviewed Program Elements one through six of the applicant's program against the acceptance criteria for the corresponding elements, as stated in SRP-LR

Section A.1.2.3. The staff's review focused on how the applicant's program manages aging effects through the effective incorporation of these program elements. The staff's evaluation of each of these elements follows.

Scope of the Program. LRA Section B.2.49 states that the Small Bore Class 1 Piping Program manages ASME Code Class 1 small bore (less than 4 in. NPS) piping components with periodic inspections to detect cracking due to SCC and other thermal and mechanical loading.

The staff reviewed the applicant's "scope of the program" program element against the criteria in SRP-LR Section A.1.2.3.1, which states that the specific program necessary for license renewal should be identified and that the scope of the program should include the specific SCs of which the program manages the effects of aging.

The staff determined that the information provided by the applicant in this program element is satisfactory because it provides a listing of the specific systems and components that are subject to the applicant's Small Bore Class 1 Piping Program, including small bore piping, fittings, branch connections, valve bodies, and butt and socket welds, which are identified in the LRA. The staff confirmed that the "scope of the program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1; therefore, the staff finds it acceptable.

Preventive Actions. LRA Section B.2.49 states that the Small Bore Class 1 Piping Program will be a Condition Monitoring Program with no actions to prevent or mitigate aging effects.

The staff reviewed the applicant's "preventive actions" program element against the criteria in SRP-LR Section A.1.2.3.2, which states that, for Condition or Performance Monitoring Programs that do not rely on preventive actions, this information need not be provided. The staff determined that the information provided by the applicant in this program element is satisfactory because it clearly states that the applicant's proposed program is a Condition Monitoring Program with no provisions for preventive actions. The staff confirmed that the "preventive actions" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1; therefore, the staff finds it acceptable.

Parameters Monitored or Inspected. LRA Section B.2.49 states that the Small Bore Class 1 Piping Program is a Periodic Inspection Program that will include visual and volumetric examinations (both destructive and nondestructive) for cracking. The applicant also states that examinations will be performed by qualified personnel using qualified examination techniques and following procedures consistent with Section XI of the ASME Code and 10 CFR Part 50, Appendix B.

The staff reviewed the applicant's "parameters monitored or inspected" program element against the criteria in SRP-LR Section A.1.2.3.2, which states that the parameters to be monitored or inspected should be identified and linked to the degradation of the particular structure and component intended functions, and, for a Condition Monitoring Program, the parameter monitored or inspected should detect the presence and extent of aging effects.

The staff determined that the information provided by the applicant in this program element is satisfactory because it identifies the parameters to be inspected, links them to the relevant degradation processes, and indicates how it will be used to detect aging effects, consistent with Section XI of the ASME Code and 10 CFR Part 50, Appendix B. The staff confirmed that the "parameters monitored or inspected" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1; therefore, the staff finds it acceptable.

Detection of Aging Effects. LRA Section B.2.49 states that the Small Bore Class 1 Piping Program will perform visual and volumetric inspection of a representative sample of small bore Class 1 piping components, including butt welds and socket welds, and will focus on the bounding or lead components most susceptible to aging due to time in service, severity of operating conditions, and lowest design margin. The applicant also stated that in-scope components will be grouped into populations based on component type, material, and environment. The applicant further stated that the sample size will be 10 percent of each population (except for socket welds) with a minimum of one location and a maximum of 20 locations; the socket weld sample will include three locations. The applicant further stated that 10 percent of each sample will be inspected each 10-year ISI interval, and inspections will start during the fourth 10-year interval, which begins prior to the period of extended operation. The applicant additionally stated that if a qualified non-destructive volumetric examination technique does not become available for socket welds, destructive examinations will be conducted.

The staff reviewed the applicant's "detection of aging effects" program element against the criteria in SRP-LR Section A.1.2.3.4, which states that detection of aging effects should occur before there is a loss of the structure and component intended functions. It also states that the parameters to be monitored or inspected should be appropriate to ensure that the structure and component intended functions will be adequately maintained for license renewal under all CLB design conditions. It further states that this program element should provide justification, including codes and standards referenced, that the technique and frequency are adequate to detect the aging effects before a loss of intended function and that it should describe all aspects of activities to collect data as part of the program. In addition, it states that, when sampling is used to inspect a group of SCs, this element should provide the basis for the inspection population and sample size and that the sample should be biased toward locations most susceptible to the specific aging effect of concern during the period of extended operation. Furthermore, provisions should also be included on expanding the sample size when degradation is detected in the initial sample.

The staff noted that the information provided in the applicant's "detection of aging effects" program element indicates that this program is designed to detect aging effects prior to failure, that the parameter to be inspected (the possible presence of cracking) is appropriate, and that the techniques (visual and volumetric examinations consistent with ASME Code Section XI and 10 CFR Part 50, Appendix B) are adequate to detect aging effects. The applicant also provides information on the sampling technique to be used in carrying out the proposed inspections, stating that the sample size will be 10 percent of each population (except for socket welds) with a minimum of 1 location and a maximum of 20 locations. Regarding the inspection of full butt welds, the staff finds it acceptable because the applicant will examine 10 percent of the weld population for each inspection interval using visual and volumetric examinations, and the inspection will ensure that aging (cracking), if present, will be detected. The applicant further stated that the sample size for the socket welds will be three locations but provides no information on the population size for this component. Consequently, the staff was unable to determine the sample size for socket welds as a percentage of the total number of such welds present in the plant. By letter dated October 20, 2010, the staff issued RAI B.2.49-2 requesting that the applicant provide more detailed sampling information, in terms of number of welds and percent of welds, for the volumetric examinations of socket welds for both nondestructive or destructive examinations, or both. In its response dated January 27, 2011, the applicant amended its program.

Regarding inspection sampling criteria, the applicant stated that it will use the sampling guidance given in GALL Report AMP XI.M35. Specifically, it stated that "the inspection will include 10% of the weld population or a maximum of 25 welds of each weld type (e.g., full penetration or socket weld) using a methodology to select the most susceptible and the most risk-significant welds." The staff finds the applicant's proposed inspection sampling acceptable because the inspections will focus on the most susceptible and risk-significant welds, and an adequate number of welds will be selected for inspection to ensure cracking, if it exists, will be detected.

Regarding volumetric examination of socket welds, the applicant stated that opportunistic destructive examination can be performed in lieu of a volumetric examination, in which each destructive weld examination will be considered equivalent to performing two volumetric examinations on socket welds. The staff finds the applicant's proposed alternative acceptable because welds that are destructively examined provide more information when compared to the information obtained from a weld that is examined with nondestructive techniques.

Based on its review, the staff finds the applicant's response to B.2.49-2 acceptable because the applicant periodic inspection program will include adequate inspection sample size for each weld type. The staff's concern described in B.2.49-2 is resolved.

The staff confirmed that the "detection of aging effects" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.3; therefore, the staff finds it acceptable.

Monitoring and Trending. LRA Section B.2.49 states the following:

- Examinations will be performed by qualified personnel following procedures that are consistent with Section XI of the ASME Code and 10 CFR Part 50, Appendix B.
- Unacceptable program findings will be evaluated, tracked, and trended by the applicant's Corrective Action Program.
- The extent of the unacceptable condition will be determined by the expansion of the sample size in accordance with ASME Code Section XI, Subsections IWB-3100 and IWB 3400.

The staff reviewed the applicant's "monitoring and trending" program element against the criteria in SRP-LR Section A.1.2.3.5, which states that monitoring and trending activities should be described and should provide predictability of the extent of degradation and affect timely corrective or mitigative actions. It also states that plant-specific or industry-wide operating experience, or both, may be considered in evaluating the appropriateness of the technique and frequency. It further states that the program element describes "how" the data collected is evaluated and may also include trending for a forward look. In addition, it states that the methodology for analyzing the inspection or test results against the acceptance criteria should be described, and trending is a comparison of the current monitoring results with previous monitoring results to make predictions for the future.

ASME Code Section XI, Subsection IWB 3100, establishes criteria that a component whose volumetric or surface examination either confirms the absence of or detects flaws that do not exceed the standards of IWB-3400. ASME Code Section XI, Subsection IWB 3400, establishes standards that determine acceptability for service. The applicant's ISI Program and its Corrective Action Program included these Code provisions for detection of degradation, extent of condition and mitigative actions, which is consistent with the criteria described in the SRP-LR Section A.1.2.3.5.

The staff determined that the information provided by the applicant in this program element is satisfactory because the referenced site-specific Corrective Action Program and ASME Code Section XI, Subsections IWB 3100 and IWB-3400 adequately address the program element requirements stated in SRP-LR Section A.1.2.3.5. The staff confirmed that the "monitoring and trending" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.5; therefore, the staff finds it acceptable.

Acceptance Criteria. LRA Section B.2.49 states that acceptance criteria will comply with ASME Code, Section XI, Subsection 3100. It also states that the evaluation of indications will include determining the extent of condition by expanding the sample size as called for by ASME Code, Section XI, Subsection IWB-3400.

The staff reviewed the applicant's "acceptance criteria" program element against the criteria in SRP-LR Section A.1.2.3.6, which states that the acceptance criteria of the program and its basis should be described and should include a methodology for analyzing the results against applicable acceptance criteria.

ASME Code Section XI, Subsection IWB 3100, establishes criteria that a component whose volumetric or surface examination either confirms the absence of or detects flaws that do not exceed the standards of IWB-3400. ASME Code Section XI, Subsection IWB 3400, establishes standards that determine acceptability for service. The use of these Code provisions gives the applicant the tools and basis for acceptance criteria, consistent with the criteria described in the SRP-LR Section A.1.2.3.6. The staff noted that, if cracking is detected during the inspection, there will be an extent of condition review as a part of the Code requirement, as specified in ASME Code Section XI, Subsection IWB 3000, and as a part of its site Corrective Action Program, to re-evaluate the inspection sample size and to ensure that it is adequate to identify cracking that could occur at other locations.

The staff determined that the information provided by the applicant in this program element is satisfactory because it referenced ASME Code Section XI, Subsection IWB-3400, and adequately addressed the program element requirements stated in SRP-LR Section A.1.2.3.5. The staff confirmed that the "acceptance criteria" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.5; therefore, the staff finds it acceptable.

<u>Operating Experience</u>. LRA Section B.2.49 summarizes operating experience related to the Small Bore Class 1 Piping Program. The applicant provided examples of plant-specific operating experience. This experience included several instances of small-bore pipe cracking due to vibrational fatigue or construction flaws, particularly during the early years of plant operation. The applicant stated that design changes have resulted in a reduction in the number of such failures since that time. The applicant also stated that no instances of SCC or low-cycle fatigue, as the sole failure mechanism, were identified. The applicant further stated that a single instance of small-bore Class 1 piping failure related to SCC occurred in 1993, but that failure also involved other factors that led to fatigue cracking.

The staff reviewed this information against the acceptance criteria in SRP-LR Section A.1.2.3.10, which states the operating experience includes past corrective actions resulting in program enhancements or additional programs, and this information should provide objective evidence to support the conclusion that the effects of aging will be adequately managed so that the structure and component intended functions will be maintained during the period of extended operation. The staff noted that the applicant instituted design changes that have been effective in reducing the frequency of high-cycle fatigue failures in small-bore piping. The staff also conducted an independent search of operating experience and did not identify any additional failures in small-bore piping beyond those noted by the applicant. During its review, the staff found no operating experience to indicate that the applicant's program would not be effective in adequately managing aging effects during the period of extended operation.

Based on its review of the application, the staff finds that operating experience related to the applicant's program demonstrates that it can adequately manage the detrimental effects of aging within the scope of the program and that implementation of the program has resulted in the applicant taking appropriate corrective actions. The staff confirmed that the "operating experience" program element satisfies the criterion in SRP-LR Section A.1.2.3.10; therefore, the staff finds it acceptable.

UFSAR Supplement. The staff reviewed this UFSAR supplement description of the program and notes that it conforms to the recommended description for this type of program, as described in SRP-LR Table 3.1-2. The staff also notes that the applicant committed (Commitment No. 49) to implement the new Small Bore Class 1 Piping Program prior to entering the period of extended operation for managing aging of applicable components.

The staff determines that the information in the UFSAR supplement, as amended, is an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its technical review of the applicant's Small Bore Class 1 Piping Program, the staff concludes that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concludes that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.4 Quality Assurance Program Attributes Integral to Aging Management Programs

3.0.4.1 Summary of Technical Information in Application

In Appendix A, "Final Safety Analysis Report Supplement," Section A.1.2, "Aging Management Program and Activities," and Appendix B, "Aging Management Programs," Section B.1.3, "Quality Assurance Program and Administrative Controls," of the LRA, the applicant described the elements of corrective action, confirmation process, and administrative controls that are applied to the AMPs for both safety-related and nonsafety-related components. The Columbia Operational Quality Assurance Program Description (OQAPD) is used, which includes the elements of corrective action, confirmation process, and administrative controls. Corrective actions, confirmation process, and administrative controls are applied in accordance with the OQAPD regardless of the safety classification of the components. Appendix A, Section A.1.2, and Appendix B, Section B.1.3, of the LRA state that the OQAPD implements the requirements of 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," and is consistent with the NUREG-1801, Volume 2, Appendix on Quality Assurance for Aging Management Programs.

3.0.4.2 Staff Evaluation

Pursuant to 10 CFR 54.21(a)(3), an applicant is required to demonstrate that the effects of aging on SCs subject to an AMR will be adequately managed so that its intended functions will remain consistent with the CLB for the period of extended operation. The SRP-LR, Branch Technical Position RLSB-1, "Aging Management Review–Generic," describes 10 attributes of an acceptable AMP. Of these 10 attributes, 3 are associated with the QA activities of corrective action, confirmation process, and administrative controls. Table A.1-1, "Elements of an Aging Management Program for License Renewal," of Branch Technical Position RLSB-1 provides the following description of these quality attributes:

- Attribute No. 7—Corrective Actions, including root cause determination and prevention of recurrence, should be timely.
- Attribute No. 8—Confirmation Process should ensure that preventive actions are adequate and that appropriate corrective actions have been completed and are effective.
- Attribute No. 9—Administrative Controls should provide a formal review and approval process.

The SRP-LR, Branch Technical Position IQMB-1, "Quality Assurance for Aging Management Programs," states that those aspects of the AMP that affect quality of safety-related SSCs are subject to the QA requirements of 10 CFR Part 50, Appendix B. Additionally, for nonsafety-related SCs subject to an AMR, the applicant's existing 10 CFR Part 50, Appendix B, OQAPD may be used to address the elements of corrective action, confirmation process, and administrative control. Branch Technical Position IQMB-1 provides the following guidance with regard to the QA attributes of AMPs:

> Safety-related SCs are subject to Appendix B to 10 CFR Part 50 requirements which are adequate to address all quality related aspects of an AMP consistent with the CLB of the facility for the period of extended operation. For nonsafety-related SCs that are subject to an AMR for license renewal, an applicant has an option to expand the scope of its Appendix B to 10 CFR Part 50 program to include these SCs to address corrective action, confirmation process, and administrative control for aging management during the period of extended operation. In this case, the applicant should document such a commitment in the Final Safety Analysis Report supplement in accordance with 10 CFR 54.21(d).

The NRC staff reviewed the applicant's AMPs, described in Appendix A and Appendix B of the LRA, and the associated implementing procedures. The purpose of this review was to ensure that the QA attributes (corrective action, confirmation process, and administrative controls) were consistent with the staff's guidance described in Branch Technical Position IQMB-1. Based on the NRC staff's evaluation, the descriptions of the AMPs and its associated quality attributes—provided in Appendix A, Section A.1, and Appendix B, Section B.1.3, of the LRA—are consistent with the staff's position regarding QA for aging management.

3.0.4.3 Conclusion

On the basis of the staff's evaluation, the descriptions and applicability of the plant-specific AMPs and its associated quality attributes—provided in Appendix A, Section A.1, and Appendix B, Section B.1.3 of the LRA—were determined to be consistent with the staff's position regarding QA for aging management. The staff concludes that the QA attributes (corrective action, confirmation process, and administrative control) of the applicant's AMPs are consistent with 10 CFR 54.21(a)(3).

3.0.5 Operating Experience for Aging Management Programs

3.0.5.1 Summary of Technical Information in Application

LRA Section B.1.4 describes the consideration of operating experience for AMPs. The LRA states that operating experience for existing programs and activities was reviewed as an input to the AMP evaluations. This review included plant records from January 2001 through July 2008, such as reports generated under the corrective action program (CAP) and licensee event reports, and was focused on degradation due to aging-related issues. The LRA also states that the operating experience review considered the results of internal and external programmatic assessments. Industry operating experience was considered specifically for new programs with no plant-specific operating experience, or when industry events were significant for existing programs. Further, some but not all of the program descriptions in LRA Appendix B state that operating experience will be considered on an ongoing basis. For example, LRA Section B.2.12 states that, "Future operating experience is captured through the normal operating experience review process, which will continue through the period of extended operation," and LRA Section B.2.53 states that, "The site corrective action program and ongoing review of industry operating experience will be used to ensure that the program continues to be effective in managing the identified aging effects."

3.0.5.2 Staff Evaluation

Pursuant to 10 CFR 54.21(a)(3), an applicant is required to demonstrate that the effects of aging on SCs subject to an AMR will be adequately managed so that its intended functions will be maintained consistent with the CLB for the period of extended operation. SRP-LR, Revision 2, Appendix A, describes 10 elements of an acceptable AMP. Section A.1.2.3.10 describes Element 10, "Operating Experience," as consisting of these three attributes:

1. Consideration of future plant-specific and industry operating experience relating to aging management programs should be discussed. Reviews of operating experience by the applicant in the future may identify areas where aging management programs should be enhanced or new programs developed. An applicant should commit to a future review of plant-specific and industry operating experience to confirm the effectiveness of its aging management programs or indicate a need to develop new aging management programs. This information should provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the structure and component intended function(s) will be maintained during the period of extended operation.

2. Operating experience with existing programs should be discussed. The operating experience of AMPs that are 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 operating experience should have resulted in appropriate program enhancements or new programs. This information can show where an existing program has succeeded and where it has failed (if at all) 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 structure- and component-intended function(s) will be maintained during the period of extended operation.

3. For new AMPs that have yet to be implemented at an applicant's facility, the programs have not yet generated any operating experience (OE). However, there may be other

relevant plant-specific OE at the plant or generic OE in the industry that is relevant to the AMP's program elements even though the OE was not identified as a result of the implementation of the new program. Thus, for new programs, an applicant may need to consider the impact of relevant OE that results from the past implementation of its existing AMPs that are existing programs and the impact of relevant generic OE on developing the program elements. Therefore, operating experience applicable to new programs should be discussed. Additionally, an applicant should commit to a review of future plant-specific and industry operating experience for new programs to confirm its effectiveness.

SER Section 3.0.3 discusses the staff's review of the second and third attributes, which concern operating experience associated with existing and new programs, respectively. The below evaluation discusses the staff's review of the first attribute, which concerns the consideration of future operating experience and is applicable to both new and existing programs.

The staff reviewed LRA Sections B.1.4 and B.2.1 through B.2.55 to determine whether the applicant will implement adequate activities for the continual review of both plant-specific and industry operating experience to identify areas where AMPs should be enhanced or new AMPs developed. The staff determined that these LRA sections describe how the applicant incorporated operating experience into its AMPs, but it does not fully describe how the applicant will use future operating experience to ensure that the AMPs will remain effective for managing the aging effects during the period of extended operation. While the majority of the program descriptions contain statements indicating that future operating experience will be used to adjust the programs as appropriate, the details of this process are not fully described. In addition, some program descriptions contain no such statements and, for these AMPs, it is not clear whether the applicant intends to implement actions to monitor operating experience on an ongoing basis and use it to ensure the continued effectiveness of these AMPs. Further, the LRA does not state whether new AMPs will be developed, as necessary. By letter dated May 24, 2011, the staff issued RAI B.1.4-1 requesting that the applicant describe in detail the programmatic activities that will be used to continually identify aging issues, evaluate them, and, as necessary, enhance the AMPs or develop new AMPs. In the description of these activities, the staff also requested that the applicant specifically address the following:

- sources of plant-specific and industry operating experience that are monitored on an ongoing basis
- criteria for classifying operating experience as related to aging
- training of plant personnel
- how aging issues are evaluated to determine potential impacts on the aging management activities
- identification and documentation of affected SCs, materials, environments, aging effects, aging mechanisms, and AMPs
- consideration of AMP inspection results
- records kept of operating experience evaluations
- process and criteria for ensuring enhancements to the aging management activities will be implemented in a timely manner
- administrative controls over the operating experience review activities

This issue was open item OI B.1.4-1 in the SER with open items.

The applicant responded to RAI B.1.4-1 by letter dated June 23, 2011, which it subsequently revised by letter dated July 11, 2011. In summary, the applicant stated that it will use its current CAP and operating experience program (OEP) to continually monitor and evaluate plant-specific and industry operating experience related to aging. The applicant stated that the CAP is used to monitor plant-specific operating experience and the OEP is used to monitor industry operating experience. Inputs to both programs were also described. With respect to training, the applicant stated that operating experience evaluations are assigned to personnel with technical knowledge in the subject area.

The staff reviewed the applicant's response to RAI B.1.4-1 and determined that it provided a general description of the processes used to evaluate operating experience on an ongoing basis; however, it did not provide specific information on how aging-related issues are addressed under these processes. In particular, the staff determined that additional information was necessary because the applicant did not describe: (a) a means for identifying and categorizing operating experience items as related to aging; (b) how evaluations of operating experience items related to aging consider the fundamental components of an AMR; (c) training requirements specific to aging issues for those plant personnel responsible for screening, evaluating, and submitting operating experience items; and (d) how it will consider as operating experience the AMP inspection results. In addition, the applicant stated that it does not consider certain guidance documents to be sources of operating experience, like the GALL Report, and the applicant stated that, under the OEP, supervisors are responsible for ensuring the timely completion of operating experience evaluations; however, the applicant provided no additional detail on what constitutes a timely evaluation.

Therefore, by letter dated September 30, 2011, the staff issued RAI B.1.4-2 requesting that the applicant address the following for both the CAP and OEP:

(a) Describe how operating experience issues will be identified and categorized as related to aging.

(b) Describe how evaluations of operating experience issues related to aging will consider SSCs, materials, environments, aging effects, aging mechanisms, and AMPs.

(c) Describe the training requirements on aging issues for those plant personnel responsible for screening, evaluating, and submitting operating experience items.

(d) Describe how the results of the AMP inspections will be reviewed.

(e) Provide a plan for considering the content of guidance documents, such as the GALL Report, as operating experience applicable to AMPs.

(f) Describe what constitutes a timely evaluation under the OEP.

By letter dated November 10, 2011, the applicant responded to RAI B.1.4-2. In summary, the applicant provided additional information on the CAP and OEP as it relates to the aging management process. The applicant described how plant-specific operating experience, which includes the effects of aging, is identified and entered into the CAP on condition reports. Through the CAP, the applicant explained that conditions adverse to quality and significant conditions adverse to quality are identified, reported to management, and subsequently corrected. Condition report reviews were also described. The applicant stated that each condition report is evaluated to identify failures or degradations that may be related to aging effects on passive and long-lived SSCs. The applicant also described the process for resolving condition reports. Each condition report determined to be, or potentially, related to aging receives an aging assessment. The applicant also stated that noteworthy plant-specific operating experience is shared with the industry and guidance will be provided on sharing operating experience related to license renewal issues, like changes to AMPs that would be of interest to the industry. Further, the applicant described the OEP, stating that it uses lessons learned from industry and plant-specific operating experience to improve plant safety and reliability and reduce the number and consequence of events. It stated that source documents for industry operating experience include revisions to the GALL Report and license renewal interim staff guidance (LR-ISG) documents. The applicant described its team reviews of the operating experience source documents and stated that the source documents are evaluated for effects on the AMPs. Similar to the resolution process for condition reports, the applicant stated that operating experience source documents determined to be, or potentially, related to aging receive an aging assessment. Training on aging issues for personnel involved in these processes was also described.

The staff reviewed the applicant's response to RAI B.1.4-2 and found that it describes certain activities, such as providing training and issuing procedures, which either have not been completed or are planned. On December 6, 2011, and December 15, 2011, the staff held teleconferences with the applicant to discuss when it plans to complete and implement these activities. In response to these discussions, by letter dated December 16, 2011, the applicant provided additional information on when the activities requiring further action will be completed.

The staff evaluated the details of the applicant's description of the ongoing operating experience review activities provided in response to RAIs B.1.4-1 and B.1.4-2 by letters dated June 23, 2011, July 11, 2011, November 10, 2011, and December 16, 2011. The staff evaluated the adequacy of these activities with respect to the following key areas:

(1) capture of operating experience related to aging
(2) sources of operating experience
(3) completion and prioritization of operating experience evaluations
(4) documentation of operating experience evaluations
(5) implementation of enhancements identified through operating experience evaluations
(6) administrative controls
(7) identification of operating experience as related to aging
(8) consideration of guidance as operating experience
(9) information considered in operating experience evaluations
(10) consideration of AMP implementation results as operating experience
(11) training
(12) reporting operating experience to the industry
(13) implementation schedule

First, the staff evaluated the applicant's activities for capturing operating experience related to aging. The applicant's response dated July 11, 2011, states that the CAP and OEP are used to continually monitor and evaluate plant-specific and industry operating experience, including operating experience related to aging issues. In its response dated November 10, 2011, the applicant further stated that all employees are required by the governing corrective action procedure to promptly document degraded and non-conforming conditions, and that the definition of degraded includes the effects of aging. Also in this response, the applicant stated that, "[t]he goal for the OEP is to use lessons learned from industry and station [operating experience] effectively and efficiently to improve plant safety and reliability and to reduce the number and consequence of events." The applicant stated that aging issues can play a part in these elements of the OEP. The staff finds acceptable the use of the CAP and OEP to capture operating experience in this respect because both programs would not preclude the capture of plant-specific and industry operating experience related to aging.

Second, the staff evaluated the sources of operating experience reviewed by the applicant. The applicant's response dated July 11, 2011, states that the CAP ensures that a broad range of issues or conditions can be documented and coded to enable trending for the purpose of addressing broader programmatic or process weaknesses. The response lists (a) adverse trends identified in the system health reports, (b) equipment failures resulting in plant-specific licensee event reports, and (c) adverse results of inspections performed under an AMP as three examples of inputs to the CAP. In its response dated November 10, 2011, the applicant further stated that all employees are required by the governing corrective action procedure to promptly document degraded and non-conforming conditions, and that the definition of degraded includes the effects of aging. Therefore, the staff finds acceptable the sources of plant-specific operating experience because procedures direct plant personnel to enter aging effects into the CAP. Also, the response dated July 11, 2011, provides examples of industry operating experience documents screened under the OEP for applicability to Columbia. The applicant stated that these documents include, but are not limited to, NRC bulletins, information notices, generic letters (GLs), and regulatory issues summaries; reports made in accordance with 10 CFR Part 21, "Reporting of Defects and Noncompliance;" Institute of Nuclear Power Operations (INPO) event reports; and vendor information. The staff also finds acceptable the sources of industry operating experience because the OEP prescribes reviews of operating experience from what the staff considers to be the primary providers of industry operating experience information (i.e., NRC, other nuclear power plants through INPO, and vendors). The NRC previously endorsed use of the INPO program as the mechanism for the central collection and screening of all events from both United States and foreign nuclear plants in GL 82-04, "Use of INPO SEE-IN Program," dated March 9, 1982. The staff also finds acceptable the sources of industry operating experience because, although certain sources are prescribed, the OEP is not limited to only their consideration.

Third, the staff evaluated the completion and prioritization of operating experience evaluations. The applicant's response dated July 11, 2011, states that, "[t]he CAP identifies required due dates commensurate with the safety significance of the condition provided reasonable efforts are made to complete the corrective actions promptly or at the first available opportunity unless appropriate justification is provided for a longer completion schedule." In the response dated November 10, 2011, the applicant described the resolution of condition reports entered into the CAP:

> Each working day, the [condition reports] that were generated from the previous day (or previous days if on a Monday) are compiled in a report for individual department reviews. A corrective action review group assigns priorities and owners to each [condition report]. They receive input from departmental reviews. Management reviews of newly issued [condition reports] are conducted to ensure that the correct responsible owner and significance are identified.

In addition, the applicant stated that departments assigned with responsibility to respond to condition reports have 30 days to initially address the identified conditions and that further responses are managed in accordance with the safety significance of each identified condition. Concerning the evaluation of operating experience under the OEP, the applicant's response dated November 10, 2011, states that weekly screening meetings with select department leads are held to review and discuss operating experience source documents to identify any susceptibility at Columbia to similar events. Concerning the completion schedule, the applicant further stated that operating experience evaluations are assigned with a due date 60 days from initiation and actions identified out of the evaluation are given a due date of 180 days, or less if warranted, and exceptions are controlled by procedure. The staff finds acceptable the applicant's processes under the CAP and OEP for the completion and prioritization of plant-specific and industry operating experience evaluations because these processes include provisions to ensure the timely completion of operating experience evaluations and take into account the significance of operating experience issues.

Fourth, the staff evaluated how the applicant will document the operating experience evaluations. In its response dated November 10, 2011, the applicant stated that all condition reports entered in the CAP and all operating experience reports entered in the OEP are reviewed to determine if it is, or potentially is, related to aging. If so, the applicant stated that it receives an aging assessment and an AMP owner determines whether a detailed review is necessary. The applicant stated that these reviews are maintained in a retrievable and auditable form in an electronic database. Therefore, the staff finds acceptable the applicant's documentation of the operating experience evaluations because it is retained in an auditable and retrievable form.

Fifth, the staff evaluated how the applicant will implement enhancements to the aging management activities, as identified through the operating experience evaluations. The applicant's response dated July 11, 2011, states that the CAP is entered when safety- or nonsafety-related equipment is degraded or not performing as expected or per design, and the definition of degraded includes the effects of aging. The response additionally states that, if an evaluation under the OEP identifies a condition adverse to quality or a non-conformance, then the condition is entered into the CAP to ensure that it is promptly reviewed and corrected. The staff finds the applicant's process for implementing enhancements to the aging management activities acceptable because the enhancements will be implemented through the CAP, which is used to meet the requirements of 10 CFR Part 50, Appendix B. Criterion XVI, "Corrective Action," of this appendix requires measures to assure the prompt identification and correction of conditions adverse to quality.

Sixth, the staff evaluated the administrative controls over the programmatic activities for the ongoing review of operating experience. The response dated June 23, 2011, states that revisions to the procedures governing the CAP and OEP are approved by the owner organization (i.e., the applicant), in addition to any other reviews designated by the owner organization, and are reviewed for technical accuracy by a minimum of two technical reviewers who are knowledgeable in the affected subject matter. The response also states that, in accordance with UFSAR Section 17.2, "Quality Assurance during the Operations Phase," the quality assurance program during the operations phase discusses both the CAP and OEP. In accordance with 10 CFR 50.54(a)(1) and 10 CFR 50.34(b)(6)(ii), this program must meet the requirements of 10 CFR Part 50, Appendix B. Criterion XVIII, "Audits," of this appendix requires a comprehensive system of planned and periodic audits to verify compliance with all aspects of the quality assurance program and to determine the effectiveness of the program. Therefore, the staff finds acceptable the administrative controls on the programmatic activities for the ongoing review of operating experience because these controls include a formal review and approval process and periodic audits to verify program effectiveness.

Seventh, the staff evaluated the applicant's identification of operating experience as related to aging. The applicant's response dated November 10, 2011, states that the License Renewal Implementation Coordinator (LRIC) will evaluate all condition reports under the CAP and all operating experience reports under the OEP to identify failures or degradations that may be related to aging effects on passive and long-lived SSCs, and those reports identified as being, or potentially being, related to aging will be identified with the key word "aging." In addition, the response states that the LRIC is required to complete training related to aging issues. Specifically, the response states that this training covers the identification of SSCs and their materials, environments, aging effects, aging mechanisms, and associated AMPs as identified in the GALL Report, and the scoping, screening, and AMR criteria in NEI 95-10. The staff finds acceptable the applicant's process for identifying operating experience as related to aging because all operating experience items submitted into the CAP and OEP will be reviewed for and identified as involving potential aging issues, and these reviews will be completed by an individual who has received training on aging related topics.

Eighth, the staff evaluated the applicant's consideration of guidance as operating experience. In particular, the issue of concern is whether the applicant acknowledges information from certain documents and publications in its consideration of sources of operating experience, as the content of these documents may contain lessons learned applicable to aging management. The primary example of such a document is a revision to the GALL Report, which provides historical information and lessons learned in response to operating experience information over a period of time, particularly on aging management issues. Due to lag in documenting historical issues, it is expected that the operating experience in these documents already will have been identified and evaluated through other vehicles, such as NRC generic communications. Nevertheless, it is important to still consider the historical lessons learned in these guidance documents to ensure completeness of issues previously identified and provide a check or verification of the previous evaluations. The applicant's response dated November 10, 2011, specifically states that the OEP uses various source documents, including LR-ISG and revisions to the GALL Report, for applicable operating experience reports; however, the OEP also does not limit what documents may be used as sources. The response further states that AMPs are covered by a plant procedure which requires periodic self-assessments. If a self-assessment finds areas, programs, or processes which require further investigation to determine if a gap exists between the program and industry standards, the response states that the CAP is used to address the gap. The staff finds acceptable the applicant's consideration of guidance as operating experience because, in addition to the sources previously identified, the applicant will review LR-ISG and revisions to the GALL Report, NRC-generated documents which provide operating experience related to aging issues. The staff also finds the applicant's consideration of guidance acceptable because the OEP is not limited to a prescribed list of sources and, thereby, facilitates the capture and review of other guidance documents. In addition, periodic self assessments will be used to identify gaps between the applicant's programs and industry standards. These assessments will provide a means to identify other sources of guidance for review as operating experience.

Ninth, the staff evaluated the information the applicant will consider in the operating experience evaluations. The applicant's response dated November 10, 2011, states that all condition reports under the CAP and all operating experience reports under the OEP will be evaluated to identify failures or degradations that may be related to aging effects on passive and long-lived SSCs, and those issues identified as, or potentially, related to aging will be identified with the key word "aging." The response states that these items then receive an aging assessment for SSCs, materials, environments, aging effects, and aging mechanisms, and to determine if there is an existing AMP that covers the issue or if a new AMP may be required. The response then states that a determination is made as to whether a detailed review by AMP owners is necessary and, if so, the applicable AMP owners review the issue for affected SSCs, materials, environments, aging effects, and aging mechanisms to determine if adjustments to the frequency of future inspections or new inspections are necessary, and a detailed review is performed of component, material, environment, and aging effect combinations. The staff finds acceptable the information that will be considered in the applicant's operating experience reviews because the reviews will identify potential aging issues and consider the fundamental components of an AMR, namely the potentially affected plant SSCs, materials, environments, aging effects, aging mechanisms, and AMPs. Consideration of this information in the operating experience reviews will help to address all potential impacts to the aging management activities.

Tenth, the staff evaluated the applicant's consideration of AMP implementation results as operating experience. The applicant's response dated November 10, 2011, states that degraded and non-conforming conditions identified during AMP inspections or program activities are entered as condition reports into the CAP. The response also states that, by procedure, AMP owners are required to review data collected by the program, initiate condition reports for any unsatisfactory conditions to ensure it will be addressed and corrected, maintain required records for the program, maintain the program current, and implement revisions to the program as needed based on program results and internal or external operating experience. The staff finds the applicant's consideration of the AMP inspection results acceptable because unsatisfactory results will be entered into the CAP, which is used to evaluate plant-specific operating experience. The staff also finds the applicant's response acceptable because data collected by the AMPs will be reviewed and revisions to the programs will be implemented as necessary, which will further help to ensure the program is effective.

Eleventh, the staff evaluated the training of plant personnel involved with the submission and processing of operating experience. The applicant's response dated November 10, 2011, describes training for three types of personnel: (1) the LRIC; (2) AMP owners; and (3) other plant personnel, such as system engineers, equipment operators, and maintenance personnel. As previously discussed, the applicant's response describes the responsibilities of the LRIC as screening all operating experience items in the CAP and OEP to identify potential aging issues, assessing these issues, and determining when detailed evaluations by the AMP owners are necessary. The LRIC also identifies when internal operating experience related to aging should be communicated to the industry. As to training, the response states that the LRIC is required to have training on the identification of SSCs and their materials, environments, aging effects, aging mechanisms, and associated AMPs as identified in the GALL Report, and the scoping, screening, and AMR criteria in NEI 95-10. The response also states that the LRIC is responsible for maintaining involvement in industry groups concerning license renewal. Also, as described in the response, AMP owners perform detailed evaluations of operating experience issues, review data collected by the AMPs, initiate conditions reports in the CAP for unsatisfactory conditions, maintain the AMPs current, and implement revisions as needed based on program results and internal or external operating experience. As to training of the AMP owners, the response states that it receives training on the identification of SCs and their materials, environments, aging effects, and aging mechanisms associated with their particular AMP, as discussed in the GALL Report and the LRA; the scoping, screening, and AMR criteria in NEI 95-10; and the applicable Electric Power Research Institute tools for the AMP's discipline. The response also states that each AMP has both a primary and backup owner and each are subject to this training, as are new AMP owners. In addition, the applicant's response describes the responsibilities of other plant personnel, such as system engineers and maintenance personnel, as being required to promptly document in condition reports discovered degraded and non-conforming conditions, including the effects of aging. As to training of these personnel, the response states that aging management training has been provided to all system engineers as well as other engineering personnel on the identification and detection of aging issues, and subsequent training is planned for the engineering staff on a recurring basis. The response also states that periodic training on identifying aging issues will be provided to equipment operators, maintenance personnel, and other plant personnel that access the plant on a routine basis. The staff finds the applicant’s training of plant personnel acceptable because the primary personnel responsible for screening, evaluating, and submitting operating experience issues will receive training on aging related topics. The staff also finds the applicant’s training acceptable because it will be periodic and will be required of personnel new to their positions.

Twelfth, the staff evaluated the reporting of Columbia’s operating experience to the industry. The applicant’s response dated November 10, 2011, states that noteworthy internal operating experience is shared with the industry. The response further states that guidance will be provided on sharing operating experience related to license renewal issues, such as aging effects or mechanisms not previously identified; changes to AMPs that would be of interest to the industry, like new testing methods, acceptance criteria, or preventive measures; and results of inspections that would be of interest to the industry. In addition, the response states that the LRIC is the individual responsible for identifying internal operation experience that should be shared with the industry. As previously described, the LRIC is required to complete training related to aging issues. The staff finds acceptable the applicant’s guidelines for reporting internal operating experience to the industry because it addresses aging issues and because the identification of noteworthy operating experience will be from an individual with training on aging topics. This reporting of operating experience to the industry is consistent with the NRC’s endorsement of the INPO program in GL 82-04.

Thirteenth and last, the staff evaluated the implementation schedule for the operating experience review activities described by the applicant. The applicant’s response dated December 16, 2011, states that all operating experience is currently being screened for aging of passive and long-lived SCs and further evaluation, as applicable, is performed by personnel trained in the requirements of license renewal scoping, screening, and AMRs. In addition, the response states that some activities currently require further action, specifically the issuance of a procedure and periodic training on the identification of aging issues for appropriate plant personnel. However, the applicant’s response also states that these activities are described in the UFSAR supplement and when this supplement is incorporated into the UFSAR, it will accurately describe the operating experience review activities, including those activities related to training. As discussed below in SER Section 3.0.5.3, the staff finds that the UFSAR supplement adequately describes the programmatic activities for the ongoing review of operating experience, including those aspects specific to the review of operating experience related to aging issues. When a renewed license is issued in accordance with 10 CFR 54.3(c), this description will be incorporated into the CLB and, at that time, the applicant will be obligated to conduct its operating experience review activities accordingly. The implementation date is when the NRC issues a renewed license. The staff finds this implementation schedule acceptable because the operating experience review activities described in the applicant’s responses will be implemented throughout the term of the renewed operating license.

Based on its review of the applicant’s response to RAI B.1.4-1, the staff determined that the response only provides a general description of the processes used to evaluate operating experience on an ongoing basis. Therefore, the staff issued RAI B.1.4-2 to request specific information on how aging related issues are covered under the operating experience review processes. By letter dated November 10, 2011, the applicant responded to RAI B.1.4- 2 with additional information on the CAP and OEP as it relates to the aging management process. In this response, the applicant also supplemented the UFSAR supplement with details on how the processes and procedures for the review of operating experience address aging issues.

3.0.5.3 UFSAR Supplement

The staff reviewed the UFSAR supplement in LRA Appendix A to determine whether the applicant provided an adequate summary description of the programmatic activities for the ongoing review of operating experience. As the staff found no such description, it also requested in RAI B.1.4-1 that the applicant provide a description of these activities for the UFSAR supplement required by 10 CFR 54.21(d).

In its response dated June 23, 2011, the applicant stated that a CLB document, the operational quality assurance program description, discusses both the CAP and OEP; however, the applicant did not provide a summary description for the UFSAR supplement. As such, on July 6, 2011, the staff held a teleconference with the applicant to discuss the need for such a description in the UFSAR supplement. In follow-up, on July 11, 2011, the applicant submitted a revised response to RAI B.1.4-1, in which it provided the following summary description of the operating experience review activities for the UFSAR supplement:

> Internal and external operating experience is reviewed in accordance with the [Operational Quality Assurance Program Description]. The review assures the existing, new, and any future required aging management programs necessary to provide reasonable assurance that components within the scope of license renewal will continue to perform its intended functions consistent with the current licensing basis (CLB) for the period of extended operation.

The staff reviewed this UFSAR supplement description against the acceptance criteria in SRP-LR Sections 3.1.2.5, 3.2.2.5, 3.3.2.5, 3.4.2.5, 3.5.2.5, and 3.6.2.5. In accordance with these sections, the summary description should be sufficiently comprehensive such that later changes can be controlled by 10 CFR 50.59. With respect to these criteria, the staff determined that this summary description is not sufficiently comprehensive. It states that operating experience is reviewed, but it does not state directly the outcome of these reviews (i.e., that the review of both plant-specific and industry operating experience ensures that the AMPs are effective to manage the aging effects for which it is credited and that the programs are either enhanced or new programs are developed when the review of operating experience indicates that the programs may not be effective). As such, in teleconferences held on August 3 and 4, 2011, the staff requested the applicant to clarify the UFSAR summary description provided in the applicant's letter dated July 11, 2011.

By letter dated August 10, 2011, the applicant provided this revised entry to the UFSAR supplement:

> The existing Corrective Action Program and the Operating Experience Program ensure, through the continual review of both plant-specific and industry operating experience, that the license renewal aging management programs are effective to manage the aging effects for which it is credited. The aging management programs are either enhanced or new programs are developed when the review of operating experience indicates that the aging management programs may not be effective. For each aging management program listed in this section, operating experience is reviewed on a continuing basis.

This issue was open item OI B.1.4-1 in the SER with open items.

Based on its review of the applicant's response to RAI B.1.4-1, the staff determined that the response only provides a general description of the processes used to evaluate operating experience on an ongoing basis. Therefore, the staff issued RAI B.1.4-2 to request specific information on how aging related issues are addressed under the processes. By letter dated November 10, 2011, the applicant responded to RAI B.1.4- 2 with additional information on the CAP and OEP as it relates to the aging management process. In this response, the applicant also supplemented the UFSAR supplement with details on how the processes and procedures for the review of operating experience address aging issues.

Also, in its letter dated December 16, 2011, the applicant further supplemented the UFSAR supplement entry with additional details on training associated with the operating experience review activities. The applicant provided this supplement in response to discussions with the staff during teleconferences held on December 6, 2011, and December 15, 2011.

Based on the information provided in letters dated and August 10, 2011, November 10, 2011, and December 16, 2011, the full summary description of the ongoing operating experience review activities for UFSAR supplement Section A.1.2 is:

> The existing Corrective Action Program and the Operating Experience Program ensure, through the continual review of both plant-specific and industry operating experience, that the license renewal aging management programs are effective to manage the aging effects for which it is credited. The aging management programs are either enhanced or new programs are developed when the review of operating experience indicates that the aging management programs may not be effective. For each aging management program listed in this section, operating experience is reviewed on a continuing basis.
>
> The processes and procedures for the review of operating experience address the following points:
>
> - All operating experience is screened for aging of long lived passive structures or components and further evaluation as applicable is performed by personnel trained in the requirements of license renewal scoping, screening, and aging management reviews (aging effects and mechanisms). The evaluation is completed and prioritized commensurate with the potential significance of the issue. Such evaluations are documented and retained in an auditable and retrievable form.
> - Periodic training for system engineers, equipment operators and maintenance personnel specific to identifying aging issues.
> - The License Renewal program lead is trained in the requirements of license renewal scoping, screening, and aging management reviews (aging effects and mechanisms).
> - Aging management program owners are trained in the requirements of license renewal scoping, screening, and aging management reviews (aging effects and mechanisms) associated with their particular aging management program.
> - When it is determined that enhancements are necessary to adequately manage the effects of aging, the enhancements are entered into and implemented

consistent with the plant corrective action program or operating experience program, as applicable. Enhancements can include, as appropriate, modifications to AMPs or the creation and implementation of new AMPs.

- Operating experience that is related to aging of long lived passive structures or components is keyword tagged “Aging.”
- The processes are adequate so as to not preclude the consideration of operating experience related to aging management. The processes appropriately gather information on all structures and components within the scope of license renewal, and their materials, environments, aging effects, and aging mechanisms. In addition, the processes include the AMPs credited for managing the effects of aging, and the activities under these AMPs (e.g., inspection methods, preventive actions, evaluation techniques, etc.).
- While the programs and procedures may specify reviews of certain sources of information, such as NRC generic communications and Institute of Nuclear Power Operations reports, they allow for any potential source of relevant plant-specific or industry operating experience information.
- AMP owners review data collected by the AMPs, utilize the corrective action program for any conditions that are unsatisfactory to ensure they will be addressed and corrected, maintain required records for the program and maintain the program current and implement revisions as needed based on program results and internal or external operating expectance [sic].
- Provide guidance on sharing internal operating experience related to license renewal issues with the industry.

The staff reviewed this description and determines that it adequately summarizes the programmatic activities for the ongoing review of operating experience, including those aspects specific to the review of operating experience related to aging. The staff also determines that this summary description is sufficiently comprehensive such that later changes can be controlled by 10 CFR 50.59 and, as such, the summary description meets the acceptance criteria in SRP-LR Sections 3.1.2.5, 3.2.2.5, 3.3.2.5, 3.4.2.5, 3.5.2.5, and 3.6.2.5. The staff's concern in OI B.1.4-1 is closed.

3.0.5.4 Conclusion

On the basis of its review of the applicant’s programmatic activities for the ongoing review of operating experience and closure of open item OI B.1.4-1, the staff concludes that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for these activities and concludes that it provides an adequate summary description, as required by 10 CFR 54.21(d).

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

This section of the SER documents the staff’s review of the applicant’s AMR results for the RCS components and component groups of the following systems:

- RPV
- RVI
- RCPB

3.1.1 Summary of Technical Information in the Application

LRA Section 3.1 provides AMR results for the RPV, RVI, and RCPB. LRA Table 3.1.1, "Summary of Aging Management Evaluations for the Reactor Vessel, Internals and Reactor Coolant System," is a summary comparison of the applicant's AMRs with those evaluated in the GALL Report for the RPV, RVI, and RCPB components and component groups.

The applicant's AMRs evaluated and incorporated applicable plant-specific and industry operating experience in the determination of AERMs. The plant-specific evaluation included issue reports and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry operating experience included a review of the GALL Report and operating experience issues identified since the issuance of the GALL Report.

3.1.2 Staff Evaluation

The staff reviewed LRA Section 3.1 to determine if the applicant provided sufficient information to demonstrate that the effects of aging for the RPV, RVI, and RCPB components within the scope of license renewal and subject to an AMR, will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff conducted an onsite audit of AMPs to ensure the applicant's claim that certain AMPs were consistent with the GALL Report. The purpose of this audit was to examine the applicant's AMPs and related documentation and to verify the applicant's claim of consistency with the corresponding GALL Report AMPs. The staff did not repeat its review of the matters described in the GALL Report. The staff's evaluations of the AMPs are documented in SER Section 3.0.3.

The staff reviewed the AMRs to confirm the applicant's claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. Details of the staff's evaluation are discussed in SER Sections 3.1.2.1 and 3.1.2.2.

The staff also reviewed the AMRs not consistent with, or not addressed in, the GALL Report. The review evaluated whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. Details of the staff's evaluation are discussed in SER Section 3.1.2.3.

For components that the applicant claimed were not applicable or required no aging management, the staff reviewed the AMR line items and the plant's operating experience to verify the applicant's claims.

Table 3.1-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.1 and addressed in the GALL Report.

Table 3.1-1 Staff evaluation for RV, RVI, and RCS components in the GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel pressure vessel support skirt and attachment welds (3.1.1-01)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA	Fatigue is a TLAA (See SER Section 3.1.2.2.1)
Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy RV components: flanges; nozzles; penetrations; safe ends; thermal sleeves; vessel shells, heads, and welds (3.1.1-02)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes	TLAA	Fatigue is a TLAA (See SER Section 3.1.2.2.1)
Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy RCPB piping, piping components, and piping elements exposed to reactor coolant (3.1.1-03)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes	TLAA	Fatigue is a TLAA (See SER Section 3.1.2.2.1)
Steel pump and valve closure bolting (3.1.1-04)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) check Code limits for allowable cycles (less than 7,000 cycles) of thermal stress-range	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.1.2.2.1)
Stainless steel and nickel-alloy RVI components (3.1.1-05)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA	Fatigue is a TLAA (See SER Section 3.1.2.2.1)
Nickel-alloy tubes and sleeves in a reactor coolant and secondary FW/steam environment (3.1.1-06)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel and stainless steel RCPB closure bolting, head closure studs, support skirts and attachment welds, pressurizer relief tank components, steam generator components, piping and components external surfaces and bolting (3.1.1-07)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.1)
Steel; stainless steel; and nickel-alloy RCPB piping, piping components, piping elements; flanges; nozzles and safe ends; pressurizer vessel shell heads and welds; heater sheaths and sleeves; penetrations; and thermal sleeves (3.1.1-08)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.1)
Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy RV components: flanges; nozzles; penetrations; pressure housings; safe ends; thermal sleeves; vessel shells, heads, and welds (3.1.1-09)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.1)
Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy steam generator components (flanges; penetrations; nozzles; safe ends, lower heads, and welds) (3.1.1-10)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.1)
Steel top head enclosure (without cladding) top head nozzles (vent, top head spray or RCIC, and spare) exposed to reactor coolant (3.1.1-11)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Water Chemistry and One-Time Inspection	Consistent with GALL Report (See SER Section 3.1.2.2.2)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel steam generator shell assembly exposed to secondary FW and steam (3.1.1-12)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.2)
Steel and stainless steel isolation condenser components exposed to reactor coolant (3.1.1-13)	Loss of material due to general (steel only), pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Water Chemistry and One-Time Inspection	Consistent with GALL Report (See SER Section 3.1.2.2.2)
Stainless steel, nickel-alloy, and steel with nickel-alloy or stainless steel cladding RV flanges, nozzles, penetrations, safe ends, vessel shells, heads, and welds (3.1.1-14)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Water Chemistry and One-Time Inspection	Consistent with GALL Report (See SER Section 3.1.2.2.2)
Stainless steel; steel with nickel-alloy or stainless steel cladding; and nickel-alloy RCPB components exposed to reactor coolant (3.1.1-15)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Water Chemistry and One-Time Inspection	Consistent with GALL Report (See SER Section 3.1.2.2.2)
Steel steam generator upper and lower shell and transition cone exposed to secondary FW and steam (3.1.1-16)	Loss of material due to general, pitting and crevice corrosion	ISI (IWB, IWC, and IWD) and Water Chemistry and, for Westinghouse Model 44 and 51 S/G, if general and pitting corrosion of the shell is known to exist, additional inspection procedures are to be developed.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.2)
Steel (with or without stainless steel cladding) RV beltline shell, nozzles, and welds (3.1.1-17)	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA, evaluated in accordance with 10 CFR 50, Appendix G, and RG 1.99. The applicant may choose to demonstrate that the materials of the nozzles are not controlling for the TLAA evaluations.	Yes	TLAA	Loss of fracture toughness is a TLAA (See SER Section 3.1.2.2.3)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel (with or without stainless steel cladding) RV beltline shell, nozzles, and welds; safety injection nozzles (3.1.1-18)	Loss of fracture toughness due to neutron irradiation embrittlement	RV Surveillance	Yes	Reactor Vessel Surveillance	Consistent with GALL Report (See SER Section 3.1.2.2.3)
Stainless steel and nickel-alloy top head enclosure vessel flange leak detection line (3.1.1-19)	Cracking due to SCC and IGSCC	A plant-specific AMP is to be evaluated.	Yes	Small Bore Class 1 Piping, BWR Water Chemisty, Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.1.2.2.4)
Stainless steel isolation condenser components exposed to reactor coolant (3.1.1-20)	Cracking due to SCC and IGSCC	ISI (IWB, IWC, and IWD), Water Chemistry, and plant-specific verification program	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.1.2.2.4)
RV shell fabricated of SA508-Cl 2 forgings clad with stainless steel using a high-heat-input welding process (3.1.1-21)	Crack growth due to cyclic loading	TLAA	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.5)
Stainless steel and nickel-alloy RVI components exposed to reactor coolant and neutron flux (3.1.1-22)	Loss of fracture toughness due to neutron irradiation embrittlement and void swelling	UFSAR supplement commitment to: (1) participate in industry RVI aging programs, (2) implement applicable results, and (3) submit for NRC approval, > 24 months before the period of extended operation, an RVI inspection plan based on industry recommendation.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.6)
Stainless steel RV closure head flange leak detection line and bottom-mounted instrument guide tubes (3.1.1-23)	Cracking due to SCC	A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.7)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Class 1 CASS piping, piping components, and piping elements exposed to reactor coolant (3.1.1-24)	Cracking due to SCC	Water Chemistry and, for CASS components that do not meet the NUREG-0313 guidelines, a plant-specific AMP	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.7)
Stainless steel jet pump sensing line (3.1.1-25)	Cracking due to cyclic loading	A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.1.2.2.8)
Steel and stainless steel isolation condenser components exposed to reactor coolant (3.1.1-26)	Cracking due to cyclic loading	ISI (IWB, IWC, and IWD) and plant-specific verification program	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.1.2.2.8)
Stainless steel and nickel-alloy RVI screws, bolts, tie rods, and hold down springs (3.1.1-27)	Loss of preload due to stress relaxation	UFSAR supplement commitment to: (1) participate in industry RVI aging programs, (2) implement applicable results, and (3) submit for NRC approval, > 24 months before the period of extended operation, an RVI inspection plan based on industry recommendation.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.9)
Steel steam generator FW impingement plate and support exposed to secondary FW (3.1.1-28)	Loss of material due to erosion	A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.10)
Stainless steel steam dryers exposed to reactor coolant (3.1.1-29)	Cracking due to FIV	A plant-specific AMP is to be evaluated.	Yes	BWR Vessel Internals	Consistent with GALL Report (See SER Section 3.1.2.2.11)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Stainless steel RVI components (e.g., upper internals assembly, rod cluster control assembly guide tube assemblies, baffle/former assembly, lower internal assembly, shroud assemblies, plenum cover and plenum cylinder, upper grid assembly, control rod guide tube (CRGT) assembly, core support shield assembly, core barrel assembly, lower grid assembly, flow distributor assembly, thermal shield, and instrumentation support structures) (3.1.1-30)	Cracking due to SCC and irradiation-assisted stress-corrosion cracking (IASCC)	Water Chemistry and UFSAR supplement commitment to: (1) participate in industry RVI aging programs, (2) implement applicable results, and (3) submit for NRC approval, > 24 months before the period of extended operation, an RVI inspection plan based on industry recommendation.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.12)
Nickel alloy and steel with nickel-alloy cladding piping, piping component, piping elements, penetrations, nozzles, safe ends, and welds (other than RV head); pressurizer heater sheaths, sleeves, diaphragm plate, manways and flanges; core support pads/core guide lugs (3.1.1-31)	Cracking due to primary water stress-corrosion cracking (PWSCC)	ISI (IWB, IWC, and IWD) and Water Chemistry and UFSAR supplement commitment to implement applicable plant commitments to NRC Orders, Bulletins, and GLs associated with nickel alloys and staff-accepted industry guidelines.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.13)
Steel steam generator FW inlet ring and supports (3.1.1-32)	Wall thinning due to flow-accelerated corrosion	A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.14)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Stainless steel and nickel-alloy RVI components (3.1.1-33)	Changes in dimensions due to void swelling	UFSAR supplement commitment to: (1) participate in industry RVI aging programs, (2) implement applicable results, and (3) submit for NRC approval, > 24 months before the period of extended operation, an RVI inspection plan based on industry recommendation.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.15)
Stainless steel and nickel-alloy reactor CRD head penetration pressure housings (3.1.1-34)	Cracking due to SCC and PWSCC	ISI (IWB, IWC, and IWD) and Water Chemistry and for nickel alloy, comply with applicable NRC Orders as well as a commitment in the UFSAR supplement to implement applicable Bulletins and GLs and staff-accepted industry guidelines.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.16)
Steel with stainless steel or nickel-alloy cladding primary side components; steam generator upper and lower heads, tubesheets; and tube-to-tube sheet welds (3.1.1-35)	Cracking due to SCC and PWSCC	ISI (IWB, IWC, and IWD) and Water Chemistry and for nickel alloy, comply with applicable NRC Orders, and provide a commitment in the UFSAR supplement to implement applicable Bulletins and GLs and staff-accepted industry guidelines.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.16)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Nickel-alloy, stainless steel pressurizer spray head (3.1.1-36)	Cracking due to SCC and PWSCC	Water Chemistry and One-Time Inspection and for nickel-alloy welded spray heads, comply with applicable NRC Orders, and provide a commitment in the UFSAR supplement to implement applicable Bulletins and GLs and staff-accepted industry guidelines.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.16)
Stainless steel and nickel-alloy RVI components (e.g., upper internals assembly, rod cluster control assembly guide tube assemblies, lower internal assembly, control element assembly (CEA) shroud assemblies, core shroud assembly, core support shield assembly, core barrel assembly, lower grid assembly, flow distributor assembly) (3.1.1-37)	Cracking due to SCC, PWSCC, and IASCC	Water Chemistry and UFSAR supplement commitment to: (1) participate in industry RVI aging programs, (2) implement applicable results, and (3) submit for NRC approval, > 24 months before the period of extended operation, an RVI inspection plan based on industry recommendation.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.2.17)
Steel (with or without stainless steel cladding) CRD return line nozzles exposed to reactor coolant (3.1.1-38)	Cracking due to cyclic loading	BWR CRDRL Nozzle	No	CRDRL Nozzle	Consistent with GALL Report
Steel (with or without stainless steel cladding) FW nozzles exposed to reactor coolant (3.1.1-39)	Cracking due to cyclic loading	BWR FW Nozzle	No	BWR Feedwater Nozzle	Consistent with GALL Report
Stainless steel and nickel-alloy penetrations for CRD stub tubes instrumentation, jet pump instrumentation, SLC, flux monitor, and drain line exposed to reactor coolant (3.1.1-40)	Cracking due to SCC, IGSCC, and cyclic loading	BWR Penetrations and Water Chemistry	No	BWR Penetrations and BWR Water Chemistry	Consistent with GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Stainless steel and nickel-alloy piping, piping components, and piping elements ≥ 4 in. NPS; nozzle safe ends and associated welds (3.1.1-41)	Cracking due to SCC and IGSCC	BWR Stress Corrosion Cracking and Water Chemistry	No	BWR Stress Corrosion Cracking and BWR Water Chemistry	Consistent with GALL Report
Stainless steel and nickel-alloy vessel shell attachment welds exposed to reactor coolant (3.1.1-42)	Cracking due to SCC and IGSCC	BWR Vessel ID Attachment Welds and Water Chemistry	No	BWR Vessel ID Attachment Welds and BWR Water Chemistry	Consistent with GALL Report
Stainless steel fuel supports and CRD assemblies CRD housing exposed to reactor coolant (3.1.1-43)	Cracking due to SCC and IGSCC	BWR Vessel Internals and Water Chemistry	No	BWR Vessel Internals and BWR Water Chemistry	Consistent with GALL Report
Stainless steel and nickel-alloy core shroud, core plate, core plate bolts, support structure, top guide, core spray lines, spargers, jet pump assemblies, CRD housing, nuclear instrumentation guide tubes (3.1.1-44)	Cracking due to SCC, IGSCC, and IASCC	BWR Vessel Internals and Water Chemistry	No	BWR Vessel Internals and BWR Water Chemistry	Consistent with GALL Report
Steel piping, piping components, and piping elements exposed to reactor coolant (3.1.1-45)	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	No	Flow-Accelerated Corrosion	Consistent with GALL Report
Nickel-alloy core shroud and core plate access hole cover (mechanical covers) (3.1.1-46)	Cracking due to SCC, IGSCC, and IASCC	ISI (IWB, IWC, and IWD), and Water Chemistry	No	ISI and BWR Water Chemistry	Consistent with GALL Report
Stainless steel and nickel-alloy RVI exposed to reactor coolant (3.1.1-47)	Loss of material due to pitting and crevice corrosion	ISI (IWB, IWC, and IWD) and Water Chemistry	No	ISI and BWR Water Chemistry	Consistent with GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel and stainless steel Class 1 piping, fittings, and branch connections < NPS 4 in. exposed to reactor coolant (3.1.1-48)	Cracking due to SCC, IGSCC (for stainless steel only), and thermal and mechanical loading	ISI (IWB, IWC, and IWD), Water Chemistry, and One-Time Inspection of ASME Code Class 1 Small Bore Piping	No	ISI; BWR Water Chemistry; and Small Bore Class 1 Piping	Consistent with GALL Report (See SER Section 3.1.2.1.3)
Nickel-alloy core shroud and core plate access hole cover (welded covers) (3.1.1-49)	Cracking due to SCC, IGSCC, and IASCC	ISI (IWB, IWC, and IWD), Water Chemistry, and, for BWRs with a crevice in the access hole covers, augmented inspection using UT, or other demonstrated acceptable inspection of the access hole cover welds	No	ISI and BWR Water Chemistry	Consistent with GALL Report
High-strength low-alloy steel top head closure studs and nuts exposed to air with reactor coolant leakage (3.1.1-50)	Cracking due to SCC and IGSCC	Reactor Head Closure Studs	No	Reactor Head Closure Studs	Consistent with GALL Report
CASS jet pump assembly castings; orificed fuel support (3.1.1-51)	Loss of fracture toughness due to thermal aging and neutron irradiation embrittlement	Thermal Aging and Neutron Irradiation Embrittlement of CASS	No	Thermal Aging and Neutron Irradiation Embrittlement of CASS	Consistent with GALL Report
Steel and stainless steel RCPB pump and valve closure bolting, manway and holding bolting, flange bolting, and closure bolting in high-pressure and high-temperature systems (3.1.1-52)	Cracking due to SCC, loss of material due to wear, loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	Bolting Integrity	Consistent with GALL Report
Steel piping, piping components, and piping elements exposed to closed-cycle cooling water (3.1.1-53)	Loss of material due to general, pitting, and crevice corrosion	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.1.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Copper alloy piping, piping components, and piping elements exposed to closed-cycle cooling water (3.1.1-54)	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.1.2.1.1)
CASS Class 1 pump casings and valve bodies and bonnets exposed to reactor coolant > 250 °C (> 482 °F) (3.1.1-55)	Loss of fracture toughness due to thermal aging embrittlement	ISI (IWB, IWC, and IWD). Thermal aging susceptibility screening is not necessary, ISI requirements are sufficient for managing these aging effects. ASME Code Case N-481 also provides an alternative for pump casings.	No	ISI and Small Bore Class 1 Piping	Consistent with GALL Report (See SER Section 3.1.2.1.2)
Copper alloy > 15% Zn piping, piping components, and piping elements exposed to closed-cycle cooling water (3.1.1-56)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Not applicable	Not applicable to Columbia (See SER Section 3.1.2.1.1)
CASS Class 1 piping, piping components, and piping elements and CRD pressure housings exposed to reactor coolant > 250 °C (> 482 °F) (3.1.1-57)	Loss of fracture toughness due to thermal aging embrittlement	Thermal Aging Embrittlement of CASS	No	Not applicable	Not applicable to Columbia (See SER Sections 3.1.2.1.1)
Steel RCPB external surfaces exposed to air with borated water leakage (3.1.1-58)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Steel steam generator steam nozzle and safe end, FW nozzle and safe end, auxiliary feedwater nozzles and safe ends exposed to secondary FW/steam (3.1.1-59)	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Stainless steel flux thimble tubes (with or without chrome plating) (3.1.1-60)	Loss of material due to wear	Flux Thimble Tube Inspection	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Stainless steel, steel pressurizer integral support exposed to air with metal temperature up to 288 °C (550 °F) (3.1.1-61)	Cracking due to cyclic loading	ISI (IWB, IWC, and IWD)	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Stainless steel, steel with stainless steel cladding RCS cold leg, hot leg, surge line, and spray line piping and fittings exposed to reactor coolant (3.1.1-62)	Cracking due to cyclic loading	ISI (IWB, IWC, and IWD)	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Steel RV flange, stainless steel and nickel-alloy RVI exposed to reactor coolant (e.g., upper and lower internals assembly, CEA shroud assembly, core support barrel, upper grid assembly, core support shield assembly, lower grid assembly) (3.1.1-63)	Loss of material due to wear	ISI (IWB, IWC, and IWD)	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Stainless steel and steel with stainless steel or nickel-alloy cladding pressurizer components (3.1.1-64)	Cracking due to SCC and PWSCC	ISI (IWB, IWC, and IWD) and Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Nickel-alloy RV upper head and CRD penetration nozzles, instrument tubes, head vent pipe (top head), and welds (3.1.1-65)	Cracking due to PWSCC	ISI (IWB, IWC, and IWD) and Water Chemistry and Nickel-Alloy Penetration Nozzles Welded to the Upper RV Closure Heads of PWRs	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Steel steam generator secondary manways and handholds (cover only) exposed to air with leaking secondary side water or steam or both (3.1.1-66)	Loss of material due to erosion	ISI (IWB, IWC, and IWD) for Class 2 components	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel with stainless steel or nickel-alloy cladding or stainless steel pressurizer components exposed to reactor coolant (3.1.1-67)	Cracking due to cyclic loading	ISI (IWB, IWC, and IWD) and Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Stainless steel, steel with stainless steel cladding Class 1 piping, fittings, pump casings, valve bodies, nozzles, safe ends, manways, flanges, CRD housing; pressurizer heater sheaths, sleeves, diaphragm plate; pressurizer relief tank components, RCS cold leg, hot leg, surge line, and spray line piping and fittings (3.1.1-68)	Cracking due to SCC	ISI (IWB, IWC, and IWD) and Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Stainless steel, nickel-alloy safety injection nozzles, safe ends, and associated welds and buttering exposed to reactor coolant (3.1.1-69)	Cracking due to SCC and PWSCC	ISI (IWB, IWC, and IWD) and Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Stainless steel; steel with stainless steel cladding Class 1 piping, fittings, and branch connections < NPS 4 in. exposed to reactor coolant (3.1.1-70)	Cracking due to SCC and thermal and mechanical loading	ISI (IWB, IWC, and IWD), Water Chemistry, and One-Time Inspection of ASME Code Class 1 Small-bore Piping	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
High-strength low-alloy steel closure head stud assembly exposed to air with reactor coolant leakage (3.1.1-71)	Cracking due to SCC and loss of material due to wear	Reactor Head Closure Studs	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Nickel-alloy steam generator tubes and sleeves exposed to secondary FW/steam (3.1.1-72)	Cracking due to outside-diameter stress-corrosion cracking (ODSCC) and intergranular attack, and loss of material due to fretting and wear	Steam Generator Tube Integrity and Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Nickel-alloy steam generator tubes, repair sleeves, and tube plugs exposed to reactor coolant (3.1.1-73)	Cracking due to PWSCC	Steam Generator Tube Integrity and Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Chrome plated steel, stainless steel and nickel-alloy steam generator anti-vibration bars exposed to secondary FW/steam (3.1.1-74)	Cracking due to SCC and loss of material due to crevice corrosion and fretting	Steam Generator Tube Integrity and Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Nickel-alloy once-through steam generator tubes exposed to secondary FW/steam (3.1.1-75)	Denting due to corrosion of carbon steel tube support plate	Steam Generator Tube Integrity and Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Steel steam generator tube support plate, tube bundle wrapper exposed to secondary FW/steam (3.1.1-76)	Loss of material due to erosion, general, pitting, and crevice corrosion and ligament cracking due to corrosion	Steam Generator Tube Integrity and Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Nickel-alloy steam generator tubes and sleeves exposed to phosphate chemistry in secondary FW/steam (3.1.1-77)	Loss of material due to wastage and pitting corrosion	Steam Generator Tube Integrity and Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Steel steam generator tube support lattice bars exposed to secondary FW/steam (3.1.1-78)	Wall thinning due to flow-accelerated corrosion	Steam Generator Tube Integrity and Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Nickel-alloy steam generator tubes exposed to secondary FW/steam (3.1.1-79)	Denting due to corrosion of steel tube support plate	Steam Generator Tube Integrity; Water Chemistry and, for plants that could experience denting at the upper support plates, evaluate potential for rapidly propagating cracks and then develop and take corrective actions consistent with NRC Bulletin 88-02.	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
CASS RVI (e.g., upper internals assembly, lower internal assembly, CEA shroud assemblies, control rod guide tube assembly, core support shield assembly, lower grid assembly) (3.1.1-80)	Loss of fracture toughness due to thermal aging and neutron irradiation embrittlement	Thermal Aging and Neutron Irradiation Embrittlement of CASS	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Nickel alloy or nickel-alloy clad steam generator divider plate exposed to reactor coolant (3.1.1-81)	Cracking due to PWSCC	Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Stainless steel steam generator primary side divider plate exposed to reactor coolant (3.1.1-82)	Cracking due to SCC	Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Stainless steel, steel with nickel-alloy or stainless steel cladding, and nickel-alloy RVI and RCPB components exposed to reactor coolant (3.1.1-83)	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)
Nickel-alloy steam generator components, such as secondary side nozzles (vent, drain, and instrumentation), exposed to secondary FW/steam (3.1.1-84)	Cracking due to SCC	Water Chemistry and One-Time Inspection, or ISI (IWB, IWC, and IWD)	No	Not applicable	Not applicable to BWRs (See SER Section 3.1.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Nickel-alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled (external) (3.1.1-85)	None	None	No	None	Consistent with GALL Report
Stainless steel piping, piping components, and piping elements exposed to air-indoor uncontrolled (external); air with borated water leakage; concrete; gas (3.1.1-86)	None	None	No	None	Consistent with GALL Report
Steel piping, piping components, and piping elements in concrete (3.1.1-87)	None	None	No	Not applicable	Not applicable to Columbia (See SER Section 3.1.2.1.1)

The staff's review of the RCS component groups followed several approaches. One approach, documented in SER Section 3.1.2.1, discusses the staff's review of AMR results for components that the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.1.2.2, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.1.2.3, discusses the staff's review of AMR results for components that the applicant indicated are not consistent with or not addressed in the GALL Report. The staff's review of AMPs credited to manage or monitor aging effects of the RCS components is documented in SER Section 3.0.3.

3.1.2.1 AMR Results that are Consistent with the GALL Report

LRA Section 3.1.2.1 identifies the materials, environments, AERMs, and the following programs that manage aging effects for the RPV, RVI, and RCPB components:

- Bolting Integrity Program
- BWR FW Nozzle Program
- BWR Penetrations Program
- BWR Stress Corrosion Cracking Program
- BWR Vessel ID Attachment Welds Program
- BWR Vessel Internals Program
- BWR Water Chemistry Program
- Chemistry Program Effectiveness Inspection
- Closed Cooling Water Chemistry Program
- CRDRL Nozzle Program
- External Surfaces Monitoring Program
- Flow-Accelerated Corrosion Program
- Heat Exchangers Inspection

- ISI Program
- ISI Program—IWF
- Reactor Head Closure Studs Program
- RV Surveillance Program
- Small Bore Class 1 Piping Program
- Thermal Aging and Neutron Irradiation Embrittlement of CASS Program
- TLAA

LRA Tables 3.1.2-1 through 3.1.2-3 summarize the results of AMRs for the RPV, RVI, and RCPB components and indicate AMRs claimed to be consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant had claimed consistency and for which the GALL Report does not recommend further evaluation, the staff performed an audit and review to determine whether the plant-specific components in these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant provided a note for each AMR line item describing how the information in the tables aligns with the information in the GALL Report. The staff reviewed those AMRs with Notes A through E, which indicate how the AMR was consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the GALL Report AMP. The staff reviewed these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff reviewed these line items to verify consistency with the GALL Report and to ensure that it had reviewed and accepted the identified exceptions to the GALL Report AMPs. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP is consistent with the AMP identified by the GALL Report. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report; however, the applicant identified a different component in the GALL Report that had the same material, environment, aging effect, and AMP as the component under review. The staff reviewed these line items to verify consistency with the GALL Report. The staff also determined whether the AMR line item of the different component applied to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff reviewed these line items to verify consistency with the GALL Report. The staff confirmed whether the AMR line item of the different component was applicable to the component under review and whether the exceptions to the GALL Report AMPs had been reviewed and accepted by the staff. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The staff reviewed these line items to verify consistency with the GALL Report and determined whether the identified AMP would manage the aging effect consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

The staff audited and reviewed the information in the LRA. The staff did not repeat its review of the matters described in the GALL Report; however, it did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMRs. The staff's evaluation is discussed below.

The staff reviewed the LRA to confirm that the applicant did the following:

- provided a brief description of the system, components, materials, and environments
- stated that the applicable aging effects were reviewed and evaluated in the GALL Report
- identified those aging effects for the RPV, RVI, and RCPB components that are subject to an AMR

On the basis of its audit and review, the staff determines that, for AMRs not requiring further evaluation—as identified in LRA Table 3.1.1—the applicant's references to the GALL Report are acceptable, and no further staff review is required.

3.1.2.1.1 AMR Results Identified as Not Applicable

For line items 3.1.1-58, 3.1.1-59, 3.1.1-60, 3.1.1-61, 3.1.1-62, 3.1.1-63, 3.1.1-64, 3.1.1-65, 3.1.1-66, 3.1.1-67, 3.1.1-68, 3.1.1-69, 3.1.1-70, 3.1.1-71, 3.1.1-72, 3.1.1-73, 3.1.1-74, 3.1.1-75, 3.1.1-76, 3.1.1-77, 3.1.1-78, 3.1.1-79, 3.1.1-80, 3.1.1-81, 3.1.1-82, 3.1.1-83, and 3.1.1-84 in LRA Table 3.1.1 the applicant claimed that the corresponding AMR items in the GALL Report are not applicable because the associated line items are only applicable to PWRs. The staff reviewed the SRP-LR, confirmed these line items only applies to PWRs, and finds these line items are not applicable to Columbia.

LRA Table 3.1.1, line Item 3.1.1-53 addresses steel piping, piping components, and piping elements exposed to closed cycle cooling water subject to loss of material due to general, pitting, and crevice corrosion for this component group. The applicant stated that this line item is not applicable because it has no in-scope steel piping, piping components, or piping elements exposed to closed cycle cooling water in the RCS, so the applicable NUREG-1801 line was not used. The staff reviewed the applicant's UFSAR and confirmed that no in-scope steel piping, piping components, and piping elements exposed to closed cycle cooling water are present in these systems; therefore, the staff finds the applicant's determination acceptable.

LRA Table 3.1.1, line Item 3.1.1-54 addresses copper alloy piping, piping components, and piping elements exposed to closed cycle cooling water subject to loss of material due to pitting, crevice, and galvanic corrosion for this component group. The applicant stated that this line item is not applicable because it has no in-scope copper alloy piping, piping components, or piping elements exposed to closed cycle cooling water in the RV, internals, and RCS, so the applicable NUREG-1801 line was not used. The staff reviewed the applicant's UFSAR and confirmed that no in-scope copper alloy piping, piping components, and piping elements exposed to closed cycle cooling water are present in these systems; therefore, the staff finds the applicant's determination acceptable.

LRA Table 3.1.1, line Item 3.1.1-56 addresses copper alloy greater than15 percent Zn piping, piping components, and piping elements exposed to closed cycle cooling water subject to loss of material due to selective leaching for this component group. The applicant stated that this line item is not applicable because it has no in-scope copper alloy greater than 15 percent Zn components exposed to closed cycle cooling water in the RV, internals, and RCS, so the applicable NUREG-1801 line was not used. The staff reviewed the applicant's UFSAR and confirmed that no in-scope copper alloy greater than 15 percent Zn piping, piping components, and piping elements exposed to closed cycle cooling water are present in these systems; therefore, the staff finds the applicant's determination acceptable.

In LRA Table 3.1.1, Item 3.1.1-57, the applicant stated that this item it is not applicable to the Columbia LRA. The applicant stated that loss of fracture toughness due to thermal aging does not need to be identified and managed for the CASS main steam flow restrictors because it is not part of the RCS pressure boundary, and there is no significant pressure drop across these components; thus, there is no driving force for the propagation of cracks.

GALL Report item IV.C1-2 recommends GALL Report AMP XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)" to manage loss of fracture toughness and thermal aging in CASS BWR piping, piping components, and piping elements (including main steam line flow elements or restrictors) that are exposed to reactor coolant and steam greater than 250ºC (482º F) environment.

By letter dated August 26, 2010, the staff issued RAI 3.1.1-57-01 requesting that the applicant clarify if the CASS main steam flow restrictors had been screened for susceptibility to loss of fracture toughness due to thermal aging embrittlement consistent with GALL Report AMP XI.M12. In its response dated November 23, 2010, the applicant stated that the main steam flow restrictors have been screened for susceptibility to loss of fracture toughness per GALL Report AMP XI.M12. The applicant further stated that the applicant's review of the design specification and certified material test reports for the flow restrictors confirmed that the flow restrictors were constructed by Wisconsin Centrifugal, Inc., from CASS, in conformance with the material Specification SA-351, Grade CF8. The applicant also stated that the certified material test reports did not include an addition of molybdenum; thus, it is considered to be constructed of low molybdenum (0.5 percent maximum) content steel and that, in accordance with guidance provided in the GALL Report AMP XI.M12, centrifugally-cast, low-molybdenum content CASS material is not susceptible to thermal aging embrittlement.

The staff noted that low-molybdenum content CASS material is not susceptible to thermal aging embrittlement if the CASS material is centrifugally-cast. Furthermore, the staff noted that the applicant did not state in its response that the CASS main steam flow restrictors were centrifugally-cast. The staff requested clarification from the applicant that the CASS main steam flow restrictors were centrifugally-cast. By letter dated January 5, 2011, the applicant indicated that the applicant's CASS main steam flow restrictors were centrifugally-cast.

Based on its review, the staff finds the applicant's response to RAI 3.1.1-57-01, supplemented by letter dated January 5, 2011, acceptable because the applicant screened the CASS main steam flow restrictors for susceptibility to loss of fracture toughness due to thermal aging embrittlement, verified that these components were centrifugally-cast low-molybdenum content steel, and determined that these components are not susceptible to this aging effect, consistent with GALL Report AMP XI.M12. The staff's concern described in RAI 3.1.1-57-01 is resolved.

LRA Table 3.1.1, line Item 3.1.1-87 addresses steel piping, piping components, and piping elements in concrete. The GALL Report states that this is not an aging effect requiring aging management. The applicant stated that this line item is not applicable because its RV, internals, and RCS components have no in-scope steel piping, piping components, or piping elements embedded in concrete, so the applicable NUREG-1801 line was not used. The staff reviewed the applicant's UFSAR and confirmed that no in-scope steel piping, piping components, and piping elements in concrete are present in these systems; therefore, the staff finds the applicant's determination acceptable.

3.1.2.1.2 Reduction of Fracture Toughness

LRA Table 3.1.1, Item 3.1.1-55 addresses CASS Class 1 valve bodies (less than or equal to 4 in.) exposed to reactor coolant, which are being managed for reduction of fracture toughness due to thermal aging embrittlement. The LRA credits the Small Bore Class 1 Piping Inspection Program to manage the aging effect for the components. The GALL Report recommends GALL Report AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for the Class 1 components. The associated AMR line items in LRA Table 3.1.2-3 cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M1 recommends using periodic ISI requirements to manage the aging effect of the line items. In its review of the components, which are associated with LRA Item 3.1.1-55, the staff noted that in LRA Table 3.1.2-3, the Small Bore Class 1 Piping Inspection Program is proposed to manage the aging of the CASS components through a one-time inspection of internal surfaces, and Generic Note E is cited for the valve bodies (less than or equal to 4 in.), which includes visual and volumetric inspection of a representative sample of small bore Class 1 piping components.

The staff further noted that the GALL Report item IV.C1-3, recommends GALL Report AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD" for managing the loss of fracture toughness in the components. However, the applicant proposed its Small Bore Class 1 Piping Inspection Program. In addition, the staff noted that the 2001 edition of the ASME Code Section XI with 2002 and 2003 addenda, referenced by GALL Report AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD," requires that valve body welds in valves less than NPS 4 in. should be examined using surface examination, in accordance with Table IWB-2500-1 (Examination Category B-M-1, item No. B12.30). By letter dated August 26, 2010, the staff issued RAI 3.1.2.1-X1 requesting that the applicant clarify whether the CASS valves less than 4 in., under the line item with Row Number 134 in LRA Table 3.1.2-3, have a valve body weld (including weld repair). If so, the staff asked the applicant to clarify whether periodic inspections are performed on the valves in accordance with the ASME Code Section XI requirements. Taking into consideration the requirement for the surface examination of the valve body weld described in ASME Code, Section XI, Table IWB-2500-1, the staff asked the applicant to justify why the Small Bore Class 1 Piping Inspection Program, which uses a one-time inspection rather than periodic inspections, is adequate to manage reduction of fracture toughness for the CASS Class 1 valves less than 4 in.

In its response dated November 11, 2010, the applicant stated that it has no small bore CASS Class 1 valves with a weld or weld repair in the valve body. The applicant also stated that all small bore CASS Class 1 valves (and bonnets) are cast as one piece, and the valve bodies and bonnets are bolted together so that there is no need for the surface inspection in the ISI Program. In addition, the applicant indicated that the Small Bore Class 1 Piping Inspection Program was revised and is now called the Small Bore Class 1 Piping Program to include periodic inspections, and the program will include visual and volumetric examinations of small bore valves. The applicant also stated that the selection of the components will be based upon its susceptibility to aging, and the program will inspect the valves most susceptible to reduction of fracture toughness.

Based on its review, the staff finds the applicant's response to RAI 3.1.2.1-X1 acceptable because the applicant clarified the following:

- There is no small bore CASS Class 1 valve body weld in the system so that the ASME surface examination requirement is not applicable.
- The Small Bore Class 1 Piping Inspection Program was replaced with the Small Bore Class 1 Piping Program that includes periodic visual and volumetric inspections of valve bodies; therefore, the program is adequate to manage this aging effect.

The staff's concern described in RAI 3.1.2.1-X1 is resolved.

The staff's evaluation of the applicant's Small Bore Class 1 Piping Program is documented in SER Section 3.0.3.3.13. In its review of components associated with line Item 3.1.1-55, the staff finds the applicant's proposal to manage aging using the Small Bore Class 1 Piping Program acceptable because it uses periodic visual and volumetric inspections of components most susceptible to the aging effect, which are adequate to manage this aging effect.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.1.3 Cracking Due to Stress Corrosion Cracking and Intergranular Attack

LRA Table 3.1.1, Item 3.1.1-48 addresses steel and stainless steel Class 1 piping, fittings, and branch connections less than NPS 4 in. exposed to reactor coolant, which are being managed for cracking due to SCC and IGA. The LRA credits the BWR Water Chemistry Program and the Small Bore Class 1 Piping Inspection Program to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," AMP XI.M2, "Water Chemistry," and AMP XI.M35, "One-time Inspection of ASME Code Class 1 Small Bore-Piping" to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note A.

In its review of components associated with Item 3.1.1-48 for which the applicant cited Generic Note A, the staff noted that the GALL Report recommends the program described in GALL Report AMP XI.M1, which recommends using NDEs; GALL Report AMP XI.M2, which recommends water chemistry controls to manage the aging of these line items; and GALL Report AMP XI.M35, which recommends a one-time inspection consisting of a volumetric examination in small bore piping to detect cracking due to SCC and cracking due to thermal and mechanical loading. The staff noted that, in LRA Table 3.1.2-3, the applicant proposed to use its Small Bore Class 1 Piping Inspection Program and the BWR Water Chemistry Program, not including the applicant's ISI Program. By letter dated August 16, 2010, the staff issued RAI 3.1.2.3-01 requesting that the applicant clarify why the applicant's ISI Program is not used to manage cracking due to SCC and IGA for the components in LRA Table 3.1.2-3 under Item 3.1.1-48, which addresses steel and stainless steel Class 1 piping and fittings less than 4 in. exposed to reactor coolant. The RAI also requested that the applicant clarify whether cracking due to thermal and mechanical loading is managed under these same line items in a manner consistent with GALL Report item IV.C1-1. The RAI further asked that, if cracking due to thermal and mechanical loading is not managed under the AMR items associated LRA issued RAI 3.1.2.1-X2 requesting that the applicant clarify whether the CASS valves less than 4 in., under the line items with Row Numbers 130 and 131 in LRA Table 3.1.2-3, have a valve body weld (or weld repair). If so, the staff asked the applicant to clarify whether periodic inspections are performed on the valves in accordance with the ASME Code Section XI requirements. Taking into consideration the surface examination requirement for the valve body weld described in ASME Code Section XI Table IWB-2500-1, the staff requested the applicant justify why the Small Bore Class 1 Piping Inspection Program, which is based on a one-time inspection rather than periodic inspections, is adequate to manage the cracking due to SCC, IGSCC, and thermal and mechanical loading.

In its response dated November 11, 2010, the applicant stated that it has no small bore CASS Class 1 valves with a weld or weld repair in the valve body. The applicant further stated that all small bore CASS Class 1 valves (and bonnets) are cast as one piece, and the bodies and bonnets are bolted together so that there is no need for the surface inspection in the ISI Program. In addition, the applicant indicated that the Small Bore Class 1 Piping Inspection Program was revised and is now called the Small Bore Class 1 Piping Program, which includes periodic visual and volumetric examinations of small bore valves. The applicant also stated that the selection of the components will be based upon its susceptibility to aging, and the program will inspect the valves most susceptible to SCC.

Based on its review, the staff finds the applicant’s response to RAI 3.1.2.1-X2 acceptable because the applicant clarified that there is no small bore CASS Class 1 valve body weld in the system; therefore, the ASME surface examination requirement is not applicable. The applicant also clarified that the Small Bore Class 1 Piping Inspection Program was replaced with the Small Bore Class 1 Piping Program, which includes periodic visual and volumetric inspections of valve bodies most susceptible to the aging effect; therefore, the program is adequate to detect and manage this aging effect. The staff’s concern described in RAI 3.1.2.1.X2 is resolved.

The applicant amended the LRA by letter dated September 21, 2010, indicating that the ISI Program is credited to manage cracking due to SCC of the small bore components. The staff noted that LRA Table 3.1.2-3, as amended by the letter, credits the ISI Program to manage this aging effect of CASS valve bodies less than 4 in. In a teleconference call held on March 8, 2011, the applicant further clarified that VT-2 examination, as required by the ASME Code, Section XI, is used to manage cracking due to SCC. The staff finds that the applicant’s use of the ISI Program is also acceptable because the use of the program is adequate to detect leakage due to SCC and manage aging consistent with the GALL Report.

The staff’s evaluation of the applicant’s ISI Program, BWR Water Chemistry Program, and the Small Bore Class 1 Piping Program is documented in SER Sections 3.0.3.1.19, 3.0.3.1.7, and 3.0.3.3.13 respectively. The staff noted that the ISI Program includes the performance of visual, surface, and volumetric examinations that provide ongoing periodic confirmation that intended function of the components is maintained during the period of extended operation. The staff noted that the applicant’s BWR Water Chemistry Program provides mitigation of aging by managing relevant conditions—such as concentrations of chlorides, oxygen, and sulfates—that could cause loss of material, cracking, or reduction of heat transfer through proper monitoring and control consistent with the current EPRI water chemistry guidelines. Furthermore, the relevant conditions are specific parameters such as sulfates, halogens, dissolved oxygen, and conductivity that could lead to, or are indicative of, conditions for corrosion or SCC of susceptible materials, as well as erosion and fouling. The staff also noted that the applicant’s Small Bore Class 1 Piping Program provides ongoing inspections of selected piping welds using a combination of visual inspections and volumetric examinations that are equivalent to and beyond those recommended in GALL Report AMP XI.M35. The staff also noted that the selection criteria for components to be inspected in the Small Bore Class 1 Piping Program include consideration of susceptibility to degradation similar to the selection criteria recommended in GALL Report AMP XI.M35. In its review of components associated with Line Item 3.1.1-48, the staff finds the applicant's proposal to manage aging using the ISI Program, BWR Water Chemistry and the Small Bore Class 1 Piping Programs acceptable because the use of the ISI Program and BWR Water Chemistry Program is consistent with the GALL Report, and the Small Bore Class 1 Piping Program is more conservative than the recommendation in GALL Report AMP XI.M35.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2 AMR Results that are Consistent with the GALL Report, for which Further Evaluation is Recommended

LRA Section 3.1.2.2 provides further evaluation of aging management, as recommended by the GALL Report for the RCS components. The applicant provided information concerning how it will manage the following aging effects:

- cumulative fatigue damage
- loss of material due to general, pitting, and crevice corrosion
- loss of fracture toughness due to neutron irradiation embrittlement
- cracking due to SCC and IGSCC
- crack growth due to cyclic loading
- loss of fracture toughness due to neutron irradiation embrittlement and void swelling
- cracking due to SCC
- cracking due to cyclic loading
- loss of preload due to stress relaxation
- loss of material due to erosion
- cracking due to FIV
- cracking due to SCC and IASCC
- cracking due to PWSCC
- wall thinning due to flow-accelerated corrosion
- changes in dimensions due to void swelling
- cracking due to SCC and PWSCC
- cracking due to SCC, PWSCC, and IASCC

For component groups evaluated in the GALL Report for which the applicant claimed consistency with the GALL Report and for which the report recommends further evaluation, the staff audited and reviewed the applicant's evaluation. The staff determined if the applicant adequately addressed the issues for which further evaluation is recommended. The staff reviewed the applicant's further evaluations against the criteria contained in SRP-LR Section 3.1.2.2. The staff's review of the applicant's further evaluation follows.

3.1.2.2.1 Cumulative Fatigue Damage

LRA Section 3.1.2.2.1 is associated with LRA Table 3.1.1, Items 3.1.1-01 through 3.1.1-10, and addresses cumulative fatigue damage in ASME Code Class 1 components and other non-Class 1 components that were analyzed to ASME Section III, Class 1 CUF evaluations.

The applicant addressed the further evaluation criteria of the SRP-LR by stating that fatigue is a TLAA, as defined in 10 CFR 54.3, and is required to be evaluated in accordance with 10 CFR 54.21(c). The applicant stated that this evaluation of this TLAA is addressed separately in LRA Section 4.3. The staff's evaluation is documented in SER Section 4.3.

The staff reviewed LRA Section 3.1.2.2.1 against the criteria in SRP-LR Section 3.1.2.2.1, which states that fatigue is a TLAA, as defined in 10 CFR 54.3, and TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). Furthermore, this TLAA is addressed separately in Section 4.3, "Metal Fatigue Analysis," of this SRP-LR.

The applicant identified the following items in LRA Table 3.1.1 that are applicable:

- Item 3.1.1-01—The applicant stated that fatigue of steel pressure vessel support skirt and attachment welds is a TLAA addressed separately in LRA Section 4.3.
- Item 3.1.1-02—The applicant stated that steel, stainless steel, steel with nickel-alloy or stainless steel cladding, and nickel-alloy RV components (e.g., flanges, nozzles, penetrations, safe ends, thermal sleeves, vessel shells, heads and welds) were analyzed to ASME Section III CUF analysis requirements, and the TLAAs are addressed separately in LRA Section 4.3.
- Item 3.1.1-03—The applicant stated that steel, stainless steel, steel with nickel-alloy or stainless steel cladding, and nickel-alloy RCPB piping, piping components, and piping elements exposed to reactor coolant were analyzed to ASME Section III CUF analysis requirements, and the TLAAs are addressed separately in LRA Section 4.3.
- Item 3.1.1-04—The applicant stated that this line item related to steel pump and valve closure bolting was not applicable for Columbia, and cumulative fatigue damage of steel pump and valve closure bolting was not identified as a TLAA, as defined in 10 CFR 54.3.
- Item 3.1.1-05—The applicant stated that the stainless steel and nickel-alloy RVI components were analyzed to ASME Section III CUF analysis requirements, and the TLAAs are addressed separately in LRA Section 4.3.
- Item 3.1.1-06 to 3.1.1-10—The applicant stated that these items were applicable to PWRs only.

The staff noted that, for Items 3.1.1-01 and 3.1.1-02, the applicant identified the aging effect of cumulative fatigue damage, consistent with the recommendations in the GALL Report. The staff confirmed that LRA Section 4.3.1 addresses the TLAAs associated with cumulative fatigue damage for various RV components and support skirt.

The staff noted that in LRA Table 3.1.2-1, Row 320 and LRA Table 3.1.2-3, Row 8, which reference Item 3.1.1-01, the applicant proposes to manage cracking due to fatigue of pressure boundary bolting exposed to uncontrolled indoor air by using the Bolting Integrity Program, and it cites Generic Note E. The staff noted that the GALL Report specifically relates a fatigue TLAA to managing the cumulative fatigue damage. The staff noted that a program consistent with GALL Report AMP X.M1, recommended by the GALL Report item to manage this aging effect, Item 3.1.1-48, the applicant justify why the LRA claims these items to be consistent with the GALL Report.

In its response to RAI B.2.49-1, dated September 13, 2010, the applicant replaced the Small Bore Class 1 Piping Inspection Program with a new, plant-specific, Small Bore Class 1 Piping Program. The staff's review of the applicant's response to RAI B.2.49-1 is documented in SER Section 3.0.3.1.28. The staff's review of the plant-specific Small Bore Class 1 Piping Program is documented in SER Section 3.0.3.3.13.The staff noted that the applicant's plant-specific Small Bore Class 1 Piping Program provides periodic inspections of selected small bore piping welds using volumetric examinations. The staff noted that the difference between the applicant's proposed aging management and the recommendations in the GALL Report is that the applicant will perform a periodic volumetric inspection in lieu of a one-time inspection of small bore piping. The staff finds the applicant's proposal to perform periodic inspections on Class 1 small-bore piping acceptable because it is more conservative than the one-time inspection recommended in the GALL Report.

In its response dated September 21, 2010, the applicant indicated that the ISI Program was not originally credited to manage cracking due to SCC and IGA for components less than 4 in. NPS exposed to reactor coolant because the ASME Code, Categories B-J and B-M-1, require no volumetric examination of the small bore components. The applicant also stated that the Columbia risk-informed ISI Program does include volumetric examination of selected small bore locations and that it will add the ISI Program to the AMPs credited for management of SCC for the selected small bore components.

In addition, the applicant indicated that it separated cracking due to SCC and cracking due to thermal and mechanical loading (referred to as cracking due to flaw growth) into separate line items. The applicant also stated that it will add the ISI Program to the AMPs for cracking due to flaw growth of small bore components for the selected small bore locations of main steam lines. The staff noted that the applicant does credit its BWR Water Chemistry Program to manage cracking due to SCC and IGSCC, consistent with the recommendations for GALL Report item IV.C1-1.

In its review, the staff noted that the applicant's response provided relevant amendments to the LRA for the aforementioned items. The staff finds the applicant's response acceptable for the following reasons:

- The applicant's use of the ISI Program to manage cracking due to SCC and IGA, in addition to the BWR Water Chemistry Program and Small Bore Class 1 Piping Inspection Program, is consistent with the GALL Report.
- The applicant clarified that cracking due to flaw growth refers to cracking due to thermal and mechanical loading.
- The applicant also included the ISI Program in the LRA to manage cracking due to thermal and mechanical loading.

The staff's concern described in RAI in RAI 3.1.2.3-01 is resolved.

The staff also noted that the 2001 edition of the ASME Code Section XI with 2002 and 2003 addenda, referenced by GALL Report AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD," requires that valve body welds in valves less than NPS 4 in. should be examined using surface examination in accordance with Table IWB-2500-1 (Examination Category B-M-1, item No. B12.30). By letter dated August 26, 2010, the staff and any other option is evaluated on a case-by-case basis. It is not clear to the staff which closure bolting is represented in the LRA by these line items and if the cited Generic Note E is appropriate. The staff also reviewed LRA Section 4.3 and noted that a TLAA associated with pressure boundary bolting was not specifically identified and does not address a disposition of a TLAA, in accordance with 10 CFR 54.21(c)(1)(iii), that the effects of aging will be managed by the Bolting Integrity Program. Furthermore, the staff noted that air-indoor uncontrolled is listed in the “Environment” column for Rows 324 and 312 of LRA Table 3.1.2-1, and both rows reference GALL Report item IV.A1-7. However, the staff noted that reactor coolant is listed in “Environment” for the GALL Report item IV.A1-7.

By letter dated December 3, 2010, the staff issued RAI 3.1.2.2.1-02 asking the applicant to clarify what specific closure bolts in the RPV and RCPB are represented in Table 3.1.2-1, Row 320, and Table 3.1.2-3, Row 8, respectively. The staff also asked the applicant to justify how the cracking due to fatigue of pressure boundary bolting can be adequately managed by the Bolting Integrity Program. The applicant was also asked to justify why a TLAA in LRA Section 4.3 associated with closure bolting does not need to be identified and to justify that Generic Note A is appropriate for both AMR line items, Rows 324 and 312 of Table 3.1.2-1, which cite GALL Report, Volume 2, Item IV.A 1-7, but designated uncontrolled, indoor air as the environment.

In its response dated January 20, 2011, the applicant clarified that the closure bolts included in Table 3.1.2-1, Row 320, are the studs and nuts used to attach three nozzles on the RV head. The applicant also stated that these closure bolts include the capscrews and washers at the following locations:

- between the CRD mechanisms and the CRD housings
- between the incore dry tubes and the incore housings
- between the power range monitors and the incore housings

The bolting included in Table 3.1.2-3, Row 8, is a pressure retaining bolting (i.e., valve closure bolting, pump closure bolting, flange bolting) in the Class 1 portions of the following systems—CRD, high-pressure core spray (HPCS), low-pressure core spray (LPCS), main steam, RCIC, RFW, RHR, reactor recirculation, reactor water cleanup, and SLC. The applicant also stated that it has searched its licensing bases and found no fatigue calculation for the aforementioned miscellaneous bolting. Therefore, there is no TLAA of pressure boundary bolting to be dispositioned per 10 CFR 54.21(c).

The applicant also corrected the generic notes for the AMR for Row 320 from LRA Table 3.1.2-1 and Row 8 from LRA Table 3.1.2-3, reflecting that there is no applicable TLAA for the pressure boundary bolting. The applicant also revised LRA Table 3.1.2-1, Rows 312 and 324, citing GALL Report, Volume 2, Item IV.A1-6, which designates an indoor air environment for the pressure vessel support skirt and attachment welds.

Based on its review, the staff finds the applicant’s response to RAI 3.1.2.2.1-01 acceptable because the applicant did the following:

- clarified which closure bolts are represented in the LRA line items
- clarified that there is no fatigue analysis in the CLB for these bolts
- revised the AMR line items and associated TLAAs for RPV components and bolts
- provided AMR results that are consistent with the recommendations of the GALL Report.

Based on the staff's review, it concludes that the applicant has met the SRP-LR Section 3.1.2.2.1 criteria. For those line items that apply to LRA Section 3.1.2.2.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). SER Section 4.3 documents the staff's review of the applicant's evaluation of the TLAA for these components.

3.1.2.2.2 Loss of Material Due to General, Pitting, and Crevice Corrosion

(1) LRA Section 3.1.2.2.2 Item 1 associated with LRA Table 3.1.1 Item 3.1.1-11 and addresses RV steel components: top head enclosure (without cladding), top head nozzles (vent, top head spray or RCIC, and spare), nozzles, piping components and internal vessel attachment brackets exposed to reactor coolant, which is being managed for loss of material by the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection Program. The applicant addressed the further evaluation criteria of the SRP-LR by stating that (a) its BWR Water Chemistry Program includes periodic monitoring and control of contaminants and (b) its Chemistry Program Effectiveness Inspection Program will provide a verification of the effectiveness of the BWR Water Chemistry Program to manage loss of material due to general, pitting, and crevice corrosion through examination of components.

The staff reviewed LRA Section 3.1.2.2.2, Item 1, against the criteria in SRP-LR Section 3.1.2.2.2, Item 1, which states that loss of material due to general, pitting, and crevice corrosion could occur in the steel top head enclosure (without cladding), top head nozzles (vent, top head spray or RCIC, and spare) exposed to reactor coolant. The GALL Report states that the existing AMP relies on monitoring and control of the water chemistry to mitigate corrosion; however, the loss of material at stagnant-flow conditions cannot be precluded by the control. Therefore, the GALL Report also recommends that the effectiveness of water chemistry program should be verified to ensure that corrosion is not occurring. The GALL Report further states that a one-time inspection of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

The staff's evaluation of the applicant's BWR Water Chemistry Program and Chemistry Program Effectiveness Inspection Program is documented in SER Section 3.0.3.1.7 and 3.0.3.1.8, respectively. The staff noted that the Chemistry Program Effectiveness Inspection Program includes detection and characterization of the material conditions in representative low-flow and stagnant areas of plant systems influenced by the BWR Water Chemistry Program, providing direct evidence of any detectable extent of loss of material in treated water environment. The staff also noted that the Chemistry Program Effectiveness Inspection will use a combination of established volumetric and visual examination techniques (equivalent to VT-1 or VT-3) performed by qualified personnel on a sample population of components to identify evidence of a loss of material. Further, the applicant's implementation of this new inspection program also includes provisions for condition assessment and corrective actions after comparing any detected loss of material with pre-determined acceptance criteria. The staff noted that the BWR Water Chemistry Program monitors and manages relevant conditions, such as concentrations of chlorides, oxygen, and sulfates, which could create an environment conducive to the loss of material. In its review of components associated with line item 3.1.1-11, the staff finds the applicant's proposal to manage aging using the BWR Water Chemistry Program and Chemistry Program Effectiveness Inspection Program acceptable because the applicant's use of these programs is consistent with the recommendations of the GALL Report and SRP-LR Section 3.1.2.2.2, Item 1.

Based on the program identified, the staff concludes that the applicant's program meets SRP-LR Section 3.1.2.2.2, Item 1, criteria. For those line items that apply to LRA Section 3.1.2.2.2, Item 1, the staff determines that the LRA is consistent with the GALL Report, and the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(2) LRA Section 3.1.2.2.2.2 refers to Table 3.1.1, Item 3.1.1-13, and addresses loss of material due to general, pitting, and crevice corrosion. The applicant stated that this aging effect is not applicable to Columbia since it does not have an isolation condenser. The applicant did state that the loss of material for the (carbon) steel portions of the main steam flow restrictors and steel flow elements are compared to this item and are managed by the BWR Water Chemistry Program—the effectiveness of which is verified by the Chemisty Program Effectiveness Inspection.

SRP-LR Section 3.1.2.2.2, Item 2, states that loss of material due to general, pitting, and crevice corrosion could occur in steel BWR isolation condenser components. 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 Chemistry Control Program should be verified to ensure that corrosion is not occurring. A one-time inspection of selected components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation. SRP-LR Table 3.1-1 identifies Item 13 applicable to steel and stainless steel isolation condenser components exposed to reactor coolant in BWRs.

The staff verified that SRP-LR Section 3.1.2.2.2 is not applicable to Columbia because Columbia does not have an isolation condenser. However, Columbia did credit the BWR Water Chemistry Program and the Chemisty Program Effectiveness Inspection to manage loss of material for the (carbon) steel portions of the main steam flow restrictors and steel flow elements.

The staff's evaluations of the applicant's BWR Water Chemistry Program and Chemistry Program Effectiveness Inspection Program are documented in SER Sections 3.0.3.1.7 and 3.0.3.1.8, respectively. The staff noted that the Chemistry Program Effectiveness Inspection Program includes detection and characterization of the material conditions in representative low-flow and stagnant areas of plant systems influenced by the BWR Water Chemistry Program, providing direct evidence of any detectable extent of loss of material in treated water environment. The staff also noted that the Chemistry Program Effectiveness Inspection will use a combination of established volumetric and visual examination techniques (equivalent to VT-1 or VT-3) performed by qualified personnel on a sample population of components to identify evidence of a loss of material. Further, the applicant's implementation of this new inspection program also includes provisions for condition assessment and corrective actions after comparing any detected loss of material with pre-determined acceptance criteria. The staff noted that the BWR Water Chemistry Program monitors and manages relevant conditions, such as concentrations of chlorides, oxygen, and sulfates, which could create an environment conducive to the loss of material. In its review of components associated with line Item 3.1.1-13, the staff finds the applicant's proposal to manage aging using the BWR Water Chemistry Program and Chemistry Program Effectiveness Inspection Program acceptable because the applicant's use of these programs is consistent with the recommendations of the GALL Report and SRP-LR Section 3.1.2.2.2, Item 2.

Based on the program identified, the staff concludes that the applicant's program meets SRP-LR Section 3.1.2.2.2, Item 2 criteria. For those line items that apply to LRA Section 3.1.2.2.2.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(3) LRA Section 3.1.2.2.2.3 associated with LRA Table 3.1.1, Items 3.1.1-14 and 3.1.1-15, and addresses RV flanges, nozzles, penetrations, safe ends, vessel shells, heads, welds, and RCPB components, which are being managed for loss of material by the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection Program. The applicant addressed the further evaluation criteria of the SRP-LR by stating that its BWR Water Chemistry Program includes periodic monitoring and control of contaminants and its Chemistry Program Effectiveness Inspection Program will provide a verification of the effectiveness of the BWR Water Chemistry Program to manage loss of material due to general, pitting, and crevice corrosion through examination of components.

The staff reviewed LRA Section 3.1.2.2.2.3 against the criteria in SRP-LR Section 3.1.2.2.2, Item 3, which states that loss of material due to general, pitting, and crevice corrosion could occur for stainless steel, nickel alloy, and steel with stainless steel or nickel ally cladding flanges, nozzles, penetrations, pressure housing, safe ends, and cessel shells, heads and welds exposed to reactor coolant. 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 Chemistry Control Program should be verified to ensure that corrosion is not occurring. A one-time inspection of selected components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation. SRP-LR Table 3.1-1 identifies Items 14 and 15 applicable to stainless steel, nickel alloy, and steel with nickel alloy or stainless steel cladding RV flanges, nozzles, penetrations, safe ends, vessel shells, heads, welds, and RCPB components.

The staff's evaluations of the applicant's BWR Water Chemistry Program and Chemistry Program Effectiveness Inspection Program are documented in SER Sections 3.0.3.1.7 and 3.0.3.1.8, respectively. The staff noted that the Chemistry Program Effectiveness Inspection Program includes detection and characterization of the material conditions in representative low-flow and stagnant areas of plant systems influenced by the BWR Water Chemistry Program, providing direct evidence of any detectable extent of loss of material in treated water environment. The staff also noted that the Chemistry Program Effectiveness Inspection will use a combination of established volumetric and visual examination techniques (equivalent to VT-1 or VT-3) performed by qualified personnel on a sample population of components to identify evidence of a loss of material. Further, the applicant's implementation of this new inspection program also includes provisions for condition assessment and corrective actions after comparing any detected loss of material with pre-determined acceptance criteria. The staff noted that the BWR Water Chemistry Program monitors and manages relevant conditions, such as concentrations of chlorides, oxygen, and sulfates, which could create an environment conducive to the loss of material. In its review of components associated with line Items 3.1.1-14 and 3.1.1-15, the staff finds the applicant's proposal to manage aging using the BWR Water Chemistry Program and Chemistry Program Effectiveness Inspection Program acceptable because the applicant's use of these programs is consistent with the recommendations of the GALL Report and SRP-LR, Section 3.1.2.2.2, Item 3.

Based on the program identified, the staff concludes that the applicant's program meets SRP-LR Section 3.1.2.2.2, Item 3. criteria. For those line items that apply to LRA Section 3.1.2.2.2, Item 3, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(4) LRA Section 3.1.2.2.2.4 associated with LRA Table 3.1.1, Item 3.1.1-16, addresses PWR steam generator upper and lower shell and transition cone of steel exposed to secondary FW and steam. The applicant stated that this line item is not applicable because the associated items in Table 3.1.1 are applicable to PWRs only. The staff noted that Columbia is a BWR design and therefore finds the applicant's assessment of this AMR item being not applicable is acceptable.

3.1.2.2.3 Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement

The staff reviewed LRA Section 3.1.2.2.3 against the criteria in SRP-LR Section 3.1.2.2.3.

(1) LRA Section 3.1.2.2.3 refers to Table 3.1.1, Item 3.1.1-17, and states that neutron irradiation embrittlement is a TLAA, as defined in 10 CFR 54.3. Applicants must evaluate TLAAs in accordance with 10 CFR 54.21(c)(1). SER Section 4.2 documents the staff's review of the applicant's evaluation of this TLAA.

(2) LRA Section 3.1.2.2.3 refers to LRA Table 3.1.2-3, Item 3.1.1-18, and addresses RPV carbon or low alloy steel with stainless steel cladding exposed to reactor coolant and neutron flux (internal), which are being managed for loss of fracture toughness due to neutron irradiation embrittlement by the RV Surveillance Program. The applicant addressed the further evaluation requirement by stating that the RV Surveillance Program relies on the BWRVIP ISP and satisfies the requirements of 10 CFR Part 50, Appendix H. Columbia will continue using the ISP during the period of extended operation by implementing the requirements of BWRVIP-116. The BWRVIP ISP has been revised for license renewal, as documented in BWRVIP-116, "BWR Vessel and Internals Project, Integrated Surveillance Program (ISP) Implementation for License Renewal, (BWRVIP-116)," July 29, 2003, to ensure representative capsules are irradiated to fluence levels corresponding to the end of the period of extended operation.

The BWRVIP ISP conducts tests on material surveillance capsules in BWR plants, as well as supplemental capsules irradiated in host plants, to provide data which bounds all operating BWR plants. According to the applicant, no surveillance capsules from Columbia are included in the BWRVIP ISP; however, the Columbia surveillance capsules will continue to be maintained in the RV in standby (deferred) status, as required by the BWRVIP ISP. Capsules from host plants will be removed and tested in accordance with the ISP implementation plan defined in BWRVIP-86-A, "BWR Vessel and Internals Project, Updated BWR Integrated Surveillance Program (ISP) Implementation Plan," September 2008. Results from these tests that are applicable to Columbia will provide the necessary data to monitor embrittlement for the Columbia RV. Columbia will apply the applicable results of the ISP capsule testing to Columbia.

The staff reviewed LRA Section 3.1.2.2.3, Item 2, against the criteria in SRP-LR Section 3.1.2.2.3, Item 2, which states that loss of fracture toughness due to neutron irradiation embrittlement could occur in BWR RV beltline shell, nozzle, and welds exposed to reactor coolant and neutron flux. The SRP-LR also states that the applicant must implement a Reactor Surveillance Program that follows the requirements of 10 CFR Part 50, Appendix H by incorporating plant-specific factors such as the composition of limiting materials, availability of surveillance capsules, and projected fluence levels. In addition, untested capsules placed in storage must be maintained for future insertion.

The staff's evaluation of the applicant's RV Surveillance Program is documented in SER Section 3.0.3.1.25. The staff noted the applicant's program consists of monitoring changes in RV materials' Charpy USE values and RT_{NDT} values, due to the effects of neutron irradiation embrittlement, monitoring the EFPY accumulated by the reactor and ensuring that the P-T limit curves contained in plant TSs are updated periodically. These updates ensure that the limit curves are always valid beyond the EFPY that the plant has accumulated, and untested capsules are either returned to the RV or maintained in storage for possible future reinsertion.

In its review of components associated with Item 3.1.1-18, the staff finds the applicant's proposal to manage aging using the RV Surveillance Program acceptable because the applicant will continue using the ISP during the period of extended operation by implementing the requirements of BWRVIP-116 for the testing and analysis of applicable surveillance capsule specimens during the period of extended operation.

Based on the program identified, the staff concludes that the applicant's program meets SRP-LR Section 3.1.2.2.3, Item 2, criteria. For those line items that apply to LRA Section 3.1.2.2.3, Item 2, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.4 Cracking Due to SCC and IGSCC

(1) LRA Section 3.1.2.2.4.1 refers to LRA Table 3.1.1, Item 3.1.1-19, and addresses top head enclosure vessel flange leak detection line, which is being managed for cracking by the Small Bore Class 1 Piping Program, BWR Water Chemistry Program, and the Chemistry Program Effectiveness Inspection Program. The applicant states the stainless steel piping is evaluated for a reactor coolant environment and is, therefore, susceptible to cracking due to SCC. Cracking of the piping is managed by the Small Bore Class 1 Piping Program. The nickel alloy nozzle is evaluated for a reactor coolant

environment and is, therefore, susceptible to cracking due to SCC. Cracking of the nozzle is managed with a combination of the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection. In addition, the applicant states that the loss of material for the stainless steel piping that forms the tube-in-a-tube seal cooler for the reactor recirculation pump is managed by the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection.

The staff reviewed LRA Section 3.1.2.2.4.1 against the criteria in SRP-LR Section 3.1.2.2.4, Item 1, which states cracking due to SCC and IGSCC could occur in the stainless steel and nickel alloy BWR top head enclosure vessel flange leak detection lines. The GALL Report recommends that a plant-specific AMP be evaluated because existing programs may not be capable of mitigating or detecting cracking due to SCC and IGSCC.

The staff's evaluations of the applicant's Small Bore Class 1 Piping Program, BWR Water Chemistry Program, and Chemistry Program Effectiveness Inspection Program are documented in SER Sections 3.0.3.3.13, 3.0.3.1.7, and 3.0.3.1.8, respectively. The staff noted that the applicant's Small Bore Class 1 Piping Program provides ongoing inspections of selected piping welds using a combination of visual inspections and volumetric examinations that are equivalent to and beyond those recommended in GALL Report AMP XI.M35. The staff also noted that the selection criteria for components to be inspected in the Small Bore Class 1 Piping Program include consideration of susceptibility to degradation similar to the selection criteria recommended in GALL Report AMP XI.M35. The staff also noted that the applicant's BWR Water Chemistry Program provides mitigation of aging by managing relevant conditions, such as concentrations of chlorides, oxygen, and sulfates, which could cause loss of material, cracking, or reduction of heat transfer through proper monitoring and control consistent with the current EPRI water chemistry guidelines. Furthermore, the relevant conditions are specific parameters such as sulfates, halogens, dissolved oxygen, and conductivity that could lead to, or are indicative of, conditions for corrosion or SCC of susceptible materials, as well as erosion and fouling. The staff noted that the Chemistry Program Effectiveness Inspection Program includes detection and characterization of the material conditions in representative low-flow and stagnant areas of plant systems influenced by the BWR Water Chemistry Program, providing direct evidence of any detectable extent of loss of material in treated water environment. The staff also noted that the Chemistry Program Effectiveness Inspection will use a combination of established volumetric and visual examination techniques (equivalent to VT-1 or VT-3) performed by qualified personnel on a sample population of components to identify evidence of a loss of material. Further, the applicant's implementation of this new inspection program also includes provisions for condition assessment and corrective actions after comparing any detected loss of material with pre-determined acceptance criteria.

In its review of components associated with line Item 3.1.1-19, the staff finds the applicant's proposal to manage aging using the Small Bore Class 1 Piping Program, BWR Water Chemistry Program, and Chemistry Program Effectiveness Inspection Program acceptable because the applicant's use of these programs is consistent with the recommendations of the GALL Report and SRP-LR Section 3.1.2.2.4, Item 1.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.1.2.2.4, Item 1, criteria. For those line items that apply to LRA Section 3.1.2.2.4, Item 1, the staff determines that the LRA is consistent with the GALL

Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(2) LRA Section 3.1.2.2.4.2 refers to Table 3.1.1, Item 3.1.1-20, and addresses the stainless steel isolation condenser components exposed to reactor coolant. The applicant stated this aging effect is not applicable because Columbia does not have isolation condensers.

SRP-LR Section 3.1.2.2.4, Item 2, states that cracking due to SCC and IGSCC may occur in stainless steel BWR isolation condenser components exposed to reactor coolant.

The staff reviewed the applicant's UFSAR and finds that SRP-LR Section 3.1.2.2.4, Item 2, is not applicable to Columbia because Columbia does not have an isolation condenser, and the staff guidance in this SRP-LR section is only applicable to BWRs with isolation condenser components.

Based on the above, the staff concludes that the staff's guidance criteria of SRP-LR Section 3.1.2.2.4, Item 2, do not apply to Columbia because the guidance is applicable to BWRs with isolation condenser components.

3.1.2.2.5 Crack Growth Due to Cyclic Loading

LRA Section 3.1.2.2.5 refers to Table 3.1.1, Item 3.1.1-21, and addresses crack growth due to cyclic loading. The applicant stated that this aging effect is not applicable to Columbia, which is a BWR.

SRP-LR Section 3.1.2.2.5 states that crack growth due to cyclic loading could occur in RV shell forgings clad with stainless steel using a high-heat-input welding process. SRP-LR Table 3.1-1 identifies Item 21 as applicable to PWRs.

The staff verified that SRP-LR Section 3.1.2.2.5 is not applicable to Columbia because Columbia is a BWR, and the staff guidance in this SRP-LR section is only applicable to PWR-designed RV shells fabricated of SA508-CI forgings clad with stainless steel using a high-heat-input welding process.

Based on the informaiton above, the staff concludes that the staff's guidance criteria of SRP-LR Section 3.1.2.2.5 do not apply to Columbia because the guidance is applicable to PWRs.

3.1.2.2.6 Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement and Void Swelling

LRA Section 3.1.2.2.6 refers to Table 3.1.1, Item 3.1.1-22, and addresses loss of fracture toughness due to neutron irradiation embrittlement and void swelling. The applicant stated that this aging effect is not applicable to Columbia, which is a BWR.

SRP-LR Section 3.1.2.2.6 states that loss of fracture toughness due to neutron irradiation embrittlement and void swelling could occur in stainless steel and nickel-alloy RVI components exposed to reactor coolant and neutron flux. SRP-LR Table 3.1-1 identifies Item 22 as applicable to PWRs.

The staff verified that SRP-LR Section 3.1.2.2.5 is not applicable to Columbia because Columbia is a BWR, and the staff guidance in this SRP-LR section is only applicable to PWR stainless steel and nickel-alloy RVI components exposed to reactor coolant and neutron flux.

Based on the information above, the staff concludes that the staff's guidance criteria of SRP-LR Section 3.1.2.2.6 do not apply to Columbia because the guidance is applicable to PWRs.

3.1.2.2.7 Cracking Due to SCC

(1) LRA Section 3.1.2.2.7.1 refers to LRA Table 3.1.1, Item 3.1.1-23, and addresses cracking due to SCC. The applicant stated that this aging effect is not applicable to Columbia, which is a BWR.

SRP-LR Section 3.1.2.2.7.1 states that cracking due to SCC could occur in the PWR stainless steel RV flange leak detection lines and bottom-mounted instrument guide tubes exposed to reactor coolant. SRP-LR Table 3.1-1 identifies Item 23 as applicable to PWRs.

The staff verified that SRP-LR Section 3.1.2.2.7.1 is not applicable to Columbia because Columbia is a BWR, and the staff guidance in this SRP-LR section is only applicable to PWR stainless steel RV closure head flange leak detection line and bottom-mounted instrument guide tubes.

(2) LRA Section 3.1.2.2.7.2 refers to LRA Table 3.1.1, item 3.1.1-24 and addresses Class 1 CASS piping, piping components, and piping elements exposed to reactor coolant. The GALL Report recommends the Water Chemistry Program to manage the aging effect. In addition, the GALL Report recommends that a plant-specific AMP manage cracking due to SCC for CASS components that do not meet the NUREG-0313 guidelines. The applicant stated that this item is not applicable because the item is listed for PWR, and the plant is a BWR. The staff reviewed the LRA against the GALL Report and SRP-LR and confirmed that the further evaluation described in SRP-LR Section 3.1.2.2.7.2 and associated line item are only applicable to PWRs; therefore, the staff finds the applicant's determination acceptable.

3.1.2.2.8 Cracking Due to Cyclic Loading

(1) LRA Section 3.1.2.2.8.1 refers to LRA Table 3.1.1, Item 3.1.1-25, and addresses cracking due to cyclic loading. The applicant stated that this aging effect is not applicable because stainless steel jet pump sensing lines internal to the RV are not required to support intended functions and are not included within the scope of license renewal. A safety assessment for these components has been performed and reported in BWRVIP-06. The evaluation concluded that these components do not perform a safety-related function. This report also concluded that failure of these components will not result in consequential failure of any safety-related equipment. The lines outside of the vessel are not subjected to FIV but are part of the RCPB and are subject to an AMR. Cracking due to SCC, and thermal and mechanical loading of the stainless steel lines external to the RV, are addressed by LRA Table 3.1.1, Item 3.1.1-48.

SRP-LR Section 3.1.2.2.8, Item 1, states that cracking due to cyclic loading could occur in the stainless steel BWR jet pump sensing lines.

The staff reviewed the BWRVIP-06 and the applicant's UFSAR and finds that SRP-LR Section 3.1.2.2.8, Item 1, is not applicable to Columbia because jet pump sensing lines do not perform a safety-related function, and failure of these components will not result in consequential failure of any safety-related equipment. Also, lines outside of the vessel are subject to an AMR, and the aging effects of cracking due to SCC, and thermal and mechanical loading of the stainless steel lines external to the RV are being addressed by LRA Table 3.1.1, Item 3.1.1-48.

(2) LRA Section 3.1.2.2.8.2 refers to LRA Table 3.1.1, Item 3.1.1-26, and addresses cracking due to cyclic loading. The applicant stated this aging effect is not applicable because Columbia does not have isolation condensers.

SRP-LR Section 3.1.2.2.8, Item 2, states that cracking due to cycling loading could occur in steel and stainless steel BWR isolation condenser components exposed to reactor coolant.

The staff reviewed the applicant's UFSAR and finds that SRP-LR Section 3.1.2.2.8, Item 2, is not applicable to Columbia because Columbia does not have an isolation condenser, and the staff guidance in this SRP-LR section is only applicable to BWRs with isolation condenser components.

3.1.2.2.9 Loss of Preload Due to Stress Relaxation

LRA Section 3.1.2.2.9 refers to LRA Table 3.1.1, Item 3.1.1-27, and addresses loss of preload due to stress relaxation. The applicant stated that this aging effect is not applicable to Columbia, which is a BWR.

SRP-LR Section 3.1.2.2.9 states that loss of preload due to stress relaxation could occur in stainless steel and nickel-alloy PWR RVI screws, bolts, tie rods, and hold down springs exposed to reactor coolant. SRP-LR Table 3.1-1 identifies Item 27 applicable to PWRs.

The staff verified that SRP-LR Section 3.1.2.2.9 is not applicable to Columbia because Columbia is a BWR, and the staff guidance in this SRP-LR section is only applicable to PWR stainless steel and nickel-alloy RVI screws, bolts, tie rods, and hold down springs.

Based on the above, the staff concludes that the staff's guidance criteria of SRP-LR Section 3.1.2.2.9 do not apply to Columbia because the guidance is applicable to PWRs.

3.1.2.2.10 Loss of Material Due to Erosion

LRA Section 3.1.2.2.10 associated with LRA Table 3.1.1, Item 3.1.1-28, addresses steel steam generator FW impingement plate and support exposed to secondary FW. The applicant stated that this line item is not applicable because the associated items in LRA Table 3.1.1 are applicable to PWRs only. The staff noted that Columbia is a BWR design; therefore, it finds that the applicant's assessment of this AMR item being not applicable is acceptable.

3.1.2.2.11 Cracking Due to Flow-Induced Vibration

LRA Section 3.1.2.2.11 refers to LRA Table 3.1.1, Item 3.1.1-29, and addresses reactor internals stainless steel steam dryer components exposed to reactor coolant, which are being managed for cracking due to FIV by the BWR Vessel Internals Program. The applicant addressed the further evaluation requirements by stating that it incorporates all of the BWRVIP documents applicable to aging management of RVI components. For the stainless steal steam dryer, the BWR Vessel Internals Program inspects, evaluates, and repairs flaws, in accordance with the guidelines provided in BWRVIP-139, "BWR Vessel and Internals Project Steam Dryer Inspection and Flaw Evaluation." The applicant further stated that following the guidelines in BWRVIP-139 will adequately identify, evaluate, and manage the effects of cracking due to FIV of the stainless steel steam dryer components.

The staff reviewed LRA Section 3.1.2.2.11 against the criteria in SRP-LR Section 3.1.2.2.11, which states that cracking due to FIV could occur for BWR stainless steel steam dryers exposed to reactor coolant. The SRP-LR also recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed.

The staff's evaluation of the applicant's BWR Vessel Internals Program is documented in SER Section 3.0.3.1.6. The staff noted that the BWR Vessel Internals Program includes inspection of the steam dryer that complies with BWRVIP-139 guidance. The staff issued its safety evaluation (SE) on BWRVIP-139 in a letter to the EPRI, dated July 30, 2008. In its SE, the staff stated that the guidelines below should be followed for reinspection:

- Each BWR applicant will determine the appropriate reinspection approach, according to GE SIL-644 or BWRVIP-139, in consideration of the steam dryer performance at its plant.
- License conditions associated with Steam Dryer Monitoring Programs in power uprate license amendments take precedence over the steam dryer reinspection provisions in GE SIL-644 or BWRVIP-139.
- The applicant will justify any adjustments to its Steam Dryer Reinspection Program where commitments exist to implement the reinspection provisions in GE SIL-644 to support a power uprate license amendment or other activities.
- The applicant is expected to inform the staff of significant changes to its Steam Dryer Reinspection Program where the staff relied on the program in a regulatory decision.

In its review of components associated with Item 3.1.1-29, the staff finds the applicant's proposal to manage aging using the BWR Vessel Internals Program acceptable because the applicant is implementing the guidelines of BWRVIP-139 as accepted by the staff in the SE, and the applicant's BWR Vessel Internals Program incorporates the guidelines of BWRVIP-139.

Based on the program identified, the staff concludes that the applicant's program meets SRP-LR Section 3.1.2.2.11 criteria. For those line items that apply to LRA Section 3.1.2.2.11, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2.12 Cracking Due to Stress-Corrosion Cracking and Irradiation-Assisted Stress-Corrosion Cracking

LRA Section 3.1.2.2.12 refers to LRA Table 3.1.1, Item 3.1.1-30, and addresses cracking due to SCC and IASCC. The applicant stated that this aging effect is not applicable to Columbia, which is a BWR.

SRP-LR Section 3.1.2.2.12 states that cracking due to SCC and IASCC could occur in PWR stainless steel reactor internals exposed to reactor coolant. SRP-LR Table 3.1-1 identifies Item 30 as applicable to PWRs.

The staff verified that SRP-LR Section 3.1.2.2.12 is not applicable to Columbia because Columbia is a BWR, and the staff guidance in this SRP-LR section is only applicable to PWR stainless steel RVI components.

Based on the above, the staff concludes that the staff's guidance criteria of SRP-LR Section 3.1.2.2.12 do not apply to Columbia because the guidance is applicable to a PWR.

3.1.2.2.13 Cracking Due to Primary Water Stress-Corrosion Cracking

LRA Section 3.1.2.2.13 refers to LRA Table 3.1.1, Item 3.1.1-31, and addresses cracking due to PWSCC. The applicant stated that this aging effect is not applicable to Columbia, which is a BWR.

SRP-LR Section 3.1.2.2.13 states that cracking due to PWSCC could occur in PWR components made of nickel alloy and steel with nickel-alloy cladding, including RCPB components and penetrations inside the RCS, such as pressurizer heater sheaths and sleeves, nozzles, and other internal components. SRP-LR Table 3.1-1 identifies Item 31 as applicable to PWRs.

The staff verified that SRP-LR Section 3.1.2.2.13 is not applicable to Columbia because Columbia is a BWR, and the staff guidance in this SRP-LR section is only applicable to PWR nickel alloy and steel with nickel-alloy cladding piping, piping components, piping elements, penetration, nozzles, safe ends, and welds; pressurizer heater sheaths, sleeves, diaphragm plate, manways and flanges; and core support pads and core guide lugs.

Based on the above, the staff concludes that the staff's guidance criteria of SRP-LR Section 3.1.2.2.13 do not apply to Columbia because the guidance is applicable to PWRs.

3.1.2.2.14 Wall Thinning Due to Flow-Accelerated Corrosion

LRA Section 3.1.2.2.14 associated with LRA Table 3.1.1, Item 3.1.1-32, addresses steel components in steam generator internals exposed to secondary FW. The applicant stated that this line item is not applicable because the associated items in LRA Table 3.1.1 are applicable to PWRs only. The staff noted that Columbia is a BWR design; therefore, it finds that the applicant's assessment of this AMR item being not applicable is acceptable.

3.1.2.2.15 Changes in Dimensions Due to Void Swelling

LRA Section 3.1.2.2.15 refers to LRA Table 3.1.1, Item 3.1.1-33, and addresses changes in dimensions due to void swelling. The applicant stated that this aging effect is not applicable to Columbia, which is a BWR.

SRP-LR Section 3.1.2.2.15 states that changes in dimensions due to void swelling could occur in stainless steel and nickel-alloy PWR reactor internal components exposed to reactor coolant. SRP-LR Table 3.1-1 identifies Item 33 as applicable to PWRs.

The staff verified that SRP-LR Section 3.1.2.2.15 is not applicable to Columbia because Columbia is a BWR, and the staff guidance in this SRP-LR section is only applicable to PWR stainless steel and nickel-alloy RVI components.

Based on the above, the staff concludes that the staff's guidance criteria of SRP-LR Section 3.1.2.2.15 do not apply to Columbia because the guidance is applicable to PWRs.

3.1.2.2.16 Cracking Due to Stress-Corrosion Cracking and Primary Water Stress-Corrosion Cracking

(1) LRA Section 3.1.2.2.16.1 is associated with LRA Table 3.1.1, items 3.1.1-34 and 3.1.1-35 and addresses PWR reactor CRD head penetration pressure housings, steam generator upper and lower beads, tube sheets, and tube-to-tube sheet welds made or clad with stainless steel or nickel alloy exposed to reactor coolant. SRP-LR Section 3.1.2.2.16.1 indicates that the GALL Report recommends ASME Section XI ISI and control of water chemistry to manage cracking due to stress corrosion cracking for this component group. The applicant indicated that the line items associated with SRP-LR Section 3.1.2.2.16 item 1 are not applicable because these items are only applicable to PWRs. The staff reviewed the LRA against the GALL Report and SRP-LR and confirmed that the further evaluation described in SRP-LR Section 3.1.2.2.16 item 1 and associated line items are only applicable to PWRs and, therefore, finds the applicant's determination acceptable because its plant is a BWR design and does not contain steam generators.

(2) LRA Section 3.1.2.2.16.2 is associated with LRA Table 3.1.1, Item 3.1.1-36, and addresses stainless steel or nickel alloy pressurizer spray heads exposed to reactor coolant. SRP-LR Section 3.1.2.2.16.2 indicates that the existing program relies on control of water chemistry to mitigate cracking due to SCC and that the GALL Report recommends one-time inspection to confirm that cracking is not occurring. The applicant indicated that the line items associated with SRP-LR Section 3.1.2.2.16, Item 2, are not applicable because these items are only applicable to PWRs. The staff reviewed the LRA against the GALL Report and SRP-LR and confirmed that this further evaluation described in SRP-LR Section 3.1.2.2.16, Item 2, and associated line items are only applicable to PWRs; therefore, it finds the applicant's determination acceptable because its plant is a BWR design and does not contain pressurizers.

3.1.2.2.17 Cracking Due to Stress-Corrosion Cracking, Primary Water Stress-Corrosion Cracking, and Irradiation-Assisted Stress-Corrosion Cracking

LRA Section 3.1.2.2.17 refers to LRA Table 3.1.1, Item 3.1.1-37, and addresses cracking due to SCC, PWSCC, and IASCC. The applicant stated that this aging effect is not applicable to Columbia, which is a BWR.

SRP-LR Section 3.1.2.2.17 states that cracking due to SCC, PWSCC, and IASCC could occur in PWR stainless steel and nickel-alloy RVI components. SRP-LR Table 3.1-1 identifies Item 37 as applicable to PWRs.

The staff verified that SRP-LR Section 3.1.2.2.17 is not applicable to Columbia because Columbia is a BWR, and the staff guidance in this SRP-LR section is only applicable to PWR stainless steel and nickel-alloy RVI components.

Based on the information above, the staff concludes that the staff's guidance criteria of SRP-LR Section 3.1.2.2.17 do not apply to Columbia because the guidance is applicable to PWRs.

3.1.2.2.18 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA Program.

3.1.2.3 AMR Results that are Not Consistent with or Not Addressed in the GALL Report

In LRA Tables 3.1.2-1 through 3.1.2-3, the staff reviewed additional details of AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

In LRA Tables 3.1.2-1 through 3.1.2-3, the applicant indicated, via notes F through J, that the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report. The applicant provided further information concerning how the aging effects will be managed. Specifically, Note F indicates that the material for the AMR line item component is not evaluated in the GALL Report. Note G indicates that the environment for the AMR line item component and material is not evaluated in the GALL Report. Note H indicates that the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report. Note I indicates that the aging effect identified in the GALL Report for the line item component, material, and environment combination is not applicable. Note J indicates that neither the component nor the material and environment combination for the line item is evaluated in the GALL Report.

For component type, material, and environment combinations not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine if the applicant demonstrated that the aging effects will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation. The staff's evaluation is discussed in the following sections.

3.1.2.3.1 Reactor Vessel, Internals, and Reactor Coolant System—Reactor Pressure Vessel—Summary of Aging Management Evaluation—LRA Table 3.1.2-1

In LRA Table 3.1.2-1, the applicant stated that the steel RPV closure studs, nuts, and washers exposed to air-indoor uncontrolled (external) are being managed for loss of material by the Reactor Head Closure Studs Program. The AMR line item cites Generic Note H.

The staff reviewed the associated line items in the LRA and confirmed that the applicant has identified the correct aging effects for this component, material, and environmental combination because, consistent with GALL Report AMP XI.M3, "Reactor Head Closure Studs," the applicant is managing cracking, loss of material, and coolant leakage from RV head studs bolting. The staff confirmed, in LRA Table 3.1.2-1, that the applicant is managing RPV closure studs, nuts, and washers exposed to air-indoor uncontrolled (external) for cracking due to SCC and fatigue, consistent with the recommendations of the GALL Report.

The staff reviewed the applicant's Reactor Head Closure Studs Program, and its evaluation is documented in SER Section 3.0.3.1.24. The staff noted that the program manages cracking and loss of material for the reactor head closure stud assemblies (studs, nuts, washers, and bushings). The staff also noted that the program includes inspections of RV stud assemblies, in accordance with ASME Code, Section XI, Subsection IWB, Table IWB 2500-1 (2003 addenda), consistent with the GALL Report. Based on its review, the staff finds the applicant's proposal to manage aging using the Reactor Head Closure Studs Program acceptable because the program includes ISIs with a demonstrated capability of detecting loss of material and implementing the preventive measures to mitigate or prevent the aging effect due to corrosion or wear, such as the application of a rust-inhibiting phosphate coating that also provides the retention of lubricity.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.1.2-1, the applicant stated that for steel RPV components and nozzles exposed to uncontrolled indoor air (external), there is no aging effect, and no AMP is proposed. The AMR line items cite Generic Note G. The AMR line items also cite plant-specific Note 0101, which states that the GALL Report Chapter IV does not list indoor air as an environment for carbon steel or low-alloy steel components such as the vessel shell and that the AMR finds that there is no identified aging effect for these components exposed to indoor air with a temperature greater than 212 °F.

The staff reviewed the associated line items in the LRA and noted that the indicated operating temperature of greater than 212 °F precludes the condensation of moisture on the component external surfaces and that, in the absence of such condensation or other sources of moisture, the general corrosion rate for carbon steel in contact with indoor air is negligible at anticipated BWR pressure vessel operating temperatures. The staff also noted that steel pressure vessel components would have the same aging effect and degradation rate as steel piping, piping components, and piping elements, given the same environment. The staff further noted that GALL Report, Item SP-1, which is applicable to the steel piping, piping components, and piping elements in an external environment of indoor air, recommends that there is no aging effect and no AMP required for this material and environment combination. The staff finds the applicant's determination, that there are no aging effects and no AMP required for these components, acceptable because the LRA components are similar to other GALL Report items for the same material and environment combination (e.g., item V.F-16).

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.1.2-1, the applicant stated that the steel nozzle N08 and nozzle flange exposed to reactor coolant (internal) are being managed for cracking due to flaw growth by the ISI Program. The AMR line items cite Generic Note H, indicating that for the line item(s), the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed the associated line items in the LRA and confirmed that the applicant correctly stated that there are no cracking due to flaw growth aging effect entries in the GALL Report for this component, material, and environment combination.

The staff's evaluation of the applicant's ISI Program is documented in SER Section 3.0.3.1.19. The staff noted that the ISI Program is an existing program based on ASME Code, Section XI, requirements. The staff further noted that the ISI Program is designed to manage cracking due to SCC and IGA and flaw growth of RCS pressure boundary components made of nickel alloy, stainless steel (including CASS), and steel (including steel with stainless steel cladding), including the RV, a limited number of internals components, and the RCS pressure boundary. The staff finds the applicant's proposal to manage cracking due to flaw growth using the ISI Program acceptable because, even though the GALL Report does not identify the aging effect under consideration for the material and environment combination stated here, the proposed application of the applicant's ISI Program inspects the internal surfaces of components subject to AMR and provides additional verification that the aging effect, cracking due to flaw growth, will be managed.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.1.2-1, the applicant stated that for steel with stainless steel cladding RPV components and nozzles, RPV shell (shell rings), RPV upper head (closure flange), nozzle N01 (RRC outlets), nozzle N02 (RRC inlets), RPV shell (closure flange), and RPV bottom head, exposed to air-indoor uncontrolled (external), there is no aging effect, and no AMP is proposed. The AMR line items cite Generic Note G. These items also cite plant-specific Note 0101, which states that the GALL Report, Chapter IV, does not list indoor air as an environment for carbon steel or low-alloy steel components such as the vessel shell; therefore, the AMR finds that there is no identified aging effect for these components whose temperature is greater than 212 °F exposed to indoor air.

The staff notes that given that the short duration of outages and the prompt return to temperatures greater than 212 °F, minimum loss of material would occur because the surfaces are dry during the majority of plant life. The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because the indicated operating temperature of greater than 212 °F precludes the condensation of moisture on the component external surfaces, and, in the absence of such condensation or other sources of moisture, the general corrosion rate for carbon steel in contact with indoor air is negligible at anticipated BWR pressure vessel operating temperatures.

The staff noted that pressure vessel steel components would have the same aging effect and degradation rate as steel piping, piping components, and piping elements, given the same environment, as in item SP-1 in the GALL Report, which is applicable to the steel piping, piping components, and piping elements in an external environment of indoor air and does not require an AERM or AMP. The staff finds the applicant's proposal acceptable because the LRA components are similar to other GALL Report items for the material and environment (e.g., GALL Report, Volume 2, Item V.F-16), in which the AERM is listed as "none," the AMP is listed as "none," and no further evaluation is required.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.1.2-1, the applicant stated that the steel support components for the RPV support skirt bearing plate exposed to an air-indoor uncontrolled (external) environment are being managed for cracking-flaw growth and loss of material by the ISI Program—IWF. The AMR line items cite Generic Note H.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination. The staff's evaluation of the applicant's ISI Program—IWF is documented in SER Section 3.0.3.1.21. The staff finds the applicant's proposal to manage aging using the AMP acceptable because visual examinations of supports are conducted and are capable of identifying indications of degradation such as cracking-flaw growth or loss of material.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.1.2-1 the applicant stated that the steel nozzle (N06) safe-end extension (RHR/LPCI) exposed to air-indoor uncontrolled (external) does not require any aging effect to be managed. The related AMR line item cites Generic Note G, indicating that the environment is not in the GALL Report for this component and material. Also, the associated plant-specific note 0101 states that there is no identified aging effect for these components, based on its being exposed to indoor air, where temperature is greater than 212 °F.

The staff reviewed all AMR result line items in the GALL Report where the material is steel and the aging effect/mechanism is loss of material due to general, pitting or crevice corrosion or stress corrosion induced cracking, and confirmed that for this environment, there are no entries in the GALL Report for this steel nozzle safe-end extension. The staff also noted that Columbia normally operates at full power with external surface temperatures in excess of 212 ºF. Furthermore, external surfaces operating at temperatures above this threshold drive off moisture and preclude corrosion of the component external surfaces. The staff noted the time period during a refueling outage that these components are exposed to ambient temperatures is for relatively short periods of time and corrosion due to atmospheric moisture is not expected to be significant.

The GALL Report indicates that the presence of both moisture and cool or warm environmental conditions are necessary for condensation or moisture to occur on component surfaces. A surface environment above 212 ºF is hot enough to preclude the precipitation of moisture or condensation, that if otherwise present, might induce corrosive type aging effects such as loss of material due to general, pitting or crevice corrosion or stress corrosion induced cracking. Based on its review, the staff finds the applicant has appropriately identified that the above mentioned component is not subject to aging effects requiring management because, during power operations, the high temperature air environment temperature greater than 212 ºF for the steel components will preclude condensation or moisture from occurring on the component surfaces.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM and AMP combinations not addressed in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.1.2-1 and 3.1.2-3 the applicant stated that various reactor vessel components of steel, steel with stainless steel cladding, stainless steel, and nickel alloys exposed to reactor coolant (internal), with one exception listed below, are being managed for “cracking – flaw growth” by the ISI Program. The related AMR line items cite Generic Note H, indicating that the aging effect is not in the GALL Report for this component, material, and environment combination. These components include: RPV shells or shell rings, various nozzles and associated safe-ends / thermal sleeves, penetrations, and support attachments/welds. The applicant has plant-specific note 0104 for some items indicating that the internal attachments inside the vessel only have an external (rather than internal) environment, which is reactor coolant.

The exception of note here is: the applicant has listed in row item 313 of LRA Table 3.1.2-1 that RPV stabilizer brackets made of steel exposed to air-indoor uncontrolled (external) are being managed for “cracking-flaw growth” by the ISI Program, and classified this with the Generic Note H. This classification did not appear to the staff to be appropriate because for the same environment of air-indoor uncontrolled (external), steel material, and the aging effect, the AMR Table 3.1.2-1 classified nozzle (N06) safe-end extension (RHR/LPCI) with the Generic Note G which states that the environment is not in the GALL Report for this component and material.

By letter dated September 16, 2010, the staff issued RAI 3.1.2.3.1-1 requesting that the applicant justify why the treatment of these two items is different for the same material exposed to same environment for managing the aging effect in one and not the other item.

In its response dated December 21, 2010 the applicant clarified that the “cracking-flaw growth” in the steel nozzle (N06) safe-end extension (RHR/LPCI) exposed to air-indoor uncontrolled (external), being managed under the ISI Program, refers to the aging effect due to its internal environment where the applied stress component is on the nozzle inside surface. The applicant further clarified that, for the steel RPV stabilizer brackets the stresses can only be associated with the external surface exposed to the external environment because the brackets have no internal surface.

The staff finds the applicant’s response acceptable because the two AMR items are different and its treatment are classified with two different generic notes. The staff’s concern described in RAI 3.1.2.3.1-1 is resolved.

The staff also reviewed all AMR line items in the GALL Report where RPV components made of steel, steel with stainless steel cladding, stainless steel, and nickel alloys exposed to reactor coolant (internal), and confirmed that there are no aging effect entries (for “cracking-flaw growth”) in the GALL Report for this component, material, and environment combination.

For all of these items with Generic Note H, except as noted in the RAI 3.1.2.3.1-1, the LRA refers to “cracking-flaw growth” as the aging effect/mechanism being managed by the ISI Program. The applicant’s use of “cracking-flaw growth” was not clear to the staff.

Therefore, by letter dated September 16, 2010, the staff issued RAI 3.1.2.3.1-2 requesting that the applicant clarify the meaning and intended use of " cracking-flaw growth " as an aging effect/mechanism, and identify any of the items for "Flaw Growth" (as associated with the Generic Note H of this AMR) in the current licensing basis (CLB) for flaw growth or flaw tolerance evaluations to analyze fatigue that involved the current operating term (40 years) and were determined to be relevant in making the safety determination.

The staff also requested the applicant to justify the adequacy of aging management of applicable items by the ISI Program (as Generic Note H items), and include these under time-limited aging analysis (TLAA) assessment.

In its response to RAI 3.1.2.3.1-2, dated December 21, 2010, the applicant clarified that the "cracking-flaw growth" (note H item) refers to the cracking of components, either from pre-service flaws or from service-induced flaws, due to the cyclic loads imposed upon those components during operation. The applicant further clarified in its supplemental information in response to RAI 3.1.2.3.1-2, letter dated January 28, 2011, that for note H "cracking-flaw growth" means that postulated flaws are considered to exist but are below the ASME code requirement for evaluation and these items credit the ISI Program for its management in the extended period of operation.

The staff finds this clarification to resolve the issue of these note H items acceptable because the intended use of "cracking-flaw growth" does not refer to existing flaws requiring any evaluation, and the ISI Program is an existing program that will be continued for the period of extended operation. The applicant also stated that the only flaws discovered through the ISI Program that required flaw growth time-limited aging analyses are the reactor vessel (RV) shell indications discussed in LRA Section 4.7.1.

The staff reviewed LRA Section 4.7.1 noting that inspections performed by the applicant in accordance with the ISI Program detected RPV shell indications in RV shell welds BG and BM which the applicant analyzed and dispositioned for further service using a time-dependent fatigue flaw growth analysis. The applicant dispositioned the TLAA in accordance with the requirement in 10 CFR 54.21(c)(1)(iii) by stating that the ISI Program will be used to manage the effect of "cracking-flaw growth" in the BG and BM welds. The LRA Section 4.7.1 clarified that the ISI will accomplish this by performing supplemental inspection of the weld indications in order to verify whether the existing fatigue flaw growth analysis will remain valid for the period of extended operation or else whether the analysis would need to be revised for the period of extended operation for the components/welds repaired or replaced.

However, the staff could not confirm which AMR item entries on "cracking-flaw growth" in LRA Tables 3.1.2-1 or 3.1.2-3 (Generic Note H with ISI) pertained to these RV weld components of LRA Section 4.7.1. In its supplemental response to RAI 3.1.2.3.1-2, dated January 28, 2011, the applicant noted that the BG and BM welds are managed as part of the RPV shell (shell Rings) in Table 3.1.2-1 rows 17 through 23. The applicant further provided an amendment to its LRA Table 3.1.2-1 by adding a plant specific row 20a for welds BG and BM of LRA Section 4.7.1, and by adding a plant specific note K to clarify that its ISI program will continue to manage the specific indications in RPV shell welds BG and BM.

The staff's evaluation of the applicant's ISI Program is documented in SER Section 3.0.3.1.19. The staff notes that the ISI Program is an existing program based on ASME Code Section XI requirements which manages cracking due to SCC/IGA and flaw growth of reactor coolant system pressure boundary components made of nickel alloy, stainless steel, and steel (including steel with stainless steel cladding), including the reactor vessel, a limited number of internals components, and the reactor coolant system pressure boundary. The staff finds the applicant's proposal to manage aging of welds BG and BM of LRA Section 4.7.1 using the ISI Program acceptable because the ISI Program is consistent with GALL Report AMP and the applicant will re-evaluate the weld indications based on results of scheduled inspection in 2015 by projecting the analysis of Section 4.7.1 through the period of extended operation or continue augmented inspections as required by the ASME Code. The staff's concern described in RAI 3.1.2.3.1-2 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM and AMP combinations not addressed in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.3.2 Reactor Vessel, Internals, and Reactor Coolant System—Reactor Vessel Internals—Summary of Aging Management Evaluation—LRA Table 3.1.2-2

In LRA Table 3.1.2-2, the applicant stated that stainless steel, nickel alloy, and CASS RVI components exposed to reactor coolant with neutron fluence (internal) are being managed for cracking due to flaw growth by the BWR Vessel Internals Program. The AMR line items cite Generic Note H.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because pre-existing fabrication flaws such as shrinkage voids and microcracks can serve as nucleation sites for cracking due to thermal or mechanical loading, possibly assisted by environmental effects.

The staff's evaluation of the applicant's BWR Vessel Internals Program is documented in SER Section 3.0.3.1.6. The staff noted that the applicant's BWR Vessel Internals Program credits portions of the BWR Water Chemistry Program and the ISI Program. The ISI Program performs inspection of Columbia's RVI in accordance with ASME Code, Section XI requirements, as required by 10 CFR 50.55a. Additionally, the BWR Vessel Internals Program implements the augmented inspection and evaluation guidelines of all BWRVIP documents applicable to inspection and evaluation of RVI components to ensure compliance with the quality assurance requirements of 10 CFR Part 50, Appendix B. The control of RCS water chemistry for mitigating SCC in RVI components at Columbia is implemented in accordance with the guidelines of applicable BWRVIP documents, as described in the Columbia BWR Water Chemistry Program. The staff finds the applicant's proposal to manage aging using the BWR Vessel Internals Program acceptable because the evaluation guidelines of all BWRVIP documents applicable to inspection and evaluation of RVI components ensure subject indications are being monitored.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.3.3 Reactor Vessel, Internals, and Reactor Coolant System—Reactor Coolant Pressure Boundary—Summary of Aging Management Evaluation—LRA Table 3.1.2-3

In LRA Table 3.1.2-3, the applicant stated that stainless steel annubar tubes, flow elements less than 4 in., and condenser components exposed to reactor coolant are being managed for cracking due to flaw growth by the Small Bore Class 1 Piping Inspection Program. The AMR line items cite Generic Note H.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because pre-existing flaws—such as weld voids and microcracks and other fabrication defects—can serve as nucleation sites for cracking due to thermal or mechanical loading, possibly assisted by environmental effects. The staff further noted that the applicant is also managing loss of material and cracking due to SCC and IGSCC with its BWR Water Chemistry Program and Chemistry Program Effectiveness Inspection Program, consistent with the recommendations of the GALL Report.

The staff's evaluation of the applicant's Small Bore Class 1 Piping Inspection Program is documented in SER Section 3.0.3.1.28. The staff noted that, in its response to RAI B.2.49-1 dated September 13, 2010, concerning this program, the applicant replaced its Small Bore Class 1 Piping Inspection Program with a new plant-specific Small Bore Class 1 Piping Program. The staff's review of this new plant-specific program is documented in SER Section 3.0.3.3.13. The staff also noted that the applicant's Small Bore Class 1 Piping Program is a periodic inspection program that will detect and characterize cracking of Class 1 small-bore (less than 4 in. NPS) piping components, including piping, fittings, connections, and valve bodies. The staff also noted that the applicant's Small Bore Class 1 Piping Program provides ongoing inspections of these components using a combination of visual inspections and volumetric examinations that are equivalent to and beyond those recommended in GALL Report AMP XI.M35 for ASME Class 1 small bore piping. The staff also noted that the selection criteria for components to be inspected in the Small Bore Class 1 Piping Program include consideration of susceptibility to degradation similar to the selection criteria recommended in GALL Report AMP XI.M35. The staff further notes that this new program includes specific provisions for the examination of butt and socket welds. The staff finds the applicant's proposal to manage aging using the Small Bore Class 1 Piping Program acceptable because the inspection techniques proposed by the applicant in this program have a demonstrated capability to detect cracking in piping weld and base metal.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.1.2-3, as amended by letter dated September 21, 2010, the applicant stated that the stainless steel, CASS, and steel piping and piping components less than 4-in. NPS exposed to reactor coolant are being managed for cracking—flaw growth by the ISI Program. The AMR line items cite Generic Note H. In the applicant's letter, the applicant clarified that the aging effect referred to as "cracking—flaw growth" is cracking due to thermal and mechanical loading, as addressed in the GALL Report.

The staff reviewed the associated items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because, even though the applicant uses a different term to address the aging effect of cracking due to thermal and mechanical loading, it adequately identified the aging effect that is applicable for the Class 1 piping and piping components less than 4-in. NPS and is consistent with GALL Report Item IV.C1-1. The staff confirmed that, for these components, the applicant is also managing loss of material with its BWR Water Chemistry Program and Chemistry Program Effectiveness Inspection Program, which are consistent with the recommendations of the GALL Report. The staff also confirmed that the applicant is managing cracking due to SCC and IGA with its ISI Program, as amended by letter dated September 23, 2010.

The staff's evaluation of the applicant's ISI Program is documented in SER Section 3.0.3.1.19. The staff noted that the ISI Program includes visual, surface, and volumetric examinations so that the program periodically confirms the maintaining of intended function of the components during the period of extended operation. The staff finds the applicant's proposal to manage aging using the ISI Program acceptable because the ISI Program includes periodic visual, surface, and volumetric examinations that are adequate to detect and manage the aging effect for the components.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.1.2-3, the applicant stated that the CASS RRC pump casing and valve bodies (greater than or equal to 4 in.) exposed to reactor coolant (internal) are being managed for "cracking—flaw growth" by the ISI Program. The AMR line items cite Generic Note H, indicating that, for these line items, the aging effect is not in the GALL Report for these components, material, and environment combinations.

In its review, the staff noted that, even though this component, material, and environment combination is not specifically addressed in the GALL Report, GALL Report Item IV.C1-1 addresses cracking due to thermal and mechanical loading of Class 1 piping, fittings, and branch connections less than NPS 4 in. The staff also finds that the applicant identified the correct aging effect for the component, material, and environmental combination because thermal and mechanical loading could cause cracking and subsequent flaw growth in the components, as addressed in GALL Report Item IV.C1-1.

The staff's evaluation of the applicant's ISI Program is documented in SER Section 3.0.3.1.19. The staff finds that the applicant's proposal to manage aging using the ISI Program acceptable because it includes periodic inspections, which are able to detect and manage this aging effect in these components, and the program also performs evaluations of the examination results in accordance with the requirements of ASME Code, Section XI, which are adequate to maintain the integrity of the components.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.1.2-3, the applicant stated that the CASS valve bodies (less than 4 in.) exposed to reactor coolant (internal) are being managed for "cracking—flaw growth" by the Small Bore Class 1 Piping Inspection Program. The AMR line item cites Generic Note H, indicating that the aging effect is not addressed in the GALL Report for this component, material, and environment combination.

The staff reviewed the associated line items in the LRA against the GALL Report and confirmed that the aging effect of “cracking—flaw growth” is not addressed in the GALL Report for these components, material, and environment combinations. The staff also noted that, in LRA Table 3.1.2-3, the applicant addressed “Cracking—SCC/IGA” for the CASS valve bodies (less than 4 in.) exposed to reactor coolant (internal). In its review, the staff finds that the applicant identified the correct aging effect for this component, material, and environmental combination because thermal and mechanical loading could cause cracking and subsequent flaw growth in the components, as addressed in GALL Report Item IV.C1-1.

In its review, the staff noted that the aging effect, “cracking—flaw growth,” described in the LRA suggests the possibility that a flaw already exists in the CASS valve bodies (less than 4 in.). In its review of line items associated with the valve bodies less than 4 in. addressed in LRA Table 3.1.2-3, the staff also noted that the Small Bore Class 1 Piping Inspection Program is proposed to manage the aging of the CASS components through a one-time inspection of internal surfaces, and LRA Section B.2.49 indicates that the program includes visual and volumetric inspection of a representative sample of small bore Class 1 piping components.

GALL Report Item IV.C1-1 recommends GALL Report AMP XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” GALL Report AMP XI.M2, “Water Chemistry,” and GALL Report AMP XI.M35, “One-Time Inspection of ASME Code Class 1 Small Bore Piping,” for managing cracking of Class 1 piping less than NPS 4 in. The staff noted that, in LRA Table 3.1.2-3, the applicant only credits its Small Bore Class 1 Piping Inspection Program. By letter dated, August 26, 2010, the staff issued RAI 3.1.2.3-02 requesting the applicant clarify whether these components have an existing flaw. If so, the staff asked the applicant to clarify why the Small Bore Class 1 Piping Inspection Program, which is based on a one-time inspection rather than periodic inspections, is adequate to manage the aging effect.

In its response dated November 11, 2010, the applicant stated that it does not have small bore CASS Class 1 valves with a flaw. The applicant also stated that it is assumed that indications below the minimum detectable size may exist in components; thus, these indications are not identified or documented. Furthermore, some Class 1 components have indications that are small enough to be acceptable per ASME Code, and the primary mechanism that would cause growth (or initiation) of these assumed flaws is thermal and mechanical loading. The applicant also stated that, to detect and manage the aging effect, the Small Bore Class 1 Piping Inspection Program was replaced by the Small Bore Class 1 Piping Program to perform periodic visual and volumetric examinations of Class 1 components based upon its susceptibility to aging.

Based on its review, the staff finds the applicant’s response to RAI 3.1.2.3-02 acceptable because the applicant clarified the following:

- There is no small bore CASS Class 1 valve body that contains an unacceptable flaw.
- The Small Bore Class 1 Piping Inspection Program was replaced by the Small Bore Class 1 Piping Program, which includes periodic visual and volumetric inspections of valve bodies so that the program is adequate to detect and manage the aging effect.

The staff’s concern described in RAI 3.1.2.3-02 is resolved.

The applicant amended the LRA by letter dated September 21, 2010, indicating that the ISI Program is credited to manage cracking due flaw growth of the small bore components. The staff noted that LRA Table 3.1.2-3, as amended by this letter, clarified that the ISI Program is also credited to manage this aging effect of CASS valve bodies less than 4 in. In a teleconference call held on March 8, 2011, the applicant further clarified that VT-2 examination, as required by the ASME Code, Section XI, is used to manage cracking due to flaw growth. The staff finds that the applicant's use of the ISI Program is also acceptable because the use of the program is adequate to detect leakage due to flaw growth and manage aging, consistent with the GALL Report.

The staff's evaluation of the applicant's Small Bore Class 1 Piping Program and the ISI Program is documented in SER Sections 3.0.3.3.13 and 3.0.3.1.19, respectively. In its review, the staff finds the applicant's proposal to manage aging using the Small Bore Class 1 Piping Program and ISI Program acceptable because the ISI Program includes periodic visual, surface, and volumetric inspections and also performs evaluations of the examination results in accordance with the requirements of ASME Code, Section XI. Additionally, the Small Bore Class 1 Piping Program include periodic visual and volumetric inspections of these components, which are adequate to maintain the integrity of these components.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.1.2-3, the applicant stated that the steel piping, fittings and valve bodies less than 4 in. exposed to reactor coolant (internal) are being managed for cracking due to flaw growth by the Small Bore Class 1 Piping Inspection Program. The AMR line items cite Generic Note H, indicating that for the line item(s), the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff's evaluation of the applicant's Small Bore Class 1 Piping Inspection Program is documented in SER Section 3.0.3.1.28. The staff noted that in its response to RAI B.2.49-1 dated September 13, 2010, concerning this program, the applicant replaced its Small Bore Class 1 Piping Inspection Program with a new plant-specific Small Bore Class 1 Piping Program. The staff also noted that the applicant's Small Bore Class 1 Piping Program is a periodic inspection program that will detect and characterize cracking of Class 1 small-bore (less than or equal to 4 in. NPS) piping components, including piping, fittings, connections, and valve bodies, using both visual and volumetric (destructive or nondestructive or both) techniques. The staff further notes that this new program includes specific provisions for the examination of butt and socket welds. The staff finds the applicant's proposal to manage aging using the Small Bore Class 1 Piping Program acceptable because pre-existing flaws (e.g., weld defects) can serve as nucleation sites for cracking and the program includes visual and volumetric inspection techniques which have a demonstrated capability to detect cracking in weld and base metals.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.1.2-3, the applicant stated that steel and stainless valve bodies (greater than or equal to 4 in.) exposed to reactor coolant (internal) are being managed for cracking due to flaw growth by the ISI Program. The AMR line items cite Generic Note H.

The staff noted that LRA Table 3.1.2-3 has other line items associated with steel and stainless valve bodies (greater than or equal to 4 in.) exposed to reactor coolant (internal), which address other aging effects including, cracking fatigue, cracking—SCC/IGA, and loss of material. The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because pre-existing fabrication flaws, such shrinkage voids and microcracks, can serve as nucleation sites for cracking due to thermal or mechanical loading, possibly assisted by environmental effects.

The staff's evaluation of the applicant's ISI Program is documented in SER Section 3.0.3.1.19. The staff noted that the applicant's ISI Program is a periodic inspection program that will manage cracking due to SCC and IGA and flaw growth in RCS steel, stainless steel, and nickel alloy pressure boundary components. The staff also noted that the applicant's ISI Program is consistent with GALL Report Section XI.M1, "ASME Section XI In-service Inspection, Subsections IWB, IWC, and IWD," and specifically includes the inspection of valve bodies. The staff finds the applicant's proposal to manage aging using the ISI Program acceptable because the inspection techniques proposed by the applicant in this program have a demonstrated capability and a proven industry record to detect cracking in piping weld and valve base material.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.1.2-3, the applicant stated that steel and stainless steel piping (including RPV flange leak off line), fittings, orifices, valve bodies, heat exchangers (tube in a tube), and tubing (all less than 4 in.) exposed to reactor coolant (internal) are being managed for cracking due to flaw growth by the Small Bore Class 1 Piping Inspection Program. The AMR line items cite Generic Note H.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because the GALL Report recommends that the components be managed for reduction of heat transfer (heat exchanger only), loss of material, and cracking, and the applicant is managing these additional aging effects in other AMR lines in LRA Table 3.1.2-3.

The staff's evaluation of the applicant's Small Bore Class 1 Piping Inspection Program is documented in SER Section 3.0.3.1.28. The staff noted that, in its response to RAI B.2.49-1 dated September 13, 2010, concerning this program, the applicant replaced its Small Bore Class 1 Piping Inspection Program with a new plant-specific Small Bore Class 1 Piping Program. The staff also noted that the applicant's Small Bore Class 1 Piping Program is a Periodic Inspection Program that will detect and characterize cracking of Class 1 small-bore (less than 4 in. NPS) piping components, including piping, fittings, connections, and valve bodies, using both visual and volumetric (destructive or nondestructive) techniques. The staff further notes that this new program includes specific provisions for the examination of butt and socket welds. The staff finds the applicant's proposal to manage aging using the Small Bore Class 1 Piping Inspection Program acceptable because pre-existing flaws (e.g., weld defects) can serve as nucleation sites for cracking, and the program includes visual and volumetric inspection techniques that have a demonstrated capability to detect cracking in weld and base metals.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.1.2-3 the applicant stated that the steel bolting exposed to air-indoor uncontrolled (external) is being managed for cracking due to SCC by the Bolting Integrity Program. The related AMR line item cites Generic Note G, indicating that the environment is not in the GALL Report for the aging effects of this component and material combination.

The staff reviewed all AMR result line items in the GALL Report where the material is steel and the aging effect and mechanism is cracking due to SCC and confirmed that for this environment, there are no entries in the GALL Report for this component and material.

The staff's evaluation of the applicant's Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The staff finds the applicant's proposal to manage aging using the Bolting Integrity Program acceptable because staff's review confirmed that the aging effects identified are appropriate for this component, material, and environment combination and that the proposed aging related periodic or walkdown inspection under the applicant's Bolting Integrity Program will be adequate to detect this aging.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.3 Conclusion

The staff concludes that the applicant provided sufficient information to demonstrate that the effects of aging for the RPV, RVI, and RCPB components within the scope of license renewal and subject to an AMR will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2 <u>Aging Management of Engineered Safety Features</u>

This section of the SER documents the staff's review of the applicant's AMR results for the ESF components and component groups of the following systems:

- RHR System
- RCIC System
- HPCS System
- LPCS System
- Standby Gas Treatment (SGT) System

3.2.1 Summary of Technical Information in the Application

LRA Section 3.2 provides AMR results for the ESF components and component groups. LRA Table 3.2.1, “Summary of Aging Management Evaluations for the Engineered Safety Features,” provides a summary comparison of its AMRs to those evaluated in the GALL Report for ESF components and component groups.

The applicant’s AMRs evaluated and incorporated applicable plant-specific and industry operating experience in the determination of AERMs. The plant-specific evaluation included issue reports and discussions with appropriate site personnel to identify AERMs. The applicant’s review of industry operating experience included a review of the GALL Report and operating experience issues identified since the issuance of the GALL Report.

3.2.2 Staff Evaluation

The staff reviewed LRA Section 3.2 to determine if the applicant provided sufficient information to demonstrate that the effects of aging for ESF components within the scope of license renewal and subject to an AMR will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff conducted an onsite audit of AMPs to confirm the applicant’s claim that certain AMPs were consistent with the GALL Report. The purpose of this audit was to examine the applicant’s AMPs and related documentation and to verify the applicant’s claim of consistency with the corresponding GALL Report AMPs. The staff did not repeat its review of the matters described in the GALL Report. The staff’s evaluations of the AMPs are documented in SER Section 3.0.3.

The staff reviewed the AMRs to confirm the applicant’s claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. Details of the staff’s evaluation are discussed in SER Sections 3.2.2.1 and 3.2.2.2.

The staff also reviewed the AMRs not consistent with or not addressed in the GALL Report. The review evaluated whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. Details of the staff’s evaluation are discussed in SER Section 3.2.2.3.

For components which the applicant claimed were not applicable or required no aging management, the staff reviewed the AMR line items and the plant’s operating experience to verify the applicant’s claims.

Table 3.2-1 summarizes the staff’s evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.2 and addressed in the GALL Report.

Table 3.2-1 Staff evaluation for ESF system components in the GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel and stainless steel piping, piping components, and piping elements in the ECCS (3.2.1-01)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA	Fatigue is a TLAA (See SER Section 3.2.2.2.1)
Steel with stainless steel cladding pump casing exposed to treated borated water (3.2.1-02)	Loss of material due to cladding breach	A plant-specific AMP is to be evaluated. Reference NRC IN 94-63, "Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks"	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.2.2.2.2)
Stainless steel containment isolation piping and components internal surfaces exposed to treated water (3.2.1-03)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Chemistry Program Effectivenes Inspection	Consistent with GALL Report (See SER Section 3.2.2.2.3)
Stainless steel piping, piping components, and piping elements exposed to soil (3.2.1-04)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.2.3)
Stainless steel and aluminum piping, piping components, and piping elements exposed to treated water (3.2.1-05)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Chemistry Program Effectivenes Inspection	Consistent with GALL Report (See SER Section 3.2.2.2.3)
Stainless steel and copper alloy piping, piping components, and piping elements exposed to lubricating oil (3.2.1-06)	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis and Lubricating Oil Inspection	Consistent with GALL Report (See SER Section 3.2.2.2.3)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Partially encased stainless steel tanks with breached moisture barrier exposed to raw water (3.2.1-07)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated for pitting and crevice corrosion of tank bottoms because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.2.3)
Stainless steel piping, piping components, piping elements, and tank internal surfaces exposed to condensation (internal) (3.2.1-08)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	Yes	External Surfaces Monitoring	Consistent with GALL Report (See SER Section 3.2.2.2.3)
Steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil (3.2.1-09)	Reduction of heat transfer due to fouling	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis and Lubricating Oil Inspection	Consistent with GALL Report (See SER Section 3.2.2.2.4)
Stainless steel heat exchanger tubes exposed to treated water (3.2.1-10)	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Heat Exchangers Inspection	Consistent with GALL Report (See SER Section 3.2.2.2.4)
Elastomer seals and components in the SGT system exposed to air-indoor uncontrolled (3.2.1-11)	Hardening and loss of strength due to elastomer degradation	A plant-specific AMP is to be evaluated.	Yes	Flexible Connection Inspection	Consistent with GALL Report (See SER Section 3.2.2.2.5)
Stainless steel high-pressure safety injection (charging) pump miniflow orifice exposed to treated borated water (3.2.1-12)	Loss of material due to erosion	A plant-specific AMP is to be evaluated for erosion of the orifice due to extended use of the centrifugal high-pressure safety injection pump for normal charging.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.2.2.2.6)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel drywell and suppression chamber spray system nozzle and flow orifice internal surfaces exposed to air-indoor uncontrolled (internal) (3.2.1-13)	Loss of material due to general corrosion and fouling	A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.2.7)
Steel piping, piping components, and piping elements exposed to treated water (3.2.1-14)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.2.2.2.8)
Steel containment isolation piping, piping components, and piping elements internal surfaces exposed to treated water (3.2.1-15)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.2.2.2.8)
Steel piping, piping components, and piping elements exposed to lubricating oil (3.2.1-16)	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis and Lubricating Oil Inspection	Consistent with GALL Report (See SER Section 3.2.2.2.8)
Steel (with or without coating or wrapping) piping, piping components, and piping elements buried in soil (3.2.1-17)	Loss of material due to general, pitting, crevice, and MIC	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.2.9)
Stainless steel piping, piping components, and piping elements exposed to treated water > 60 °C (140 °F) (3.2.1-18)	Cracking due to SCC and IGSCC	BWR SCC and Water Chemistry	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Steel piping, piping components, and piping elements exposed to steam or treated water (3.2.1-19)	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	No	Flow-Accelerated Corrosion	Consistent with GALL Report
CASS piping, piping components, and piping elements exposed to treated water (borated or unborated) > 250 °C (482 °F) (3.2.1-20)	Loss of fracture toughness due to thermal aging embrittlement	Thermal Aging Embrittlement of CASS	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
High-strength steel closure bolting exposed to air with steam or water leakage (3.2.1-21)	Cracking due to cyclic loading and SCC	Bolting Integrity	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Steel closure bolting exposed to air with steam or water leakage (3.2.1-22)	Loss of material due to general corrosion	Bolting Integrity	No	Not applicable	Not applicable to Columbia(See SER Section 3.2.2.1.1)
Steel bolting and closure bolting exposed to air-outdoor (external), or air-indoor uncontrolled (external) (3.2.1-23)	Loss of material due to general, pitting, and crevice corrosion	Bolting Integrity	No	Bolting Integrity	Consistent with GALL Report
Steel closure bolting exposed to air-indoor uncontrolled (external) (3.2.1-24)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	Bolting Integrity Program	Consistent with GALL Report
Stainless steel piping, piping components, and piping elements exposed to closed-cycle cooling water > 60 °C (140 °F) (3.2.1-25)	Cracking due to SCC	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Steel piping, piping components, and piping elements exposed to closed-cycle cooling water (3.2.1-26)	Loss of material due to general, pitting, and crevice corrosion	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Steel heat exchanger components exposed to closed-cycle cooling water (3.2.1-27)	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Stainless steel piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water (3.2.1-28)	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Copper alloy piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water (3.2.1-29)	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Stainless steel and copper alloy heat exchanger tubes exposed to closed-cycle cooling water (3.2.1-30)	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
External surfaces of steel components including ducting, piping, ducting closure bolting, and containment isolation piping external surfaces exposed to air-indoor uncontrolled (external); condensation (external) and air-outdoor (external) (3.2.1-31)	Loss of material due to general corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring Supplemental Piping and Tank Inspection Program	Consistent with GALL Report (See SER Section 3.2.2.1.2)
Steel piping and ducting components and internal surfaces exposed to air-indoor uncontrolled (internal) (3.2.1-32)	Loss of material due to general corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	Preventive Maintenance - RCIC Turbine Casing External Surfaces Monitoring	Consistent with GALL Report
Steel encapsulation components exposed to air-indoor uncontrolled (internal) (3.2.1-33)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Steel piping, piping components, and piping elements exposed to condensation (internal) (3.2.1-34)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Steel containment isolation piping and components internal surfaces exposed to raw water (3.2.1-35)	Loss of material due to general, pitting, crevice, and MIC and fouling	Open-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel heat exchanger components exposed to raw water (3.2.1-36)	Loss of material due to general, pitting, crevice, galvanic, and MIC and fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water	Consistent with GALL Report
Stainless steel piping, piping components, and piping elements exposed to raw water (3.2.1-37)	Loss of material due to pitting, crevice, and MIC	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water	Consistent with GALL Report
Stainless steel containment isolation piping and components internal surfaces exposed to raw water (3.2.1-38)	Loss of material due to pitting, crevice, and MIC and fouling	Open-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia
Stainless steel heat exchanger components exposed to raw water (3.2.1-39)	Loss of material due to pitting, crevice, and MIC and fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water	Consistent with GALL Report
Steel and stainless steel heat exchanger tubes (serviced by open-cycle cooling water) exposed to raw water (3.2.1-40)	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water	Consistent with GALL Report
Copper alloy > 15% Zn piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water (3.2.1-41)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Gray cast iron piping, piping components, piping elements exposed to closed-cycle cooling water (3.2.1-42)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Gray cast iron piping, piping components, and piping elements exposed to soil (3.2.1-43)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Gray cast iron motor cooler exposed to treated water (3.2.1-44)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Selective Leaching of Materials	Consistent with GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Aluminum, copper alloy > 15% Zn and steel external surfaces, bolting, and piping, piping components, and piping elements exposed to air with borated water leakage (3.2.1-45)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Not applicable	Not applicable to BWRs (See SER Section 3.2.2.1.1)
Steel encapsulation components exposed to air with borated water leakage (internal) (3.2.1-46)	Loss of material due to general, pitting, crevice, and boric acid corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	Not applicable	Not applicable to BWRs (See SER Section 3.2.2.1.1)
CASS piping, piping components, and piping elements exposed to treated borated water > 250 °C (482 °F) (3.2.1-47)	Loss of fracture toughness due to thermal aging embrittlement	Thermal Aging Embrittlement of CASS	No	Not applicable	Not applicable to BWRs (See SER Section 3.2.2.1.1)
Stainless steel or stainless-steel-clad steel piping, piping components, piping elements, and tanks (including safety injection tanks/accumulators) exposed to treated borated water > 60 °C (140 °F) (3.2.1-48)	Cracking due to SCC	Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.2.2.1.1)
Stainless steel piping, piping components, piping elements, and tanks exposed to treated borated water (3.2.1-49)	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.2.2.1.1)
Aluminum piping, piping components, and piping elements exposed to air-indoor uncontrolled (internal/external) (3.2.1-50)	None	None	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Galvanized steel ducting exposed to air-indoor controlled (external) (3.2.1-51)	None	None	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Glass piping elements exposed to air-indoor uncontrolled (external), lubricating oil, raw water, treated water, or treated borated water (3.2.1-52)	None	None	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Stainless steel, copper alloy, and nickel-alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled (external) (3.2.1-53)	None	None	No	None	Consistent with GALL Report
Steel piping, piping components, and piping elements exposed to air-indoor controlled (external) (3.2.1-54)	None	None	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Steel and stainless steel piping, piping components, and piping elements in concrete (3.2.1-55)	None	None	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Steel, stainless steel, and copper alloy piping, piping components, and piping elements exposed to gas (3.2.1-56)	None	None	No	Not applicable	Not applicable to Columbia (See SER Section 3.2.2.1.1)
Stainless steel and copper alloy < 15% Zn piping, piping components, and piping elements exposed to air with borated water leakage (3.2.1-57)	None	None	No	Not applicable	Not applicable to BWRs (See SER Section 3.2.2.1.1)

The staff's review of the ESF component groups followed several approaches. One approach, documented in SER Section 3.2.2.1, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.2.2.2, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.2.2.3, discusses the staff's review of AMR results for components the applicant indicated are not consistent with or not addressed in the GALL Report. The staff's review of

AMPs credited to manage or monitor aging effects of the ESF components is documented in SER Section 3.0.3.

3.2.2.1 AMR Results that are Consistent with the GALL Report

In LRA Section 3.2.2.1, the applicant identified the materials, environments, and AERMs. The applicant identified the following programs that manage the aging effects of ESF components:

- Bolting Integrity Program
- BWR Water Chemistry Program
- Chemistry Program Effectiveness Inspection
- External Surfaces Monitoring Program
- Flexible Connection Inspection Program
- Flow-Accelerated Corrosion Program
- Heat Exchangers Inspection
- Lubricating Oil Analysis Program
- Lubricating Oil Inspection
- Open-Cycle Cooling Water Program
- PM–RCIC Turbine Casing
- Selective Leaching Inspection
- Supplemental Piping/Tank Inspection
- TLAA

LRA Tables 3.2.2-1 to 3.2.2-5 summarize AMRs for the ESF components and indicate AMRs claimed to be consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant claimed consistency and for which the GALL Report does not recommend further evaluation, the staff performed a review to determine whether the plant-specific components in these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant provided a note for each AMR line item. The notes describe how the information in the tables aligns with the information in the GALL Report. The staff audited those AMRs with notes A through E, which indicate how the AMR was consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the GALL Report AMP. The staff audited these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report, and it ensured that it had reviewed and accepted the identified exceptions to the GALL Report AMPs. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP is consistent with the AMP identified by the GALL Report. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report; however, the applicant identified a different component in the GALL Report that had the same material, environment, aging effect, and AMP as the component under review. The staff audited these line items to verify consistency with the GALL Report. The staff also determined whether the AMR line item of the different component applied to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report. The staff confirmed whether the AMR line item of the different component was applicable to the component under review and whether it had reviewed and accepted the exceptions to the GALL Report AMPs. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The staff audited these line items to verify consistency with the GALL Report. The staff also determined whether the identified AMP would manage the aging effect consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

LRA Tables 3.2.2-1 to 3.2.2-5 provide a summary of the AMR results for component types associated with the ESF. The summary information for each component type included the following:

- intended function
- material
- environment
- AERM
- AMPs
- GALL Report, Volume 2 item
- cross reference to LRA Table 3.2.1
- generic and plant-specific notes related to consistency with the GALL Report

The staff reviewed the information in the LRA. The staff did not repeat its review of the matters described in the GALL Report; however, it did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs.

On the basis of its review, the staff determines that, for AMRs not requiring further evaluation, as identified in LRA Table 3.2.1, the applicant’s references to the GALL Report are acceptable, and no further evaluation is required.

3.2.2.1.1 AMR Results Identified as Not Applicable

For line items 3.2.1-45, 3.2.1-46, 3.2.1-47, 3.2.1-48, 3.2.1-49, and 3.2.1-57 in LRA Table 3.2.1 the applicant claimed that the corresponding AMR items in the GALL Report are not applicable because the associated line items are only applicable to PWRs. The staff reviewed the SRP-LR, confirmed these line items only applies to PWRs, and finds these line items are not applicable to Columbia.

For line items 3.2.1-18, 3.2.1-20, 3.2.1-21, 3.2.1-22, 3.2.1-25, 3.2.1-26, 3.2.1-27, 3.2.1-28, 3.2.1-29, 3.2.1-30, 3.2.1-33, 3.2.1-34, 3.2.1-35, 3.2.1-38, 3.2.1-41, 3.2.1-42, 3.2.1-43, 3.2.1-50, 3.2.1-51, 3.2.1-52, 3.2.1-54, 3.2.1-55, 3.2.1-56 in LRA Table 3.2.1, the applicant claimed that it was not applicable. The staff reviewed the LRA and UFSAR and confirmed that the applicant's LRA does not have any AMR results that are applicable to these line items.

LRA Table 3.2.1, Item 3.2.1-52, addresses glass piping elements exposed to air-indoor uncontrolled (external), lubricating oil, raw water, treated water, or treated borated water and states that there are no aging effects, aging mechanisms, or AMPs. The GALL Report recommends that there is no aging effect or aging mechanism, and no AMP is recommended for this component group exposed to this environment; therefore, the staff finds the applicant's determination acceptable.

3.2.2.1.2 Loss of Material Due to General Corrosion

LRA Table 3.2.1, item 3.2.1-31 addresses external steel piping surfaces exposed to air-indoor uncontrolled, which are being managed for loss of material due to general corrosion. For the AMR items that cite Generic Note E, the LRA credits the Supplemental Piping and Tank Inspection Program to manage loss of material. The AMR items cite plant-specific note 201 which states, "The Supplemental Piping/Tank Inspection will manage loss of material at the air-water interface on the piping at the surface of the suppression pool." The GALL Report recommends GALL Report AMP XI.M36, "External Surfaces Monitoring," program to ensure that these aging effects are adequately managed. The AMR items also cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M36 recommends using periodic visual inspections to manage the aging of these line items. In its review of components associated with item number 3.2.1-31, for which the applicant cited Generic Note E, the staff noted that the applicant proposes to use the Supplemental Piping and Tank Inspection Program to manage the aging of steel piping and tanks at the air-water interface through the use visual examination techniques during a one-time inspection of a representative sample of susceptible components.Based on the results of this one-time inspection, the severity of degradation will be assessed to determine if increased sample sizes and sample locations are required.

The staff's evaluation of the applicant's External Surfaces Monitoring Program and Supplemental Piping and Tank Inspection Program are documented in SER Sections 3.0.3.2.6 and 3.0.3.1.29, respectively. In its review of components associated with item 3.2.1-31, the staff finds the applicant's proposal to manage aging using the Supplemental Piping and Tank Inspection Program acceptable because (a) the program utilizes visual inspection methods that are capable of detecting general corrosion, and (b) Technical Specification 3.6.2.2 states that the allowable suppression pool range is four inches and therefore, the piping that is in the air-water interface zone will also be inspected during the periodic visual inspections conducted by the External Surfaces Monitoring Program for piping that is not in the air-water interface zone.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2 AMR Results that are Consistent with the GALL Report, for which Further Evaluation is Recommended

LRA Section 3.2.2.2 provides further evaluation of aging management, as recommended by the GALL Report for the ESF components. The applicant provided information concerning how it will manage the following aging effects:

- cumulative fatigue damage
- loss of material due to cladding
- loss of material due to pitting and crevice corrosion
- reduction of heat transfer due to fouling
- hardening and loss of strength due to elastomer degradation
- loss of material due to erosion
- loss of material due to general corrosion and fouling
- loss of material due to general, pitting, and crevice corrosion
- loss of material due to general, pitting, crevice, and MIC

For component groups evaluated in the GALL Report for which the applicant claimed consistency with the GALL Report and for which further evaluation is recommended, the staff audited and reviewed the applicant's evaluations to determine whether it adequately address those issues. In addition, the staff reviewed the applicant's further evaluations against the criteria in SRP-LR Section 3.2.2.2. The staff's review of the applicant's further evaluation follows.

3.2.2.2.1 Cumulative Fatigue Damage

LRA Section 3.2.2.2.1 associated with LRA Table 3.2.1, Item 3.2.1-01, addresses steel and stainless steel piping, piping components, and piping elements in ECCS exposed to treated water, which are being managed for cumulative fatigue damage. The applicant addressed the further evaluation criteria of the SRP-LR by stating that fatigue is a TLAA, as defined in 10 CFR 54.3, is required to be evaluated in accordance with 10 CFR 54.21(c). The applicant stated that this evaluation of this TLAA is addressed separately in LRA Section 4.3.4. The staff's evaluation is documented in SER Section 4.3.4.2.

The staff reviewed LRA Section 3.2.2.2.1 against the criteria in SRP-LR Section 3.2.2.2.1, which states that cumulative fatigue damage of steel and stainless steel piping, piping components, and piping elements in the ESF system is a TLAA evaluated in accordance 10 CFR 54.21(c) and in accordance with the staff's recommended acceptance criteria and review procedures in SRP-LR Section 4.3, "Metal Fatigue Analysis."

The staff has noted that, although LRA Sections 3.2.2.2.1 states that fatigue TLAA analyses are required to be evaluated in accordance with 10 CFR 54.21(c), the LRA does not include any applicable AMR items for non-Class 1 piping, piping components, piping elements, and, in some cases, for applicable heat exchanger components managed for cumulative fatigue damage. By letter dated August 26, 2010, the staff issued RAI "Cumulative Fatigue Damage AMR" requesting the applicant to explain why LRA Tables 3.2.2-1 to 3.2.2-5 for ESF system components do not include any AMR items related to TLAA for managing cumulative fatigue damage in the steel and stainless steel piping, piping components, and piping elements, and possibly in applicable heat exchanger components.

In its response dated November 11, 2010, the applicant stated that it listed cumulative fatigue damage of Class 1 components in LRA Tables 3.1.2-X because fatigue of Class 1 components are managed by its Fatigue Monitoring Program, as stated in LRA Sections 4.3.1, 4.3.2, and 4.3.3. The applicant further stated that it opted not to list fatigue TLAA of non-Class 1 components in LRA Section 3.2 tables because it is not managed by an AMP. The applicant stated that, as discussed in LRA Section 4.3.4, all non-Class 1 components were reviewed as part of the AMR process. The applicant also stated that non-Class 1 components fatigue evaluation was accomplished by use of a stress-range reduction factor, and these fatigue analyses of non-Class 1 components remain valid through the extended period of operation. The applicant concluded that, in either case, there is no fatigue managed by a GALL Report AMP for non-Class 1 components.

Based on its review, the staff noted that all non-Class 1 components are part of the AMR, and fatigue analysis of these components was performed by a stress-range reduction factor, as stated in LRA Section 4.3.4. Therefore, LRA Tables 3.2.2-X should include AMR items related to TLAA for managing cumulative fatigue damage of non-Class 1 components. Furthermore, 10 CFR 54.21(a)(1) requires that components subjected to AMR be identified and listed in the LRA.

By letter dated December 3, 2010, the staff issued followup RAI, “Cumulative Fatigue Damage AMR,” asking the applicant to justify that LRA Tables 3.2.2-x, 3.3.2-x, and 3.4.2-x do not need to identify and list all the AMR results for non-Class 1 components associated with a TLAA for managing the aging effect of cumulative fatigue damage. In its response dated January 20, 2011, the applicant amended the LRA to include line items in LRA Tables to identify non-Class 1 piping and in-line components for which an AMR related to TLAA for cumulative fatigue damage was performed. The applicant added AMR line items in two subsystems in Section 3.2 for ESF systems, in six subsystems in Section 3.3 for auxiliary systems, and in five subsystems in Section 3.4 for steam and power conversion systems.

Based on its review of the amended LRA Tables, the staff finds the applicant’s response to the followup, “Cumulative Fatigue Damage AMR,” and the additions of the AMR line items acceptable because it is consistent with GALL Report AMR Items for the non-Class 1 piping and components. The staff’s concern described in followup RAI, “Cumulative Fatigue Damage AMR,” is resolved.

Based on the staff’s review, it concludes that the applicant has met the SRP-LR Section 3.2.2.2.1 criteria. For those line items that apply to LRA Section 3.2.2.2.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). SER Section 4.3 documents the staff’s review of the applicant’s evaluation of the TLAA for these components.

3.2.2.2.2 Loss of Material Due to Cladding Breach

LRA Section 3.2.2.2.2 refers to LRA Table 3.2.1, Item 3.2.1-02, and addresses loss of material due to cladding breach. The applicant stated that this aging effect is not applicable to Columbia, which is a BWR.

SRP-LR Section 3.2.2.2.2 states that loss of material due to cladding breach could occur for PWR steel pump casings with stainless steel cladding exposed to treated borated water. SRP-LR Table 3.2-1 identifies Item 2 as applicable to PWRs.

The staff verified that SRP-LR Section 3.2.2.2.2 is not applicable to Columbia because Columbia is a BWR, and the staff guidance in this SRP-LR section is only applicable to PWR steel with stainless steel cladding pump casings exposed to treated borated water.

Based on the above, the staff concludes that the staff's guidance criteria of SRP-LR Section 3.2.2.2.2 do not apply to Columbia because the guidance is applicable to PWRs.

3.2.2.2.3 Loss of Material Due to Pitting and Crevice Corrosion

(1) LRA Section 3.2.2.2.3.1 refers to LRA Table 3.2.1, item 3.2.1-03, and addresses stainless steel containment isolation piping and components exposed to treated water, which are being managed for loss of material due to pitting and crevice corrosion by the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection Program. The applicant addressed the further evaluation criteria of the SRP-LR by stating that containment isolation piping and components were grouped with similar piping and components having the same material, environment, aging effects, and aging management programs. The applicant also stated that the components matching the description provided in LRA item 3.2.1-03 were included in the evaluation of components associated with LRA item 3.2.1-05, which was reviewed in LRA Section 3.2.2.2.3.3.

The staff reviewed the LRA and confirmed that it did not associateany components with LRA item 3.2.1-03. In addition, the staff reviewed SRP-LR Section 3.2.2.2.3, item 3 and Table 3.2.1 item 3.2.1-5 and noted that it includes the same material, environment, aging effects and evaluation criteriaas SRP-LR Section 3.2.2.2.3, item 1 and Table 3.2.1 item 3.2.1-3. The staff finds the applicant's decision to evaluate Table 3.2.1 item 3.2.1-03 with components associated with LRA Table 3.2.1 item 3.2.1-05 acceptable because the same evaluation criteria and same AMPs apply.

(2) LRA Section 3.2.2.2.3.2, is associated with LRA Table 3.2.1, Item 3.2.1-04 and addresses pitting and crevice corrosion in stainless steel piping, piping components, and piping elements exposed to soil. The applicant stated that this line item is not applicable because there are no buried stainless steel piping or piping components in the ESF systems. The staff reviewed LRA Sections 2.3.2 and 3.2 and the UFSAR and confirmed that no in-scope stainless steel piping, piping components, and piping elements exposed to soil are present in the ESF systems; therefore, it finds the applicant's determination acceptable.

(3) LRA Section 3.2.2.2.3.3 refers to LRA Table 3.2.1, Item 3.2.1-05, and addresses stainless steel and aluminum piping, piping components, and piping elements exposed to treated water, which are being managed for loss of material due to pitting and crevice corrosion by the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that loss of material due to pitting and crevice corrosion for stainless steel piping components exposed to treated water is managed by the BWR Water Chemistry Program. Additionally, it will use its Chemistry Program Effectiveness Inspection Program to verify the effectiveness of the BWR Water Chemistry Program in

stagnant-flow areas. The applicant, also stated that it has no aluminum components that refer to LRA Table 3.2.1, Item 3.2.1-05.

The applicant stated that for line Item 3.2.1-05, the applicability is limited to the stainless steel piping, piping components, piping elements, and heat exchanger components exposed to treated water. The staff reviewed the applicant's UFSAR and confirmed that no in-scope aluminum components and piping elements exposed to treated water are present in the engineered safety features systems.

The staff reviewed LRA Section 3.2.2.2.3.3 against the criteria in SRP-LR Section 3.2.2.2.3, Item 3, which states that loss of material from pitting and crevice corrosion could occur for BWR stainless steel and aluminum piping, piping components, and piping elements exposed to treated water. The SRP-LR also states that the existing AMP relies on monitoring and control of water chemistry for BWRs to mitigate degradation. However, control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant-flow. The SRP-LR further states that the GALL Report recommends a one-time inspection of select components at susceptible locations as an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly, such that the component's intended function will be maintained during the period of extended operation.

The staff's evaluation of the applicant's BWR Water Chemistry Program is documented in SER Section 3.0.3.1.7, and it's evaluation of the Chemistry Program Effectiveness Inspection Program is documented in Section 3.0.3.1.8. The staff noted that as part of the BWR Water Chemistry Program the applicant has committed to implement a one-time inspection program, Chemistry Program Effectiveness Inspection Program, to characterize and detect loss of material due to crevice, general, galvanic or pitting corrosion in stagnant flow areas managed by the BWR Water Chemistry Program. In its review of components associated with item 3.2.1-05, the staff finds the applicant's proposal to manage aging using the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs acceptable because the BWR Water Chemistry Program will mitigate loss of material due to general, pitting, and crevice corrosion by managing the concentration of contaminants in the systems to below the levels known to cause loss of material and the Chemistry Program Effectiveness Inspection Program will verify the effectiveness of the BWR Water Chemistry Program in stagnant flow areas, such that the components' intended function will be maintained during the period of extended operation.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.2.2.2.3, Item 3, criteria. For those line items that apply to LRA Section 3.2.2.2.3.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(4) LRA Section 3.2.2.2.3.4 is referenced by LRA Table 3.2.1, Item 3.2.1-06, and addresses stainless steel and copper alloy piping, piping components, and piping elements exposed to lubricating oil, which are being managed for loss of material due to pitting and crevice corrosion by the Lubricating Oil Analysis and Lubricating Oil Inspection programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the Lubricating Oil Inspection program will be used to verify the effectiveness

of the Lubricating Oil Analysis program to manage the loss of material through examination of susceptible locations in stainless steel piping and copper alloy piping components.

The staff reviewed LRA Section 3.2.2.2.3.4 against the criteria in SRP-LR Section 3.2.2.2.3, Item 4, which states loss of material from pitting and crevice corrosion could occur for stainless steel and copper alloy piping, piping components, and piping elements exposed to lubricating oil. The SRP-LR also states that the existing program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. The SRP-LR further states that control of lubricating oil contaminants may not always have been adequate to preclude corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur. The SRP-LR also states that the GALL Report recommends further evaluation to verify the effectiveness of the Lubricating Oil Program for which a one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that the component's intended function will be maintained during the period of extended operation.

The staff's evaluation of the applicant's Lubricating Oil Analysis and Lubricating Oil Inspection Programs is documented in SER Sections 3.0.3.2.13 and 3.0.3.1.22, respectively. In its review of components associated with Item 3.2.1-06, the staff finds the applicant's proposal to manage aging using the Lubricating Oil Inspection Program to verify the effectiveness of the Lubricating Oil Analysis Program acceptable for the following reasons:

- The use of the Lubricating Oil Analysis Program is consistent with the recommendation of the GALL Report.
- The Lubricating Oil Inspection Program will be used to examine stainless steel piping and copper alloy piping components to verify the effectiveness of the Lubricating Oil Analysis Program.

This satisfies the acceptance criteria in SRP-LR Section 3.2.2.2.3, Item 4; therefore, the applicant's AMR is consistent with the GALL Report Items V.D1-24 and V.D2-22.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.2.2.2.3, Item 4, criteria. For the line items that apply to LRA Section 3.2.2.2.3.4, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(5) LRA Section 3.2.2.2.3.5 is associated with LRA Table 3.2.1, Item 3.2.1-07, and addresses pitting and crevice corrosion in partially encased stainless steel tanks with a breached moisture barrier exposed to raw water. The applicant stated that this item is not applicable because there are no stainless steel tanks in the ESF systems that are exposed to raw water as a result of a breached moisture barrier. The staff reviewed LRA Sections 2.3.2 and 3.2 and the UFSAR and confirmed that no in-scope stainless steel tanks with breached moisture barrier exposed to raw water are present in the ESF systems; therefore, it finds the applicant's determination acceptable.

(6) LRA Section 3.2.2.2.3.6 is referenced by LRA Table 3.2.1, Item 3.2.1-08, and addresses stainless steel piping, piping components and tank internal surfaces exposed to internal condensation, which are being managed for loss of material due to pitting and crevice corrosion by the External Surfaces Monitoring Program. The applicant addressed the further evaluation criteria of the SRP-LR by stating that there are no corresponding components exposed to internal condensation in the ESF systems; however, the applicant applied this item to external condensation on stainless steel valve bodies in the RHR system. The applicant also stated that the External Surfaces Monitoring Program consists of observation and surveillance activities to detect age-related degradation.

The staff reviewed LRA Section 3.2.2.2.3.6 against the criteria in SRP-LR Section 3.2.2.2.3, Item 6, which states that loss of material due to pitting and crevice corrosion could occur for stainless steel piping, piping components, piping elements, and tanks exposed to internal condensation. The SRP-LR also states that the GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed.

The staff's evaluation of the applicant's External Surfaces Monitoring Program is documented in SER Section 3.0.3.2.6. The staff noted that the applicant's External Surfaces Monitoring Program is a condition monitoring program that consists of visual inspections and surveillance activities of accessible external surfaces on a frequency that is generally greater than once per fuel cycle. In its review of components associated with item 3.2.1-08, the staff finds the applicant's proposal to manage aging using the External Surfaces Monitoring Program acceptable because this program uses visual inspection techniques that are capable of detecting pitting and crevice corrosion on stainless steel components.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.2.2.2.3, Item 6, criteria. For those line items that apply to LRA Section 3.2.2.2.3.6, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.4 Reduction of Heat Transfer Due to Fouling

(1) LRA Section 3.2.2.2.4.1, referenced by LRA Table 3.2.1, Item 3.2.1-09, addresses steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil, which are being managed for reduction of heat transfer due to fouling by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the Lubricating Oil Inspection Program will be used to verify the effectiveness of the Lubricating Oil Analysis Program to manage reduction of heat transfer through examination of susceptible locations in stainless steel and copper alloy heat exchanger tubes.

The staff reviewed LRA Section 3.2.2.2.4.1 against the criteria in SRP-LR Section 3.2.2.2.4, Item 1, which states that reduction of heat transfer due to fouling could occur for steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil. The SRP-LR also states that the existing AMP relies on monitoring and control of lubricating oil chemistry to mitigate reduction of heat transfer due to fouling. The SRP-LR further states that control of lubricating oil chemistry may not always have been adequate to preclude fouling; therefore, the effectiveness of lubricating oil chemistry control should be verified to ensure that fouling does not occur. The SRP-LR also states that the GALL Report recommends further evaluation of programs to verify the effectiveness of lubricating oil chemistry control for which a one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

The staff's evaluation of the applicant's Lubricating Oil Analysis and Lubricating Oil Inspection Programs is documented in SER Sections 3.0.3.2.13 and 3.0.3.1.22, respectively. In its review of components associated with Item 3.2.1-09, the staff finds the applicant's proposal to manage aging using the Lubricating Oil Inspection Program to verify the effectiveness of the Lubricating Oil Analysis Program acceptable for the following reasons:

- The use of the Lubricating Oil Analysis Program is consistent with the recommendations in the GALL Report.
- The Lubricating Oil Inspection Program will be used to examine stainless steel and copper alloy heat exchanger tubes to verify the effectiveness of the Lubricating Oil Analysis Program.

This satisfies the acceptance criteria in SRP-LR Section 3.2.2.2.4, Item 1; therefore, the applicant's AMR is consistent with GALL Report Items V.D2-9 and V.D2-11.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.2.2.2.4, Item 1, criteria. For the line items that apply to LRA Section 3.2.2.2.4.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effect of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(2) LRA Section 3.2.2.2.4.2 is associated with LRA Table 3.2.1, Item 3.2.1-10, and addresses stainless steel heat exchanger tubes exposed to treated water. The GALL Report recommends the Water Chemistry and One-Time Inspection Programs to manage reduction of heat transfer for this component group. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the Heat Exchangers Inspection will be used to verify the effectiveness of the BWR Water Chemistry Program to manage reduction of heat transfer due to fouling through examination of stainless steel heat exchanger tubes.

The staff reviewed LRA Section 3.2.2.2.4.2 against the criteria in SRP-LR Section 3.2.2.2.4, Item 2, which states that reduction of heat transfer due to fouling could occur for stainless steel heat exchanger tubes exposed to treated water. The SRP-LR also states that the existing AMP relies on control of water chemistry to manage reduction of heat transfer due to fouling. The SRP-LR further states that control of water chemistry may not always have been adequate to preclude fouling; therefore, the effectiveness of chemistry control should be verified to ensure that reduction of heat transfer due to fouling is not occurring. The SRP-LR also states that the GALL Report recommends further evaluation of programs to verify the effectiveness of chemistry control for which a one-time inspection of select components at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly such that the component's intended function will be maintained during the period of extended operation.

The staff's evaluation of the applicant's BWR Water Chemistry Program and Heat Exchangers Inspection is documented in SER Sections 3.0.3.1.7 and 3.0.3.1.17, respectively. In its review of components associated with Item 3.2.1-10, the staff finds the applicant's proposal to manage aging using the Heat Exchangers Inspection to verify the effectiveness of the BWR Water Chemistry Program for the following reasons:

- The use of the BWR Water Chemistry Program is consistent with the recommendations in the GALL Report.
- The Heat Exchangers Inspection will be used to examine stainless steel heat exchanger tubes to verify the effectiveness of the BWR Water Chemistry Program.

This satisfies the acceptance criteria in SRP-LR Section 3.2.2.2.4, Item 2; therefore, the applicant's AMR is consistent with GALL Report Item V.D2-13.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.2.2.2.4, Item 2, criteria. For the line item that apply to LRA Section 3.2.2.2.4.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effect of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.5 Hardening and Loss of Strength Due to Elastomer Degradation

LRA section 3.2.2.2.5 is associated with LRA Table 3.2.1 item 3.2.1-11 and addresses elastomer seals and components in the standby gas treatment system exposed to air-indoor uncontrolled which are being managed for hardening and loss of strength due to elastomer degradation by the Flexible Connection Inspection Program. The applicant addressed the further evaluation criteria of the SRP-LR by stating that elastomer flexible connections subject to hardening and loss of strength are managed by the Flexible Connection Inspection Program, a plant-specific AMP.

The staff reviewed LRA Section 3.2.2.2.5 against the criteria in SRP-LR Section 3.2.2.2.5 which states that hardening and loss of strength due to elastomer degradation could occur in elastomer seals and components associated with the standby gas treatment system ductwork and filters exposed to air-indoor uncontrolled. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed.

The staff's evaluation of the applicant's Flexible Connection Inspection Program submitted in its original application is documented in SER Section 3.0.3.2.10. The staff noted that in the original LRA submitted by letter dated January 19, 2010, the Flexible Connection Inspection Program was a new One-Time Inspection Program that consisted of visual inspections for evidence of degradation, such as cracking and discoloration, and physical examinations to verify whether hardening and loss of strength has occurred. The staff does not believe that it is possible to state that the aging effects of all elastomeric materials meets at least one of the three criteria contained in the "program description" for GALL Report AMP XI. M32, "One-time Inspection Program," in that many elastomers will harden and lose strength over a 60-year period, particularly in the presence of ultraviolet (UV) light, ozone, or radiation, and the degradation mechanism expected to occur, does not necessarily progress slowly, nor include a long incubation period. By letter dated October 20, 2010, the staff issued RAI 3.2.2-1 requesting that the applicant justify the use of a One-Time Inspection Program for the specific elastomeric material exposed to air-indoor uncontrolled to confirm the following:

- An aging effect is not expected to occur, but the data is insufficient to rule it out with reasonable confidence.
- An aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than that generally expected.
- The characteristics of the aging effect include a long incubation period and establish that each component will be capable of meeting its CLB function(s) throughout the period of extended operation.

To respond to RAI 3.2.2-1, the applicant provided a comprehensive response to RAI B.2.14-1. In its response to RAI B.2.14-1 dated January 28, 2011, the applicant revised LRA Section B.2.27, Flexible Connections Inspection Program from a one-time based program to a plant-specific program based on collecting baseline information during the 10-year period prior to the period of extended operation, followed by opportunistic inspections. The staff's evaluation of the new Flexible Connections Inspection Program is documented in SER Section 3.0.3.3.6.

The staff finds the applicant's response acceptable because the applicant revised its Flexible Connections Inspection Program to no longer be a one-time inspection-based program. The staff's concern described in RAI 3.2.2-1 is resolved.

In its review of components associated with line Item 3.2.1-11, the staff finds the applicant proposal to manage the aging using the Flexible Connection Inspection Program acceptable for the following reasons:

- Visual inspections can detect signs of elastomer degradation such as cracking, loss of material due to wear, and discoloration.
- Physical examinations can detect hardening and loss of strength.
- Baseline inspections will be conducted in the 10-year period prior to the period of extended operation.
- The applicant committed to ensure that within 5 years of the baseline inspections, the opportunistic inspections will encompass all combinations of material, environment and aging effects.
- Plant-specific operating experience will be used to adjust tracking of follow-on opportunistic inspections.

Based on the programs identified, the staff concludes that the applicant's program meets SRP-LR Section 3.2.2.2.5 criteria. For those line items that apply to LRA Section 3.2.2.2.5, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.6 Loss of Material Due to Erosion

LRA Section 3.2.2.2.6 is associated with LRA Table 3.2.1, Item 3.2.1-12, and addresses loss of material in stainless steel orifices exposed to treated borated water in the minimum flow line for the high pressure safety injection pump. The applicant stated that the associated items are applicable to PWRs only. The staff reviewed the SRP-LR and confirmed this item only applies to PWRs. The staff finds the applicant's determination acceptable.

3.2.2.2.7 Loss of Material Due to General Corrosion and Fouling

LRA Section 3.2.2.2.7 is associated with LRA Table 3.2.1, item 3.2.1-13 and addresses steel drywell and suppression chamber spray system nozzle and flow orifice internal surfaces exposed to indoor uncontrolled air which are being managed for loss of material due to general corrosion and fouling. The applicant stated that this line item is not applicable because it has no steel spray nozzles in its ESF systems.

The staff reviewed LRA Sections 2.3.2 and 3.2 and confirmed that the applicant’s LRA does not have any AMR results for the ESF systems that include steel spray nozzles. The staff also reviewed the applicant’s UFSAR and confirmed that no in-scope steel spray nozzles are present in the ESF systems and, therefore, the staff finds the applicant’s determination acceptable.

3.2.2.2.8 Loss of Material Due to General, Pitting, and Crevice Corrosion

(1) LRA Section 3.2.2.2.8.1 refers to LRA Table 3.2.1, Item 3.2.1-14, and addresses steel piping components exposed to treated water, which are being managed for loss of material due to general, pitting, and crevice corrosion by the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection Program. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the BWR Water Chemistry Program manages aging effects through periodic monitoring and control of contaminants. The applicant also stated that the Chemistry Program Effectiveness Inspection Program will provide verification of the effectiveness of the BWR Water Chemistry Program through examination of stainless steel piping components. The applicant further stated that these programs are being used to manage loss of material due to general, pitting, and crevice corrosion for steel heat exchanger components.

The staff reviewed LRA Section 3.2.2.2.8.1 against the criteria in SRP-LR Section 3.2.2.2.8, Item 1, which states that loss of material due to general, pitting, and crevice corrosion could occur for BWR steel piping, piping components, and piping elements exposed to treated water. The SRP-LR also states that the existing AMP relies on monitoring and control of water chemistry to mitigate degradation. The SRP-LR further states that the effectiveness of the chemistry control should be verified to ensure that corrosion is not occurring by using a one-time inspection of select components at susceptible locations.

The staff’s evaluations of the applicant’s BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection Program are documented in SER Sections 3.0.3.1.7 and 3.0.3.1.8, respectively. The applicant stated that the BWR Water Chemistry Program is a mitigation program that will manage loss of material, cracking, and reduction of heat transfer through monitoring and control of water chemistry parameters consistent with the EPRI water chemistry guidelines. The applicant stated that the Chemistry Program Effectiveness Inspection Program will detect and characterize the material conditions in representative low-flow and stagnant areas of the plant systems.

In its review of components associated with Item 3.2.1-14, the staff finds the applicant's proposal to manage aging using the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection Program acceptable for the following reasons:

- The BWR Water Chemistry Program will establish the plant water chemistry control parameters and identify the actions required if the parameters exceed limits.
- The Chemistry Program Effectiveness Inspection Program will include a one-time inspection of select components to verify the effectiveness of the BWR Water Chemistry Program for managing the effects of aging due to the potential corrosion mechanism, consistent with the GALL Report guidance.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.2.2.2.8, Item 1, criteria. For those line items that apply to LRA Section 3.2.2.2.8.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(2) LRA Section 3.2.2.2.8.2 refers to LRA Table 3.2.1, Item 3.2.1-15, and addresses steel containment isolation piping components exposed to treated water, which are being managed for loss of material due to general, pitting, and crevice corrosion by the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection Program. The applicant addressed the further evaluation criteria of the SRP-LR by stating that containment isolation piping and components are grouped with similar piping having the same material, environment, and aging effects, and AMPs. The applicant further stated that these components are included in the evaluation of components for Item 3.2.1-14, which are evaluated in LRA Section 3.2.2.2.8.1.

The staff reviewed the LRA and confirmed that it did not associate components with item 3.2.1-15. In addition, the staff reviewed SRP-LR Section 3.2.2.2.8, Item 1, and Table 3.2.1, Item 3.2.1-14, and noted it encompassed the material, environment and aging effects for SRP-LR Section 3.2.2.2.8, Item 2. and Table 3.2.1, Item 3.2.1-15. and also specified the same evaluation criteria. The staff finds the applicant's decision to evaluate Table 3.2.1, Item 3.2.1-15, with components associated with Table 3.2.1, Item 3.2.1-14, acceptable because the same evaluation criteria and same AMPs apply.

(3) LRA Section 3.2.2.2.8.3, refers to LRA Table 3.2.1, Item 3.2.1-16, addresses steel piping, piping components, and piping elements exposed to lubricating oil, which are being managed for loss material due to general, pitting, and crevice corrosion by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the Lubricating Oil Inspection Program will be used to verify the effectiveness of the Lubricating Oil Analysis Program to manage loss of material due to general, pitting, and crevice corrosion through examination of susceptible locations in steel piping, piping components, and piping elements exposed to lubricating oil, including selective leaching for gray cast iron.

The staff reviewed LRA Section 3.2.2.2.8.3 against the criteria in SRP-LR Section 3.2.2.2.8, Item 3, which states that loss of material due to general, pitting, and crevice corrosion could occur for steel piping, piping components, and piping elements exposed to lubricating oil. The SRP-LR also states that the existing AMP relies on periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. The SRP-LR further states that control of lubricating oil contaminants may not always have been adequate to preclude corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur. The SRP-LR also states that the GALL Report recommends further evaluation of programs to verify the effectiveness of Lubricating Oil Program for which a one-time inspection of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

The staff's evaluation of the applicant's Lubricating Oil Analysis and Lubricating Oil Inspection Programs is documented in SER Sections 3.0.3.2.13 and 3.0.3.1.22, respectively. In its review of components associated with item 3.2.1-16, the staff finds the applicant's proposal to manage aging using the Lubricating Oil Inspection Program to verify the effectiveness of the Lubricating Oil Analysis Program acceptable because: (1) use of the Lubricating Oil Analysis Program is consistent with the GALL Report, and (2) the Lubricating Oil Inspection Program will be used to examine steel piping, piping components, and piping elements to verify the effectiveness of the Lubricating Oil Analysis Program. This satisfies the acceptance criteria in SRP-LR Section 3.2.2.2.8, item 3 and, therefore, the applicant's AMR is consistent with the one under GALL Report item V.D2-30.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.2.2.2.8, Item 3, criteria. For the line items that apply to LRA Section 3.2.2.2.8.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effect of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.9 Loss of Material Due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion

LRA Section 3.2.2.2.9 is associated with LRA Table 3.2.1, Item 3.2.1-17, and addresses loss of material due to general, pitting, crevice, and MIC in steel piping, piping components, and piping elements, with or without coating or wrapping, exposed to soil. The applicant stated that this line item is not applicable because there are no buried steel piping or piping components in the ESF systems that are exposed to soil. The staff reviewed LRA Sections 2.3.2 and 3.2, and the UFSAR and confirmed that no in-scope steel piping, piping components, and piping elements exposed to soil are present in the ESF systems; therefore, the staff finds the applicant's determination acceptable.

3.2.2.2.10 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA Program.

3.2.2.3 AMR Results that are Not Consistent with or Not Addressed in the GALL Report

In LRA Tables 3.2.2-1 through 3.2.2-5, the staff reviewed additional details of AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

In LRA Tables 3.2.2-1 through 3.2.2-5, the applicant indicated, via notes F through J, that the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report. The applicant provided further information concerning how the aging effects will be managed. Specifically, Note F indicates that the material for the AMR line item component is not evaluated in the GALL Report. Note G indicates that the environment for the AMR line item component and material is not evaluated in the GALL Report. Note H indicates that the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report. Note I indicates that the aging effect identified in the GALL Report for the line item component, material, and environment combination is not applicable. Note J indicates that neither the component nor the material and environment combination for the line item is evaluated in the GALL Report.

For component type, material, and environment combinations not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine if the applicant demonstrated that the aging effects will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation. The staff's evaluation is discussed in the following sections.

3.2.2.3.1 Engineered Safety Features—Residual Heat Removal System—Summary of Aging Management Evaluation—LRA Table 3.2.2-1

In LRA Tables 3.2.2-1 and 3.2.2-2, the applicant stated that steel piping exposed to moist air (internal) are being managed for loss of material by the Supplemental Piping/Tank Inspection Program. The AMR items cite Generic Note G. Line items associated with steel piping in LRA Table 3.2.2-1 cite plant-specific Note 0201, which states that the Supplemental Piping/Tank Inspection Program will manage loss of material at the air-water interface on the piping at the surface of the suppression pool.

The staff reviewed the associated items in the LRA and determined that there is insufficient information in the LRA to conclude that the applicant identified the correct AMP for this material, aging effect, and environmental combination, as discussed in the RAI below. The staff noted that given the definitions in LRA Table 3.0-1, moist air is susceptible to condensation. The staff also noted that the GALL Report recommends that steel piping exposed to an air-indoor uncontrolled or condensation internal environment be managed by GALL Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components."

The staff's evaluation of the applicant's Supplemental Piping/Tank Inspection Program is documented in SER Section 3.0.3.1.29. The staff noted that the Supplemental Piping/Tank Inspection Program is a new one-time inspection program which focuses on detection and characterization of the material condition for steel and stainless steel components exposed to moist air environments, such as at air-water interfaces or air spaces of piping and tanks. The staff also noted that the GALL recommended AMP, XI.M38 consists of periodic inspections which are based on plant-specific inspection intervals which are consistent with industry practice and staff expectations such that it provides timely detection of degradation. However, because the inspection frequency is plant-specific and depends on the plant operating experience, the applicant's plant-specific operating experience or applicable generic operating experience is further evaluated for the extended period of operation. GALL Report AMP XI.M38 also includes recommendations for monitoring and trending of aging degradation.

The staff further noted that the applicant has proposed a One-Time Inspection Program that conflicts with the periodic inspections recommended by GALL Report AMP XI.M38 and had not provided sufficient plant-specific or industry operating experience information to justify why a One-Time Inspection Program is adequate to manage aging for these components nor justified why monitoring and trending need not be performed.

By letter dated October 14, 2010, the staff issued RAI 3.2.2.3.1-1 requesting that the applicant provide sufficient plant-specific or industry operating experience to justify the use of a One-Time Inspection Program in lieu of a periodic inspection program, and justify why the monitoring and trending recommendations of GALL Report AMP XI.M38 need not be met.

In its response, dated January 18, 2010, the applicant stated that the item in LRA Table 3.2.2-1 refers to piping from the RHR system associated with the deactivated steam condensing mode that penetrates the surfaces of the suppression pool, and the item in LRA Table 3.2.2-2 refers to the air-filled lines in the reactor core isolation system that enter the suppression pool. The applicant also stated that the air-water interface has the potential to be an aggressive environment due to alternate wetting and drying and that the same air-water interface exists on the internal and external surfaces of the subject piping. The applicant further stated that the surface above the air-water interface is being managed for aging by the External Surfaces Monitoring and PM–RCIC Turbine Casing Programs and that the surface below the air-water interface is being managed for aging by the BWR Water Chemistry Program with the Chemistry Program Effectiveness Inspection Program. Finally, the applicant stated that a review of station operating experience did not identify any aging effect associated with air-water interfaces and that the Supplemental Piping/Tank Inspection Program will confirm conditions where degradation is not expected.

The staff finds the applicant's response acceptable because the applicant is managing the subject components for aging both above and below the air-water interface using appropriate programs for the material and environment combination, and the degradation at the air-water interfaces is not expected. The staff's concern described in RAI 3.2.2.3.1-1 is resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.2.2-1 and 3.3.2-1, the applicant stated that the steel bolting exposed to condensation (external) and outdoor air (external) are being managed for cracking, loss of material, and loss of preload by the Bolting Integrity Program. The AMR line items associated with cracking and loss of material cite Generic Note G. The AMR line items associated with loss of preload cite Generic Note H.

The staff reviewed all AMR result line items in the GALL Report where the component and material is steel bolting exposed to condensation (external) and outdoor air (external) and confirmed that there are no loss of preload aging effect entries in the GALL Report for this component, material, and environment combination.

The staff's evaluation of the applicant's Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The staff noted that the applicant's Bolting Integrity Program includes proper selection of bolting materials and assembly in accordance with EPRI guidelines and the periodic inspections of bolting for indications of degradation such as leakage, loss of material due to corrosion, loss of pre-load, and cracking due to SCC and fatigue. The staff finds the applicant's proposal to manage aging using the Bolting Integrity Program acceptable because proper selection and assembly of bolting will prevent loss of preload, and the periodic inspections performed under this program ensures that any cracking, loss of material, or loss of preload will be detected in prior to loss of function.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.3.2 Engineered Safety Features—Reactor Core Isolation Cooling System—Summary of Aging Management Evaluation—LRA Table 3.2.2-2

In LRA Tables 3.2.2-2, 3.3.2-6, and 3.4.2-4, the applicant stated that the stainless steel bolting exposed to air-indoor uncontrolled (external) are being managed for loss of pre-load by the Bolting Integrity Program. The AMR line item cite Generic Note F.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because Table VIII.H of the GALL Report states that loss of preload due to thermal effects, gasket creep, and self-loosing is an aging effect for steel bolting exposed to air-indoor uncontrolled (external). The GALL Report recommends XI.M18, "Bolting Integrity" for managing the aging effect, and the GALL Report does not identify any other AERMs for stainless steel bolting exposed to air-indoor uncontrolled.

The staff's evaluation of the applicant's Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The staff finds the applicant's proposal to manage aging using the Bolting Integrity Program acceptable because the Bolting Integrity Program consists of periodic inspections of bolting for indications of loss of pre-load, and the preventive measures in the program will preclude or minimize loss of preload.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for steel piping exposed to moist air (internal) being managed for loss of material by the Supplemental Piping/Tank Inspection Program with Generic Note G is documented in 3.2.2.3.1.

In LRA Table 3.2.2-2, the applicant stated that the stainless steel heat exchanger tubes (RCIC-HX-2) exposed to air-indoor uncontrolled (internal) are being managed for reduction in heat transfer by the Heat Exchangers Inspection Program. The AMR line item cites Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because the GALL Report addresses stainless steel exposed to air-indoor uncontrolled and recommends that there are no aging effects and no AMP, and monitoring for reduction in heat transfer would be an acceptable enhancement to the GALL Report recommendations that complements the need for monitoring for heat transfer reduction due to lubricating oil being on the other side of the tube.

The staff's evaluation of the applicant's Heat Exchangers Inspection Program is documented in SER Section 3.0.3.1.17. The staff finds the applicant's proposal to manage aging using the Heat Exchangers Inspection Program acceptable because the Heat Exchangers Inspection Program is a new One-Time Inspection Program that uses visual examination techniques that can be effective in detecting evidence of fouling.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.3.3 Engineered Safety Features—High-Pressure Core Spray System—Summary of Aging Management Evaluation—LRA Table 3.2.2-3

The staff reviewed LRA Table 3.2.2-3, which summarizes the results of AMR evaluations for the HPCS system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J, whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.2.2.1.

3.2.2.3.4 Engineered Safety Features—Low-Pressure Core Spray System—Summary of Aging Management Evaluation—LRA Table 3.2.2-4

In LRA Table 3.2.2-4, the applicant stated that the copper alloy heat exchanger tubes and fittings exposed to raw water (internal) are being managed for reduction in heat transfer by the Open-Cycle Cooling Water Program. The AMR line items cite Generic Note G, indicating that for these line items, the environment is not in the GALL Report for these components and materials.

The staff reviewed all AMR result line items in the GALL Report where the material is copper and the aging effect and mechanism is reduction of heat transfer and confirmed that, for this environment, there are no entries in the GALL Report for these components and materials.

The staff reviewed the applicant's Open-Cycle Cooling Water Program, and its evaluation is documented in SER Section 3.0.3.2.17. The staff reviewed Table IX.C of the GALL Report that states that copper alloys (less than 15 percent zinc) are generally resistant to other aging effects, such as SCC, selective leaching, pitting, and crevice corrosion. In addition, the components are part of a heat exchanger where the potential for contaminant build up is possible. Thus, the applicant's use of the reduction in heat transfer aging effect is appropriate.

The staff finds that the applicant's proposal to manage aging using the Open-Cycle Cooling Water Program is acceptable because the program uses visual inspections and surveillance activities, as well as testing of water chemistry in order to detect aging effects that could result in a loss of component intended function due to reduction in heat transfer.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.2.2-4, the applicant stated that the copper alloy heat exchanger tubes, fittings, and valve bodies exposed to raw water (internal) are being managed for loss of material by the Open-Cycle Cooling Water Program. The AMR line items cite Generic Note G, indicating that, for these line items, the environment is not in the GALL Report for these components and material.

The staff reviewed all AMR result line items in the GALL Report where the material is copper and the aging effect and mechanism is loss of material and confirmed that for this environment, there are no entries in the GALL Report for these components and materials.

The staff reviewed the applicant's Open-Cycle Cooling Water Program, and its evaluation is documented in SER Section 3.0.3.2.17. The staff reviewed Table IX.C of the GALL Report that states that copper alloys (less than 15 percent zinc) are generally resistant to other aging effects, such as SCC, selective leaching, pitting, and crevice corrosion. In addition, the components are part of a heat exchanger where the potential for contaminant build up and corrosion is possible. Thus, the applicant's use of the loss of material aging effect is appropriate. The staff finds that the applicant's proposal to manage aging using the Open-Cycle Cooling Water Program is acceptable because the program uses visual inspections, surveillance activities, as well as testing of water chemistry in order to detect aging effects that could result in a loss of component intended function due to loss of material.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.2.2-4, the applicant stated that, for the copper alloy heat exchanger tubes and fittings exposed to lubricating oil (external), with the intended function of pressure boundary, there is no aging effect and no AMP is proposed for copper components with 15 percent or less zinc content. The AMR line item cites Generic Note I.

The staff reviewed Table IX.C of the GALL Report that states that copper alloys (less than 15 percent zinc) are generally resistant to other aging effects, such as SCC, selective leaching, pitting, and crevice corrosion. However, the components are part of a heat exchanger where the potential for contaminant build up is possible. Thus, the applicant also credits the Lubricating Oil Analysis and Lubricating Oil Inspection. The AMR line item cites Generic Note A.

The staff notes that even though the applicant credits no aging effect and no AMP for the intended function of pressure boundary for the copper alloy heat exchanger tubes and fittings exposed to lubricating oil (external), the applicant does manage aging using the Lubricating Oil Analysis and Lubricating Oil Inspection. The staff's evaluations of the applicant's Lubricating Oil Analysis and Lubricating Oil Inspection Programs are documented in SER Sections 3.0.3.2.13 and 3.0.3.1.22, respectively. The staff finds the applicant's program to manage aging using the Lubricating Oil Analysis and Lubricating Oil Inspection acceptable because the Lubricating Oil Analysis Program was determined to be consistent with the GALL Report, and the applicant stated that the Lubricating Oil Inspection Program will be used to examine copper alloy piping, piping components, and piping elements to verify the effectiveness of the Lubricating Oil Analysis Program.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.3.5 Engineered Safety Features—Standby Gas Treatment System—Summary of Aging Management Evaluation—LRA Table 3.2.2-5

The staff reviewed LRA Table 3.2.2-5, which summarizes the results of AMR evaluations for the standby gas treatment system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J, whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.2.2.1.

3.2.3 Conclusion

The staff concludes that the applicant provided sufficient information to demonstrate that the effects of aging for the ESF system components within the scope of license renewal and subject to an AMR will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3 Aging Management of Auxiliary Systems

This section of the SER documents the staff's review of the applicant's AMR results for the auxiliary systems components and component groups of the following systems:

- Circulating Water System
- Condensate Processing Radioactive (Demineralizer) System
- Containment Atmosphere Control System
- Containment Exhaust Purge and Containment Supply Purge Systems
- Containment Instrument Air System
- Containment Monitoring System
- Containment Nitrogen System
- Containment Return Air System
- Containment Vacuum Breaker System
- Control Air System

- CRD System
- Control Room Chilled Water System
- Demineralized Water System
- Diesel Building HVAC System
- Diesel Cooling Water System
- Diesel (Engine) Exhaust System
- Diesel Engine Starting Air System
- Diesel Fuel Oil System
- Diesel Generator System
- Diesel Lubricating Oil System
- EDR System
- Fire Protection System
- Floor Drains System
- Floor Drains Radioactive System
- Fuel Pool Cooling System
- Miscellaneous Waste Radioactive System
- Plant Sanitary Drains Systems
- TSW Systems
- Potable Cold Water System
- Potable Hot Water System
- Primary Containment System
- Process Sampling System
- Process Sampling Radioactive System
- Pump House HVAC System
- Radwaste Building Chilled Water System
- Radwaste Building HVAC System
- Reactor Building HVAC System
- Reactor Closed Cooling Water System
- Reactor Water Cleanup System
- Service Air System
- SLC System
- SSW System
- TMU System
- Traversing Incore Probe System
- Heating Steam System System
- Heating Steam Condensate System System
- Heating Steam Vent System System

3.3.1 Summary of Technical Information in the Application

LRA Section 3.3 provides AMR results for the auxiliary systems components and component groups. LRA Table 3.3.1, “Summary of Aging Management Programs for Auxiliary Systems,” is a summary comparison of the applicant’s AMRs with those evaluated in the GALL Report for the auxiliary systems components and component groups.

The applicant’s AMRs evaluated and incorporated applicable plant-specific and industry operating experience in the determination of AERMs. The plant-specific evaluation included CRs and discussions with appropriate site personnel to identify AERMs. The applicant’s review of industry operating experience included a review of the GALL Report and operating experience issues identified since the issuance of the GALL Report.

3.3.2 Staff Evaluation

The staff reviewed LRA Section 3.3 to determine if the applicant provided sufficient information to demonstrate that the effects of aging for auxiliary system components, within the scope of license renewal and subject to an AMR, will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff conducted an onsite audit of AMPs to ensure the applicant's claim that certain AMPs were consistent with the GALL Report. The purpose of this audit was to examine the applicant's AMPs and related documentation and to verify the applicant's claim of consistency with the corresponding GALL Report AMPs. The staff did not repeat its review of the matters described in the GALL Report. The staff's evaluations of the AMPs are documented in SER Section 3.0.3.

The staff reviewed the AMRs to confirm the applicant's claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. Details of the staff's evaluation are discussed in SER Sections 3.3.2.1 and 3.3.2.2.

The staff also reviewed the AMRs not consistent with or not addressed in the GALL Report. The review evaluated whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. Details of the staff's evaluation are discussed in SER Section 3.3.2.3.

For components that the applicant claimed were not applicable or required no aging management, the staff reviewed the AMR line items and the plant's operating experience to verify the applicant's claims.

Table 3.3-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.3 and addressed in the GALL Report.

Table 3.3-1 Staff evaluation for auxiliary system components in the GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel cranes—structural girders exposed to air-indoor uncontrolled (external) (3.3.1-1)	Cumulative fatigue damage	TLAA to be evaluated for structural girders of cranes. See SRP-LRA Section 4.7 for generic guidance for meeting the requirements of 10 CFR 54.21(c)(1).	Yes	TLAA	Fatigue is a TLAA (See SER Section 3.3.2.2.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel and stainless steel piping, piping components, piping elements, and heat exchanger components exposed to air-indoor uncontrolled, treated borated water, or treated water (3.3.1-2)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA	Fatigue is a TLAA (See SER Section 3.3.2.2.1)
Stainless steel heat exchanger tubes exposed to treated water (3.3.1-3)	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Heat Exchangers Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.2)
Stainless steel piping, piping components, and piping elements exposed to sodium pentaborate solution > 60 °C (140 °F) (3.3.1-4)	Cracking due to SCC	Water Chemistry and One-Time Inspection	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.2.3)
Stainless steel and stainless clad steel heat exchanger components exposed to treated water > 60 °C (140 °F) (3.3.1-5)	Cracking due to SCC	A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.2.3)
Stainless steel diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust (3.3.1-6)	Cracking due to SCC	A plant-specific AMP is to be evaluated.	Yes	Diesel System Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.3)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Stainless steel non-regenerative heat exchanger components exposed to treated borated water > 60 °C (140 °F) (3.3.1-7)	Cracking due to SCC and cyclic loading	Water Chemistry and a plant-specific verification program. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.3.2.2.4)
Stainless steel regenerative heat exchanger components exposed to treated borated water > 60 °C (140 °F) (3.3.1-8)	Cracking due to SCC and cyclic loading	Water Chemistry and a plant-specific verification program. The AMP is to be augmented by verifying the absence of cracking due to SCC and cyclic loading. A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.3.2.2.4)
Stainless steel high-pressure pump casing in PWR chemical and volume control system (3.3.1-9)	Cracking due to SCC and cyclic loading	Water Chemistry and a plant-specific verification program. The AMP is to be augmented by verifying the absence of cracking due to SCC and cyclic loading. A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.3.2.2.4)
High-strength steel closure bolting exposed to air with steam or water leakage (3.3.1-10)	Cracking due to SCC and cyclic loading	Bolting Integrity. The AMP is to be augmented by appropriate inspection to detect cracking if the bolts are not otherwise replaced during maintenance.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.2.4)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Elastomer seals and components exposed to air-indoor uncontrolled (internal/external) (3.3.1-11)	Hardening and loss of strength due to elastomer degradation	A plant-specific AMP is to be evaluated.	Yes	Flexible Connection Inspection External Surfaces Monitoring	Consistent with GALL Report (See SER Section 3.3.2.2.5)
Elastomer lining exposed to treated water or treated borated water (3.3.1-12)	Hardening and loss of strength due to elastomer degradation	A plant-specific AMP is to be evaluated.	Yes	Flexible Connection Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.5)
Boral®, boron steel spent fuel storage racks neutron-absorbing sheets exposed to treated water or treated borated water (3.3.1-13)	Reduction of neutron-absorbing capacity and loss of material due to general corrosion	A plant-specific AMP is to be evaluated.	Yes	Boron Carbide Monitoring Program and BWR Water Chemistry	Consistent with GALL Report (See SER Section 3.3.2.2.6)
Steel piping, piping component, and piping elements exposed to lubricating oil (3.3.1-14)	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis and Lubricating Oil Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.7)
Steel reactor coolant pump oil collection system piping, tubing, and valve bodies exposed to lubricating oil (3.3.1-15)	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.2.7)
Steel reactor coolant pump oil collection system tank exposed to lubricating oil (3.3.1-16)	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection to evaluate the thickness of the lower portion of the tank	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.2.7)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel piping, piping components, and piping elements exposed to treated water (3.3.1-17)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Chemistry Program Effectiveness Inspection Monitoring and Collection Systems Inspection Program	Consistent with GALL Report (See SER Section 3.3.2.2.7)
Stainless steel and steel diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust (3.3.1-18)	Loss of material/general (steel only), pitting, and crevice corrosion	A plant-specific AMP is to be evaluated.	Yes	Diesel System Inspection Diesel-Driven Fire Pump Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.7)
Steel (with or without coating or wrapping) piping, piping components, and piping elements exposed to soil (3.3.1-19)	Loss of material due to general, pitting, crevice, and MIC	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	No Yes	Buried Piping and Tanks Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.8)
Steel piping, piping components, piping elements, and tanks exposed to fuel oil (3.3.1-20)	Loss of material due to general, pitting, crevice, and MIC and fouling	Fuel Oil Chemistry and One-Time Inspection	Yes	Fuel Oil Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.9)
Steel heat exchanger components exposed to lubricating oil (3.3.1-21)	Loss of material due to general, pitting, crevice, and MIC and fouling	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis and Lubricating Oil Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.9)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel with elastomer lining or stainless steel cladding piping, piping components, and piping elements exposed to treated water and treated borated water (3.3.1-22)	Loss of material due to pitting and crevice corrosion (only for steel after lining/cladding degradation)	Water Chemistry and One-Time Inspection	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.2.10)
Stainless steel and steel with stainless steel cladding heat exchanger components exposed to treated water (3.3.1-23)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry, Chemistry Program Effectiveness Inspection, and Monitoring and Collection Systems Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.10)
Stainless steel and aluminum piping, piping components, and piping elements exposed to treated water (3.3.1-24)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry, Chemistry Program Effectiveness Inspection, and Monitoring and Collection Systems Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.10)
Copper alloy HVAC piping, piping components, piping elements exposed to condensation (external) (3.3.1-25)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	Yes	External Surfaces Monitoring, Open-Cycle Cooling Water, Cooling Units Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.10)
Copper alloy piping, piping components, and piping elements exposed to lubricating oil (3.3.1-26)	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis and Lubricating Oil Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.10)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Stainless steel HVAC ducting and aluminum HVAC piping, piping components, and piping elements exposed to condensation (3.3.1-27)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	Yes	External Surfaces Monitoring, Open-Cycle Cooling Water, Cooling Units Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.10)
Copper alloy fire protection piping, piping components, and piping elements exposed to condensation (internal) (3.3.1-28)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.2.10)
Stainless steel piping, piping components, and piping elements exposed to soil (3.3.1-29)	Loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.2.10)
Stainless steel piping, piping components, and piping elements exposed to sodium pentaborate solution (3.3.1-30)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.10)
Copper alloy piping, piping components, and piping elements exposed to treated water (3.3.1-31)	Loss of material due to pitting, crevice, and galvanic corrosion	Water Chemistry and One-Time Inspection	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.2.11)
Stainless steel, aluminum and copper alloy piping, piping components, and piping elements exposed to fuel oil (3.3.1-32)	Loss of material due to pitting, crevice, and MIC	Fuel Oil Chemistry and One-Time Inspection	Yes	Fuel Oil Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.12)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Stainless steel piping, piping components, and piping elements exposed to lubricating oil (3.3.1-33)	Loss of material due to pitting, crevice, and MIC	Lubricating Oil Analysis and One-Time Inspection	Yes	Lubricating Oil Analysis and Lubricating Oil Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.12)
Elastomer seals and components exposed to air-indoor uncontrolled (internal or external) (3.3.1-34)	Loss of material due to wear	A plant-specific AMP is to be evaluated.	Yes	Flexible Connection Inspection	Consistent with GALL Report (See SER Section 3.3.2.2.13)
Steel with stainless steel cladding pump casing exposed to treated borated water (3.3.1-35)	Loss of material due to cladding breach	A plant-specific AMP is to be evaluated. Reference NRC IN 94-63, “Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks”	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.3.2.2.14)
Boraflex spent fuel storage racks neutron-absorbing sheets exposed to treated water (3.3.1-36)	Reduction of neutron-absorbing capacity due to boraflex degradation	Boraflex Monitoring	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)
Stainless steel piping, piping components, and piping elements exposed to treated water > 60 °C (140 °F) (3.3.1-37)	Cracking due to SCC and IGSCC	BWR Reactor Water Cleanup System	No	BWR Water Chemistry, Chemistry Program Effectiveness Inspection, BWR SCC, Monitoring and Collection Systems Inspection	Consistent with GALL Report)
Stainless steel piping, piping components, and piping elements exposed to treated water > 60 °C (140 °F) (3.3.1-38)	Cracking due to SCC	BWR SCC and Water Chemistry	No	BWR Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Stainless steel BWR spent fuel storage racks exposed to treated water > 60 °C (140 °F) (3.3.1-39)	Cracking due to SCC	Water Chemistry	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)
Steel tanks in diesel fuel oil system exposed to air-outdoor (external) (3.3.1-40)	Loss of material due to general, pitting, and crevice corrosion	Aboveground Steel Tanks	No	External Surfaces Monitoring	Consistent with GALL Report (See SER Section 3.3.2.1.5)
High-strength steel closure bolting exposed to air with steam or water leakage (3.3.1-41)	Cracking due to cyclic loading and SCC	Bolting Integrity	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)
Steel closure bolting exposed to air with steam or water leakage (3.3.1-42)	Loss of material due to general corrosion	Bolting Integrity	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)
Steel bolting and closure bolting exposed to air-indoor uncontrolled (external) or air-outdoor (external) (3.3.1-43)	Loss of material due to general, pitting, and crevice corrosion	Bolting Integrity	No	Bolting Integrity	Consistent with GALL Report
Steel compressed air system closure bolting exposed to condensation (3.3.1-44)	Loss of material due to general, pitting, and crevice corrosion	Bolting Integrity	No	Bolting Integrity	Consistent with GALL Report
Steel closure bolting exposed to air-indoor uncontrolled (external) (3.3.1-45)	Loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	Bolting Integrity	Consistent with GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Stainless steel and stainless clad steel piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water > 60 °C (140 °F) (3.3.1-46)	Cracking due to SCC	Closed-Cycle Cooling Water System	No	Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.3.2.1.4)
Steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to closed-cycle cooling water (3.3.1-47)	Loss of material due to general, pitting, and crevice corrosion	Closed-Cycle Cooling Water System	No	Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.3.2.1.5)
Steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to closed-cycle cooling water (3.3.1-48)	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.3.2.1.6)
Stainless steel; steel with stainless steel cladding heat exchanger components exposed to closed-cycle cooling water (3.3.1-49)	Loss of material due to MIC	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)
Stainless steel piping, piping components, and piping elements exposed to closed-cycle cooling water (3.3.1-50)	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	No	Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.3.2.1.7)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Copper alloy piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water (3.3.1-51)	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.3.2.1.8)
Steel, stainless steel, and copper alloy heat exchanger tubes exposed to closed-cycle cooling water (3.3.1-52)	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	No	Closed Cooling Water Chemistry and Heat Exchangers Inspection	Consistent with GALL Report (See SER Section 3.3.2.1.10)
Steel compressed air system piping, piping components, and piping elements exposed to condensation (internal) (3.3.1-53)	Loss of material due to general and pitting corrosion	Compressed Air Monitoring	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)
Stainless steel compressed air system piping, piping components, and piping elements exposed to internal condensation (3.3.1-54)	Loss of material due to pitting and crevice corrosion	Compressed Air Monitoring	No	Supplemental Piping/Tank Inspection	Consistent with GALL Report
Steel ducting closure bolting exposed to air-indoor uncontrolled (external) (3.3.1-55)	Loss of material due to general corrosion	External Surfaces Monitoring	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)
Steel HVAC ducting and components external surfaces exposed to air-indoor uncontrolled (external) (3.3.1-56)	Loss of material due to general corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring	Consistent with GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel piping and components external surfaces exposed to air-indoor uncontrolled (external) (3.3.1-57)	Loss of material due to general corrosion	External Surfaces Monitoring	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)
Steel external surfaces exposed to air-indoor uncontrolled (external), air-outdoor (external), and condensation (external) (3.3.1-58)	Loss of material due to general corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring Supplemental Piping/Tank Inspection	Consistent with GALL Report (See SER Section 3.3.2.1.9)
Steel heat exchanger components exposed to air-indoor uncontrolled (external) or air-outdoor (external) (3.3.1-59)	Loss of material due to general, pitting, and crevice corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring	Consistent with GALL Report
Steel piping, piping components, and piping elements exposed to air-outdoor (external) (3.3.1-60)	Loss of material due to general, pitting, and crevice corrosion	External Surfaces Monitoring	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)
Elastomer fire barrier penetration seals exposed to air-outdoor or air-indoor uncontrolled (3.3.1-61)	Increased hardness, shrinkage, and loss of strength due to weathering	Fire Protection	No	Fire Protection	Consistent with GALL Report
Aluminum piping, piping components, and piping elements exposed to raw water (3.3.1-62)	Loss of material due to pitting and crevice corrosion	Fire Protection	No	Potable Water Monitoring	Consistent with GALL Report (See SER Section 3.3.2.1.7)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel fire rated doors exposed to air-outdoor or air-indoor uncontrolled (3.3.1-63)	Loss of material due to wear	Fire Protection	No	Fire Protection	Consistent with GALL Report
Steel piping, piping components, and piping elements exposed to fuel oil (3.3.1-64)	Loss of material due to general, pitting, and crevice corrosion	Fire Protection and Fuel Oil Chemistry	No	Fire Protection Fuel Oil Chemistry	Consistent with GALL Report
Reinforced concrete structural fire barriers/walls, ceilings, and floors exposed to air-indoor uncontrolled (3.3.1-65)	Concrete cracking and spalling due to aggressive chemical attack and reaction with aggregates	Fire Protection and Structures Monitoring Program	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)
Reinforced concrete structural fire barriers/walls, ceilings, and floors exposed to air-outdoor (3.3.1-66)	Concrete cracking and spalling due to freeze thaw, aggressive chemical attack, and reaction with aggregates	Fire Protection and Structures Monitoring Program	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)
Reinforced concrete structural fire barriers/walls, ceilings, and floors exposed to air-outdoor or air-indoor uncontrolled (3.3.1-67)	Loss of material due to corrosion of embedded steel	Fire Protection and Structures Monitoring Program	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)
Steel piping, piping components, and piping elements exposed to raw water (3.3.1-68)	Loss of material due to general, pitting, crevice, and MIC and fouling	Fire Water System	No	Fire Water Diesel-Drive Fire Pumps Inspection Potable Water Monitoring Monitoring and Collection Systems Inspection	Consistent with GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Stainless steel piping, piping components, and piping elements exposed to raw water (3.3.1-69)	Loss of material due to pitting and crevice corrosion, and fouling	Fire Water System	No	Fire Water	Consistent with GALL Report
Copper alloy piping, piping components, and piping elements exposed to raw water (3.3.1-70)	Loss of material due to pitting, crevice, and MIC and fouling	Fire Water System	No	Fire Water Diesel-Drive Fire Pumps Inspection	Consistent with GALL Report
Steel piping, piping components, and piping elements exposed to moist air or condensation (internal) (3.3.1-71)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	Cooling Units Inspection Monitoring and Collection Systems Inspection Supplemental Piping/Tank Inspection	Consistent with GALL Report (See SER Section 3.3.2.1.5)
Steel HVAC ducting and components internal surfaces exposed to condensation (internal) (3.3.1-72)	Loss of material due to general, pitting, crevice, and (for drip pans and drain lines) MIC	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	Cooling Units Inspection	Consistent with GALL Report
Steel crane structural girders in load handling system exposed to air-indoor uncontrolled (external) (3.3.1-73)	Loss of material due to general corrosion	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	No	Material Handling System Inspection	Consistent with GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel cranes—rails exposed to air-indoor uncontrolled (external) (3.3.1-74)	Loss of material due to wear	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	No	Not applicable	Not applicable to Columbia
Elastomer seals and components exposed to raw water (3.3.1-75)	Hardening and loss of strength due to elastomer degradation and loss of material due to erosion	Open-Cycle Cooling Water System	No	Fire Protection	Consistent with GALL Report
Steel piping, piping components, and piping elements (without lining/ coating or with degraded lining/coating) exposed to raw water (3.3.1-76)	Loss of material due to general, pitting, crevice, and MIC, fouling, and lining/coating degradation	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water Diesel Starting Air Inspection Diesel Systems Inspection Monitoring and Collection Systems Inspection Potable Water Monitoring	Consistent with GALL Report (See SER Section 3.3.2.1.2)
Steel heat exchanger components exposed to raw water (3.3.1-77)	Loss of material due to general, pitting, crevice, galvanic, and MIC and fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water Monitoring and Collection Systems Inspection	Consistent with GALL Report (See SER Section 3.3.2.1.2)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Stainless steel, nickel alloy, and copper alloy piping, piping components, and piping elements exposed to raw water (3.3.1-78)	Loss of material due to pitting and crevice corrosion	Open-Cycle Cooling Water System	No	ISI-IWF Structures Monitoring	Consistent with GALL Report
Stainless steel piping, piping components, and piping elements exposed to raw water (3.3.1-79)	Loss of material due to pitting and crevice corrosion, and fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water Monitoring and Collection Systems Inspection	Consistent with GALL Report
Stainless steel and copper alloy piping, piping components, and piping elements exposed to raw water (3.3.1-80)	Loss of material due to pitting, crevice, and MIC	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water Diesel Starting Air Inspection Diesel-Driven Fire Pumps Inspection	Consistent with GALL Report
Copper alloy piping, piping components, and piping elements exposed to raw water (3.3.1-81)	Loss of material due to pitting, crevice, and MIC and fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System Potable Water Monitoring	Consistent with GALL Report (See SER Section 3.3.2.1.2)
Copper alloy heat exchanger components exposed to raw water (3.3.1-82)	Loss of material due to pitting, crevice, galvanic, and MIC and fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System Diesel-Driven Fire Pumps Inspection	Consistent with GALL Report (See SER Section 3.3.2.1.3)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Stainless steel and copper alloy heat exchanger tubes exposed to raw water (3.3.1-83)	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	No	Open-Cycle Cooling Water System Diesel-Driven Fire Pumps Inspection	Consistent with GALL Report (See SER Section 3.3.2.1.3)
Copper alloy > 15% Zn piping, piping components, piping elements, and heat exchanger components exposed to raw water, treated water, or closed-cycle cooling water (3.3.1-84)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Selective Leaching of Materials	Consistent with GALL Report
Gray cast iron piping, piping components, and piping elements exposed to soil, raw water, treated water, or closed-cycle cooling water (3.3.1-85)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Selective Leaching of Materials	Consistent with GALL Report
Structural steel (new fuel storage rack assembly) exposed to air-indoor uncontrolled (external) (3.3.1-86)	Loss of material due to general, pitting, and crevice corrosion	Structures Monitoring Program	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)
Boraflex spent fuel storage racks neutron-absorbing sheets exposed to treated borated water (3.3.1-87)	Reduction of neutron-absorbing capacity due to boraflex degradation	Boraflex Monitoring	No	Not applicable	Not applicable to BWRs (See SER Section 3.3.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Aluminum and copper alloy > 15% Zn piping, piping components, and piping elements exposed to air with borated water leakage (3.3.1-88)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Not applicable	Not applicable to BWRs (See SER Section 3.3.2.1.1)
Steel bolting and external surfaces exposed to air with borated water leakage (3.3.1-89)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Not applicable	Not applicable to BWRs (See SER Section 3.3.2.1.1)
Stainless steel and steel with stainless steel cladding piping, piping components, piping elements, tanks, and fuel storage racks exposed to treated borated water > 60 °C (140 °F) (3.3.1-90)	Cracking due to SCC	Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.3.2.1.1)
Stainless steel and steel with stainless steel cladding piping, piping components, and piping elements exposed to treated borated water (3.3.1-91)	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.3.2.1.1)
Galvanized steel piping, piping components, and piping elements exposed to air-indoor uncontrolled (3.3.1-92)	None	None	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Glass piping elements exposed to air, air-indoor uncontrolled (external), fuel oil, lubricating oil, raw water, treated water, and treated borated water (3.3.1-93)	None	None	No	None	Consistent with GALL Report
Stainless steel and nickel-alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled (external) (3.3.1-94)	None	None	No	None	Consistent with GALL Report
Steel and aluminum piping, piping components, and piping elements exposed to air-indoor controlled (external) (3.3.1-95)	None	None	No	Not applicable	Not applicable to Columbia (See SER Section 3.3.2.1.1)
Steel and stainless steel piping, piping components, and piping elements in concrete (3.3.1-96)	None	None	No	None	Consistent with GALL Report
Steel, stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to gas (3.3.1-97)	None	None	No	None	Consistent with GALL Report
Steel, stainless steel, and copper alloy piping, piping components, and piping elements exposed to dried air (3.3.1-98)	None	None	No	None	Consistent with GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Stainless steel and copper alloy < 15% Zn piping, piping components, and piping elements exposed to air with borated water leakage (3.3.1-99)	None	None	No	Not applicable	Not applicable to BWRs (See SER Section 3.3.2.1.1)

The staff's review of the auxiliary systems component groups followed several approaches. One approach, documented in SER Section 3.3.2.1, discusses the staff's review of AMR results for components that the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.3.2.2, discusses the staff's review of AMR results for components that the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.3.2.3, discusses the staff's review of AMR results for components that the applicant indicated are not consistent with or not addressed in the GALL Report. The staff's review of AMPs credited to manage or monitor aging effects of the auxiliary systems components is documented in SER Section 3.0.3.

3.3.2.1 AMR Results that are Consistent with the GALL Report

LRA Section 3.3.2.1 identifies the materials, environments, AERMs, and the following programs that manage aging effects for the auxiliary systems components:

- Air Quality Sampling Program
- Bolting Integrity Program
- Buried Piping and Tanks Inspection Program
- BWR Stress Corrosion Cracking Program
- BWR Water Chemistry Program
- Chemistry Program Effectiveness Inspection
- Closed Cooling Water Chemistry Program
- Cooling Units Inspection Program
- Diesel-Driven Fire Pumps Inspection Program
- Diesel Starting Air Inspection
- Diesel Systems Inspection Program
- External Surfaces Monitoring Program
- Fire Protection Program
- Fire Water Program
- Flexible Connection Inspection Program
- Flow-Accelerated Corrosion Program
- Fuel Oil Chemistry Program
- Heat Exchangers Inspection
- Lubricating Oil Analysis
- Lubricating Oil Inspection

- Monitoring and Collection Systems Inspection Program
- Open-Cycle Cooling Water Program
- Potable Water Monitoring Program
- Selective Leaching Program
- Small Bore Class 1 Piping Inspection
- Service Air System Inspection Program
- Supplemental Piping/Tank Inspection
- TLAA

LRA Tables 3.3.2-1 through 3.3.2-47 summarize AMRs for the auxiliary systems components and indicate AMRs claimed to be consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant had claimed consistency and for which the GALL Report does not recommend further evaluation, the staff performed an audit and review to determine whether the plant-specific components in these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant provided a note for each AMR line item. The notes describe how the information in the tables aligns with the information in the GALL Report. The staff audited those AMRs with notes A through E, which indicate how the AMR was consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the GALL Report AMP. The staff audited these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report and confirmed that it had reviewed and accepted the identified exceptions to the GALL Report AMPs. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP is consistent with the AMP identified by the GALL Report. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report; however, the applicant identified a different component in the GALL Report that had the same material, environment, aging effect, and AMP as the component under review. The staff audited these line items to verify consistency with the GALL Report. The staff also determined whether the AMR line item of the different component applied to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report and confirmed whether the AMR line item of the different component was applicable to the component under review. The staff confirmed whether it had reviewed and accepted the exceptions to the GALL Report AMPs. It also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The staff audited these line items to verify consistency with the GALL Report and determined whether the identified AMP would manage the aging effect consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

The staff did not repeat its review of the matters described in the GALL Report; however, it did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMRs. The staff's evaluation is discussed below.

The staff reviewed the LRA to confirm that the applicant provided a brief description of the system, components, materials, and environments; stated that the applicable aging effects were reviewed and evaluated in the GALL Report; and identified those aging effects for the auxiliary systems components that are subject to an AMR.

On the basis of its audit and review, the staff determines that, for AMRs not requiring further evaluation, as identified in LRA Table 3.3.1, the applicant's references to the GALL Report are acceptable, and no further staff review is required.

3.3.2.1.1 ARM Results Identified as Not Applicable

For line items 3.3.1-87, 3.3.1-88, 3.3.1-89, 3.3.1-90, 3.3.1-91, and 3.3.1-99 in LRA Table 3.3.1 the applicant claimed that the corresponding AMR items in the GALL Report are not applicable because the associated line items are only applicable to PWRs. The staff reviewed the SRP-LR, confirmed these line items only applies to PWRs, and finds these line items are not applicable to Columbia.

For line items 3.3.1-36, 3.3.1-39, 3.3.1-41, 3.3.1-42, 3.3.1-65, 3.3.1-66, 3.3.1-67, 3.3.1-92, 3.3.1-95 in LRA Table 3.3.1, the applicant claimed that it was not applicable. The staff reviewed the LRA and UFSAR and confirmed that the applicant's LRA does not have any AMR results that are applicable to these line items.

LRA Table 3.3.1, item 3.3.1-49 addresses stainless steel and stainless steel clad heat exchanger components exposed to closed-cycle cooling water. The GALL Report recommends using the Closed Cycle Cooling Water Program to manage loss of material due to microbiologically influenced corrosion for this component group. The applicant stated that this line item is not applicable because loss of material due to microbiologically influenced corrosion is not an aging effect requiring management for stainless steel heat exchanger components in the auxiliary systems that are exposed to closed cycle cooling water. In its review for this item, the staff noted that the applicant utilized item 3.3.1-50 for stainless steel heat exchangers components in several systems. Item 3.3.1-50 addresses the same material, stainless steel, the same environment, closed cycle cooling water, and same aging effect, loss of material, but addresses different components, piping and piping components, etc., and a different aging mechanism, microbiologically influenced corrosion. Although the staff does not agree with the applicant's claim that loss of material due to microbiologically influenced corrosion is not an aging effect requiring management for this component, material, and environment combination, since the components are being managed for the same aging effect, loss of material, any degradation caused by the different aging mechanism will still be identified. The staff finds that the applicant's use of item 3.3.1-50 will ensure that the aging effect being addressed by item 3.3.1-49 will be identified, and therefore, finds the applicant's determination acceptable.

LRA Table 3.3.1, item 3.3.1-53 addresses steel compressed air system piping, piping components, and piping elements exposed to condensation (internal). The GALL Report recommends use of AMP XI.M24, "Compressed Air Monitoring," to manage loss of material due to general and pitting corrosion for this component group. The applicant stated that this item is not applicable because steel compressed air system piping, piping components, and piping elements are not exposed to condensation (internal). The staff noted that the LRA indicates that the GALL Report Table 3, line items 53 and 54 are not applicable to CGS for compressed air system steel and stainless steel piping, piping components and piping elements exposed to internal condensation. By letter dated August 26, 2010, the staff issued RAI 3.3.1-53.1 requesting that the applicant clarify the Compressed Air System components and justify how those environments are kept free of all moisture.

In its response dated November 23, 2010, the applicant provided a detailed description of the three Columbia systems that encompass the Compressed Air Systems: the Containment Instrument Air System, Control Air System, and Service Air System. For each system, the applicant provided a detailed description of the system function as well as how environments and aging effects were dispositioned. The applicant also further clarified that the Control Air System, which provides oil free, dried instrument quality air throughout the plant for pneumatic instrumentation, controls and actuators is maintained through the continued use of the Air Quality Sampling Program, which ensures that the system remains dry and free of contaminants, thereby validating the AMR conclusion that there are no aging effects that require management. The staff finds the applicant's response acceptable because clarification was provided to help differentiate the compressed air related systems at the plant and the associated environments and aging effects were identified. Furthermore, the applicant clarified that the Air Quality Sampling Program is used to ensure dry and contaminant free air is supplied. The staff's evaluation of the applicant's Air Quality Sampling Program is documented in SER Section 3.0.3.3.1. The staff evaluated the applicant's not applicable claim and found it acceptable because the environment specified was correctly identified as "dried air" which is addressed by item number 3.3.1-98 as no aging effect requiring management.

LRA Table 3.3.1, item 3.3.1-54 addresses stainless steel compressed air system piping, piping components, and piping elements exposed to condensation (internal). The GALL Report recommends use of AMP XI.M24, "Compressed Air Monitoring," to manage loss of material due to pitting and crevice corrosion for this component group. The applicant stated that this item is not applicable because stainless steel compressed air system piping, piping components, and piping elements are not exposed to condensation (internal). The staff noted that the LRA indicates that the GALL Report Table 3, line items 53 and 54 are not applicable to CGS for compressed air system steel and stainless steel piping, piping components and piping elements exposed to internal condensation. By letter dated August 26, 2010, the staff issued RAI 3.3.1-53.1 requesting that the applicant clarify the Compressed Air System components and justify how those environments are kept free of all moisture.

In its response dated November 23, 2010, the applicant provided a detailed description of the three Columbia systems that encompass the Compressed Air Systems: the Containment Instrument Air System, Control Air System, and Service Air System. For each system, the applicant provided a detailed description of the system function as well as how environments and aging effects were dispositioned. The applicant also further clarified that the Control Air System, which provides oil free, dried instrument quality air throughout the plant for pneumatic instrumentation, controls and actuators is maintained through the continued use of the Air Quality Sampling Program, which ensures that the system remains dry and free of contaminants, thereby validating the AMR conclusion that there are no aging effects that require management. The staff finds the applicant's response acceptable because clarification was provided to help differentiate the compressed air related systems at the plant and the associated environments and aging effects were identified. Furthermore, the applicant clarified that the Air Quality Sampling Program is used to ensure dry and contaminant free air is supplied. The staff's evaluation of the applicant's Air Quality Sampling Program is documented in SER Section 3.0.3.3.1. The staff evaluated the applicant's not applicable claim and found it acceptable because the environment specified was correctly identified as "dried air" which is addressed by item number 3.3.1-98 as no aging effect requiring management.

LRA Table 3.3.1, item 3.3.1-55 addresses steel ducting closure bolting exposed to air- indoor uncontrolled (external). The GALL Report recommends use of AMP XI.M36, "External Surfaces Monitoring," to manage loss of material due to general corrosion for this component group. The applicant stated that this item is not applicable because this component, material, and environment combination is addressed by item number 3.3.1-43. The staff evaluated the applicant's claim and found it acceptable because 1) the applicant has credited an alternate table 1 line item (3.3.1-43) to manage this component group and 2) item number 3.3.1-43 manages the same aging effects for a similar component group using the Bolting Integrity Program, which includes the same or more stringent inspection methods to identify loss of material as used in the External Surfaces Monitoring Program.

LRA Table 3.3.1, item 3.3.1-57 addresses steel piping and components external surfaces exposed to air- indoor uncontrolled (external). The GALL Report recommends use of AMP XI.M36, "External Surfaces Monitoring," to manage loss of material due to general corrosion for this component group. The applicant stated that this item is not applicable because this component, material, and environment combination is addressed by item number 3.3.1-58. The staff evaluated the applicant's claim and found it acceptable because 1) the applicant has credited an alternate table 1 line item (3.3.1-58) to manage this component group and 2) item number 3.3.1-58 manages the same aging effects for a similar component group by also crediting the External Surfaces Monitoring Program.

LRA Table 3.3.1, item 3.3.1-60 addresses steel piping, piping components, and piping elements exposed to air- outdoor (external). The GALL Report recommends use of AMP XI.M36, "External Surfaces Monitoring," to manage loss of material due to general corrosion for this component group. The applicant stated that this item is not applicable because this component, material, and environment combination is addressed by item number 3.3.1-58. The staff evaluated the applicant's claim and found it acceptable because 1) the applicant has credited an alternate table 1 line item (3.3.1-58) to manage this component group and 2) item number 3.3.1-58 manages the same aging effects for a similar component group by also crediting the External Surfaces Monitoring Program.

LRA Table 3.3.1, item 3.3.1-74 addresses steel cranes- rails exposed to air- indoor uncontrolled (external). The GALL Report recommends the use of AMP XI.M24, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems," to manage loss of material for this component group. The applicant stated that this item is not applicable because loss of material due to wear was not identified as an aging effect requiring management for steel crane rails that are exposed to air-indoor uncontrolled. The staff evaluated the applicant's claim and found it acceptable because 1) the applicant manages loss of material for steel crane rails that are exposed to air-indoor with an alternate table 1 line item (3.3.1-73) and 2) item number

3.3.1-73 manages the same aging effects for a similar component group by crediting the Material Handling System Inspection Program which is an existing program consistent with AMP XI.M24, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems."

LRA Table 3.3.1, Item 3.3.1-86, addresses structural steel (new fuel storage rack assembly) exposed to air-indoor uncontrolled (external). The GALL Report recommends use of the Structures Monitoring Program to manage loss of material due to general, pitting, and crevice corrosion for this component group. The applicant stated that this line item is not applicable because there is no structural steel (new fuel storage rack assembly) exposed to air-indoor uncontrolled (external). Plant-specific Note 511 states:

> The new fuel storage racks are located in a dry mild environment inside the new fuel storage vault. The new fuel storage racks are made from aluminum with stainless steel fasteners. The use of stainless steel fasteners in aluminum to avoid detrimental galvanic corrosion in a predominantly air environment, is a recommended practice and has been used successfully for many years by the aluminum industry.

The staff notes that the applicant stated that Item 3.3.1-86 was not applicable and alternatively used line Items 3.5.1-58 and 3.5.1-59, which state that the GALL Report recommends that there are no aging effects or AMP. The staff evaluated the applicant's claim and found it acceptable because, given the dry air environment the GALL Report recommends for both stainless steel and aluminum, there are no recommended aging effects and AMP.

3.3.2.1.2 Loss of Material Due to General, Pitting, Crevice, and Microbiologically Influenced Corrosion, Fouling, and Lining or Coating Degradation

LRA Table 3.3.1, Item 3.3.1-76, addresses steel drain piping in the diesel (engine) exhaust system exposed to raw water, which are being managed for loss of material due to general, pitting, crevice, and MIC, fouling, and lining or coating degradation. The LRA credits the Diesel Systems Inspection Program to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M20 "Open-Cycle Cooling Water System" to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M20 recommends using appropriate materials, condition and performance monitoring, and chemical treatment if biological fouling species exists, to manage the aging of these line items. In its review of components associated with Item 3.3.1-76, for which the applicant cited Generic Note E, the staff noted that the Diesel Systems Inspection Program proposes to manage the aging of steel components through the use of the One-Time Inspection Program. It is not clear to the staff how the Diesel System Inspection Program, which is a One-Time Inspection Program, will appropriately manage aging of this component type. By letter dated August 26, 2010, the staff issued RAI 3.3.2.1-Y2 requesting that the applicant provide technical justification for how the Diesel Systems Inspection Program will adequately manage loss of material for the steel piping exposed to raw water.

The applicant re-evaluated the use of one-time inspections described in the LRA and provided a comprehensive response to this issue by responding to RAI 3.3.2.2.7.3-2. By letter dated January 28, 2011, the applicant responded to RAI 3.3.2.2.7.3-2 by stating that the Diesel System Inspection Program has been modified to do the following:

- clarify that the program is a plant-specific program
- change the one-time inspection to a baseline inspection of each material exposed to each environment prior to the period of extended operation
- describe sample population selection and limits, as well as acceptance criteria
- include opportunistic inspection of components within the scope of the program during the maintenance, repair, or surveillance activities through the period of extended operation
- include trending of the results of these inspection to ensure that each material and environment combination is examined opportunistically within a 5-year period

The staff finds the applicant's response acceptable because the applicant committed to modify its program from a one-time inspection to a periodic inspection, which is consistent with the guidance in the GALL Report. The staff's concern described in RAI 3.3.2.1-Y2 is resolved.

The staff's evaluation of the applicant's Diesel System Inspection Program is documented in SER Section 3.0.3.3.5. In its review of components associated with Item 3.3.1-76, the staff finds the applicant's proposal to manage aging using the Diesel System Inspection Program acceptable because, as discussed in the above RAI response, the program now consists of baseline inspections of components, with additional opportunistic inspections during maintenance, repair or surveillance activities, and trending of results that are able to manage loss of material.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

LRA Table 3.3.1, Items 3.3.1-76 and 3.3.1-80, address steel and stainless steel drain piping in the diesel starting air system exposed to raw water, which are being managed for loss of material due to general, pitting, crevice, and MIC, fouling, and lining or coating degradation. The LRA credits the Diesel Starting Air Inspection Program to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M20 "Open-Cycle Cooling Water System" to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M20 recommends using appropriate materials, condition and performance monitoring, and chemical treatment if biological fouling species exists, to manage the aging of these line items. In its review of components associated with Items 3.3.1-76 and 3.3.1-80, for which the applicant cited Generic Note E, the staff noted that the Diesel Starting Air Inspection Program proposes to manage the aging of steel and stainless steel components through the use of a One-Time Inspection Program. It is not clear to the staff how the Diesel Starting Air Inspection Program, which is a One-Time Inspection Program, will appropriately manage aging of this component type. By letter dated August 26, 2010, the staff issued RAI 3.3.2.1-Y3 requesting that the applicant provide technical justification for how the Diesel Starting Air Inspection Program will adequately manage loss of material for steel and stainless steel components exposed to raw water.

In its response dated November 23, 2010, the applicant stated that loss of material for steel and stainless steel components exposed to raw water will be adequately managed with the Diesel Starting Air Inspection Program as a supplement to the Air Quality Sampling Program. The applicant stated that the air receivers are the first section of the diesel starting air system that is cold, relative to the air temperature coming from the compressor, and it is where water may be trapped in the system. The applicant also stated that some of the air receivers have been periodically inspected, and these inspections identified the receivers were dry with some slight dry corrosion identified. The applicant further stated that, in another inspection where corrosion was observed, the thinning from UT thickness data showed that corrosion rates were minimal, and additional inspections of the valves and flexible hoses between the air compressors and the air dryers also identified minimal corrosion. The staff finds the applicant's response acceptable because the GALL Report states that use of one-time inspections may be used to provide additional assurance that aging is not occurring or that the evidence of aging shows the aging is so insignificant that an AMP is not warranted. The staff finds that the applicant's operating experience currently indicates that insignificant aging is currently ongoing, and the use of the One-Time Inspection Program is acceptable to confirm that the aging in this system contines to be insignificant. The staff's concern described in RAI 3.3.2.1-Y3 is resolved.

The staff's evaluation of the applicant's Diesel Starting Air Inspection Program is documented in SER Section 3.0.3.1.11. In its review of components associated with Items 3.3.1-76 and 3.3.1-80, the staff finds the applicant's proposal to manage aging using the Diesel Starting Air Inspection Program acceptable because, as discussed in the above RAI response, a One-Time Inspection Program is supported by the applicant's current operating experience for these components.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

LRA Table 3.3.1, Item 3.3.1-76, addresses steel tanks in the diesel engine starting air system exposed to raw water, which are being managed for loss of material due to general, pitting, crevice, and MIC, fouling, and lining or coating degradation. The LRA credits the Air Quality Sampling Program to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M20 "Open-Cycle Cooling Water System" to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M20 recommends using appropriate materials, condition and performance monitoring, and chemical treatment if biological fouling species exists, to manage the aging of these line items. In its review of components associated with Item 3.3.1-76, for which the applicant cited Generic Note E, the staff noted that the Air Quality Sampling Program proposes to manage the aging of steel components through the use of periodic air quality sampling and periodic UT inspections of air receivers to ensure that the pressure boundary integrity is maintained.

The staff's evaluation of the applicant's Air Quality Sampling Program is documented in SER Section 3.0.3.3.1. In its review of components associated with Item 3.3.1-76, the staff finds the applicant's proposal to manage aging using the Air Quality Sampling Program acceptable because the Air Quality Sampling Program conducts periodic inspections similar to that of the Open-Cycle Cooling Water System, as recommended by the GALL Report.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

LRA Table 3.3.1, Items 3.3.1-76, 3.3.1-77, and 3.3.1-79, address steel and stainless steel drain piping and heat exchanger components in the EDRs, floor drain, floor drain radioactive, fuel pool cooling, miscellaneous waste radioactive, process sampling radioactive, and reactor closed cooling water systems exposed to raw water, which are being managed for loss of material due to general, pitting, crevice, and MIC, fouling, and lining or coating degradation. The LRA credits the Monitoring and Collection Systems Inspection to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M20 "Open-Cycle Cooling Water System" Program to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M20 recommends using appropriate materials, condition and performance monitoring, and chemical treatment if biological fouling species exists, to manage the aging of these line items. In its review of components associated with Items 3.3.1-76 and 3.3.1-79, for which the applicant cited Generic Note E, the staff noted that the Monitoring and Collection Systems Inspection Program proposes to manage the aging of steel and stainless steel components through the use of a One-Time Inspection Program. It is not clear to the staff how the Monitoring and Collection Systems Inspection Program, which is a One-Time Inspection Program, will appropriately manage aging of this component type. By letter dated August 26, 2010, the staff issued RAI 3.3.2.1-Y4 requesting that the applicant provide technical justification for how the Monitoring and Collection Systems Inspection Program will adequately manage loss of material for the steel components.

The applicant re-evaluated the use of one-time inspections described in the LRA and provided a comprehensive response to this issue by responding to RAI 3.3.2.2.7.3-2. By letter dated January 28, 2011, the applicant responded to RAI 3.3.2.2.7.3-2 by stating that the Monitoring and Collection Systems Inspection Program has been modified to do the following:

- clarify that the program is a plant-specific program
- change the one-time inspection to a baseline inspection of each material exposed to each environment prior to the period of extended operation
- describe sample population selection and limits, as well as acceptance criteria
- include opportunistic inspection of components within the scope of the program during the maintenance, repair, or surveillance activities through the period of extended operation
- include trending of the results of these inspection to ensure that each material and environment combination is examined opportunistically within a 5-year period

The staff finds the applicant's response acceptable because the applicant has committed to modify its program from a one-time inspection to a periodic inspection which is consistent with the guidance in the GALL Report. The staff's concern described in RAI 3.3.2.1-Y4 is resolved.

The staff's evaluation of the applicant's Monitoring and Collection Systems Inspection Program is documented in SER Section 3.0.3.1.23. In its review of components associated with Items 3.3.1-76, 3.3.1-77, and 3.3.1-79, the staff finds the applicant's proposal to manage aging using the Monitoring and Collection Systems Program acceptable because, as discussed in the above RAI response, the program now consists of baseline inspections of components, with additional opportunistic inspections during maintenance, repair or surveillance activities, and trending of results that are able to manage loss of material.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

LRA Table 3.3.1, Item 3.3.1-76, addresses steel air washers and associated components in the reactor building HVAC systems exposed to raw water, which are being managed for loss of material due to general, pitting, crevice, and MIC, fouling, and lining or coating degradation. In addition, LRA Table 3.3.1, Item 3.3.1-81, addresses copper alloy components in the PWC, potable hot water, and reactor building HVAC systems exposed to raw water, which are being managed for loss of material due to pitting, crevice, and MIC, and fouling. The LRA credits the Potable Water Monitoring Program to manage these aging effects. The GALL Report recommends GALL Report AMP XI.M20 "Open-Cycle Cooling Water System" Program to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M20 recommends using appropriate materials, condition and performance monitoring, and chemical treatment if biological fouling species exists, to manage the aging of these line items. In its review of components associated with Items 3.3.1-76 and 3.3.1-81, for which the applicant cited Generic Note E, the staff noted that the Potable Water Monitoring Program proposes to manage the aging of copper alloy and steel components through the use of periodic inspections. During the staff's review, it was noted that the applicant stated the Potable Water Monitoring Program would conduct inspections at least once every 5 years.

The staff's evaluation of the applicant's Potable Water Monitoring Program is documented in SER Section 3.0.3.3.9. In its review of components associated with Items 3.3.1-76 and 3.3.1-81, the staff finds the applicant's proposal to manage aging using the Potable Water Monitoring Program acceptable because the program conducts periodic inspections similar to that of the Open-Cycle Cooling Water System, as recommended by the GALL Report.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.3 Loss of Material Due to Pitting, Crevice, Galvanic, and Microbiologically-Influenced Corrosion, Fouling, and Reduction of Heat Transfer

LRA Table 3.3.1, Items 3.3.1-80, 3.3.1-82, and 3.3.1-83, address stainless steel and copper alloy heat exchanger tubes in the fire protection system exposed to raw water, which are being managed for loss of material due to pitting, crevice, galvanic, and MIC, fouling, and reduction of heat transfer. The LRA credits the Diesel-Driven Fire Pumps Inspection Program to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M20 "Open-Cycle Cooling Water System" to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M20 recommends using appropriate materials, condition and performance monitoring, and chemical treatment if biological fouling species exists, to manage the aging of these line items. In its review of components associated with Items 3.3.1-80, 3.3.1-82, and 3.3.1-83, for which the applicant cited Generic Note E, the staff noted that the Diesel-Driven Fire Pumps Program proposes to manage the aging of stainless steel and copper alloy components through the use of a One-Time

Inspection Program. It is not clear to the staff how the Diesel-Driven Fire Pumps Program, which is a One-Time Inspection Program, will appropriately manage aging of this component type. By letter dated August 26, 2010, the staff issued RAI 3.3.2.1-Y5 requesting that the applicant provide technical justification for how the Diesel-Driven Fire Pumps Inspection Program will adequately manage these aging effects for the stainless steel and copper components exposed to raw water.

The applicant reevaluating the use of one-time inspections described in the LRA, and provided a comprehensive response to this issue by responding to RAI 3.3.2.2.7.3-2. By letter dated January 28, 2011, the applicant responded to RAI 3.3.2.2.7.3-2 by stating that the Diesel-Driven Fire Pumps Inspection Program has been modified to do the following:

- clarify that the program is a plant-specific program
- change the one-time inspection to a baseline inspection of each material exposed to each environment prior to the period of extended operation
- describe sample population selection and limits, as well as acceptance criteria
- include opportunistic inspection of components within the scope of the program during the maintenance, repair, or surveillance activities through the period of extended operation
- include trending of the results of these inspection to ensure that each material and environment combination is examined opportunistically within a 5-year period

The staff finds the applicant’s response acceptable because the applicant committed to modify its program from a one-time inspection a to periodic inspection, which is consistent with the guidance in the GALL Report. The staff’s concern described in RAI 3.3.2.1-Y5 is resolved.

The staff’s evaluation of the applicant’s Diesel-Driven Fire Pumps Inspection Program is documented in SER Section 3.0.3.3.4. In its review of components associated with Items 3.3.1-80, 3.3.1-82, and 3.3.1-83, the staff finds the applicant’s proposal to manage aging using the Diesel-Driven Fire Pump Inspection Program acceptable because, as discussed in the above RAI response, the program now consists of baseline inspections of components, with additional opportunistic inspections during maintenance, repair or surveillance activities, and trending of results that are able to manage loss of material.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.4 Cracking Due to Stress Corrosion Cracking

LRA Table 3.3.1, Item 3.3.1-46, addresses stainless steel components exposed to closed-cycle cooling water with a temperature greater than 60 °C (140 °F), which are being managed for cracking due to SCC. The LRA credits the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M21 “Closed-Cycle Cooling Water System” to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M21 recommends using chemistry control with guidance from the EPRI closed cooling water chemistry guidelines Report. In addition, GALL Report AMP XI.M21 recommends performance monitoring techniques for pumps and heat exchangers to manage the aging of these line items. In its review of components associated with Item 3.3.1-46, for which the applicant cited Generic Note E, the staff noted that the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs propose to manage the aging of stainless steel components through the use of chemistry control, corrosion rate measurements, and one-time inspections.

The staff's evaluations of the applicant's Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs are documented in SER Sections 3.0.3.2.4 and 3.0.3.1.8, respectively. In its review of components associated with line Item 3.3.1-46, the staff finds the applicant's proposal to manage aging using the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs acceptable because the applicant is supplementing the GALL Report's recommended program with a One-Time Inspection Program to identify if cracking due to SCC of susceptible materials has occurred.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.5 Loss of Material Due to General, Pitting, and Crevice Corrosion

LRA Table 3.3.1, Item 3.3.1-40, addresses steel diesel fuel oil tanks exposed to air-outdoor (external), which are being managed for loss of material due to general, pitting, and crevice corrosion. The LRA credits the External Monitoring Program to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M29, "Aboveground Steel Tanks," to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E. The applicant states that the steel tanks in the diesel fuel oil system are buried and not exposed to air-outdoor (external). However, this item is applied to the internal surface of the fuel oil tanks that are evaluated as exposed to ambient air, i.e., air-outdoor (internal). The External Surfaces Monitoring Program is credited to manage loss of material.

For those line items associated with Generic Note E, GALL Report AMP XI.M29 recommends using periodic visual inspections at accessible locations as well as thickness measurements at inaccessible locations to manage the aging of these line items. In its review of components associated with Item 3.3.1-40, for which the applicant cited Generic Note E, the staff noted that the External Surfaces Monitoring Program proposes to manage the aging of aluminum, copper alloy, copper alloy > 15% Zn, gray cast iron, stainless steel (including CASS), and steel components that are exposed to condensation, air-indoor uncontrolled, and air-outdoor environments on external surfaces, and in some cases the internal surfaces, of mechanical components within the scope of license renewal.

The staff's evaluation of the applicant's External Surfaces Monitoring Program is documented in SER Section 3.0.3.2.6. The staff noted that the applicant's External Surfaces Monitoring Program provides inspections and surveillance activities of accessible external surfaces on a frequency that generally exceeds once per fuel cycle. Surfaces that are inaccessible during normal plant operation are inspected during refueling outages. Surfaces that are inaccessible or not readily visible during both plant operations and refueling outages, such as surfaces that are insulated, are inspected opportunistically, for example during maintenance activities during which insulation is removed. In its review of components associated with line Item 3.3.1-40, the staff finds the applicant's proposal to manage aging using the External Surfaces Monitoring Program acceptable because the program includes periodic inspections and surveillance testing capable of detecting loss of material on accessible and inaccessible surfaces.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

LRA Table 3.3.1, Item 3.3.1-47, addresses steel components exposed to closed-cycle cooling water, which are being managed for loss of material due to general, pitting, and crevice corrosion. The LRA credits the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M21 "Closed-Cycle Cooling Water System" to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M21 recommends using chemistry control with guidance from the EPRI closed cooling water chemistry guidelines Report. In addition, GALL Report AMP XI.M21 recommends performance monitoring techniques for pumps and heat exchangers to manage the aging of these line items. In its review of components associated with Item 3.3.1-47 for which the applicant cited Generic Note E, the staff noted that the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs propose to manage the aging of steel components through the use of chemistry control, corrosion rate measurements, and one-time inspections.

The staff's evaluations of the applicant's Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs are documented in SER Sections 3.0.3.2.4 and 3.0.3.1.8, respectively. In its review of components associated with line Item 3.3.1-47, the staff finds the applicant's proposal to manage aging using the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs acceptable because the applicant is supplementing the GALL Report's recommended program with a One-Time Inspection Program to identify if a loss of material due to crevice, general, galvanic, or pitting corrosion has occurred.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

LRA Table 3.3.1, Item 3.3.1-71, addresses steel pump casings exposed to moist air (internal), which are being managed for loss of material due to general, pitting, and crevice corrosion. The LRA credits the Supplemental Piping/Tank Inspection Program to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M38 "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components" to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E and plant-specific Note 0303, which states that the Supplemental Piping/Tank Inspection will manage loss of material at the air-water interface.

For those line items associated with Generic Note E, GALL Report AMP XI.M38 recommends using periodic visual inspections to manage the aging of these line items. In its review of components associated with Item 3.3.1-71, for which the applicant cited Generic Note E, the staff noted that the Supplemental Piping/Tank Inspection Program proposes to manage the aging of steel, gray cast iron, and stainless steel components that are exposed to moist air environments, particularly the aggressive alternate wet and dry environment that exists at air water interfaces or air spaces of susceptible piping and tanks using a combination of volumetric and visual one-time inspections of internal and external surfaces to identify evidence of a loss of material.

The staff's evaluation of the applicant's Supplemental Piping/Tank Inspection Program is documented in SER Section 3.0.3.1.29. The staff noted that the applicant's Supplemental Piping/Tank Inspection Program provides for a one-time inspection of internal and external surfaces components exposed to the environment in question. The staff noted that the applicant also credited the Open-Cycle Cooling Water Program to manage aging for the internal surfaces of these components exposed to raw water. The staff further noted that the Open-Cycle Cooling Water Program includes periodic inspections and surveillance testing to detect loss of material, cracking, and fouling. In its review of components associated with line Item 3.3.1-71, the staff finds the applicant's proposal to manage aging using the Supplemental Piping/Tank Inspection Program acceptable because the program includes a combination of visual and volumetric examinations that are capable of detecting loss of material, and the components are also being managed by the Open-Cycle Cooling Water Program, which includes periodic inspections and surveillance testing capable of detecting loss of material.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.6 Loss of Material Due to General, Pitting, Crevice, and Galvanic Corrosion

LRA Table 3.3.1, Item 3.3.1-48, addresses steel components exposed to closed-cycle cooling water, which are being managed for loss of material due to general, pitting, crevice, and galvanic corrosion. The LRA credits the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M21 "Closed-Cycle Cooling Water System" to ensure that these aging effects are adequately managed. The associated AMR line items cites Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M21 recommends using chemistry control with guidance from the EPRI closed cooling water chemistry guidelines Report. In addition, GALL Report AMP XI.M21 recommends performance monitoring techniques for pumps and heat exchangers to manage the aging of these line items. In its review of components associated with Item 3.3.1-48, for which the applicant cited Generic Note E, the staff noted that the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs propose to manage the aging of steel components through the use of chemistry control, corrosion rate measurements, and one-time inspections.

The staff's evaluations of the applicant's Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs are documented in SER Sections 3.0.3.2.4 and 3.0.3.1.8, respectively. In its review of components associated with line Item 3.3.1-48, the staff finds the applicant's proposal to manage aging using the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs acceptable because the applicant is supplementing the GALL Report's recommended program with a One-Time Inspection Program to identify if a loss of material due to crevice, general, galvanic, or pitting corrosion has occurred.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.7 Loss of Material Due to Pitting and Crevice Corrosion

LRA Table 3.3.1, Item 3.3.1-50, addresses stainless steel components exposed to closed-cycle cooling water, which are being managed for loss of material due to pitting and crevice corrosion. The LRA credits the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M21 “Closed-Cycle Cooling Water System” to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M21 recommends using chemistry control with guidance from the EPRI closed cooling water chemistry guidelines Report. In addition, GALL Report AMP XI.M21 recommends performance monitoring techniques for pumps and heat exchangers to manage the aging of these line items. In its review of components associated with Item 3.3.1-50, for which the applicant cited Generic Note E, the staff noted that the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs propose to manage the aging of stainless steel components through the use of chemistry control, corrosion rate measurements, and one-time inspections.

The staff’s evaluations of the applicant’s Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs are documented in SER Sections 3.0.3.2.4 and 3.0.3.1.8, respectively. In its review of components associated with line Item 3.3.1-50, the staff finds the applicant’s proposal to manage aging using the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs acceptable because the applicant is supplementing the GALL Report’s recommended program with a One-Time Inspection Program to identify if a loss of material due to crevice or pitting corrosion has occurred.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

LRA Table 3.3-1, Item 3.3.1-62, addresses aluminum piping, piping components, and piping elements exposed to raw water, which are being managed for loss of material due to pitting and crevice corrosion. The applicant stated that this item is applied to aluminum tank in the PWC system exposed to raw water. The LRA credits the Potable Water Monitoring Program to manage the aging effects. The GALL Report recommends GALL Report AMP XI.M.26 “Fire Protection” to ensure that these aging effects are adequately managed. The associated AMR line item cites Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M26 “Fire Protection” recommends using visual inspections to manage the aging effect. The staff noted that the Potable Water Monitoring Program proposes to manage the aging effects of line Item 3.3.1-62 through the use of visual inspections and volumetric examinations. The Potable Water Monitoring Program preventive actions include water treatment activities such as flocculation, sedimentation, filtration, and chemical addition. The program monitors the water treatment plant performance and the overall status of the potable water system, including water quality.

The staff reviewed the applicant's Potable Water Monitoring Program, and its evaluation is documented in SER Section 3.0.3.3.9. In its review of components associated with line Item 3.3.1-62, the staff finds the applicant's proposal to manage aging effects using the Potable Water Monitoring Program acceptable because the program includes visual inspections and volumetric examinations that can detect loss of material due to pitting and crevice corrosion, as well as water treatment activities including flocculation, sedimentation, filtration, and chemical addition, which are effective preventive actions.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.8 Loss of Material Due to Pitting, Crevice, and Galvanic Corrosion

LRA Table 3.3.1, Item 3.3.1-51, addresses copper alloy components exposed to closed-cycle cooling water, which are being managed for loss of material due to pitting, crevice, and galvanic corrosion. The LRA credits the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M21 "Closed-Cycle Cooling Water System" to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M21 recommends using chemistry control with guidance from the EPRI closed cooling water chemistry guidelines Report. In addition, GALL Report AMP XI.M21 recommends performance monitoring techniques for pumps and heat exchangers to manage the aging of these line items. In its review of components associated with Item 3.3.1-51, for which the applicant cited Generic Note E, the staff noted that the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs propose to manage the aging of copper alloy components through the use of chemistry control, corrosion rate measurements, and one-time inspections.

The staff's evaluations of the applicant's Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs are documented in SER Sections 3.0.3.2.4 and 3.0.3.1.8, respectively. In its review of components associated with line Item 3.3.1-51, the staff finds the applicant's proposal to manage aging using the Closed Cooling Water Chemistry and Chemistry Program Effectiveness Inspection Programs acceptable because the applicant is supplementing the GALL Report's recommended program with a One-Time Inspection Program, which will identify whether a loss of material due to crevice, galvanic, or pitting corrosion has occurred.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.9 Loss of Material Due to General Corrosion

LRA Table 3.3.1, Item 3.3.1-58, addresses steel pump casings exposed to uncontrolled indoor air (external), which are being managed for loss of material due to general corrosion. The LRA credits the Supplemental Piping/Tank Inspection Program to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M36 "External Surfaces Monitoring" to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic

Note E and plant-specific Note 0303, which states that the Supplemental Piping/Tank Inspection will manage loss of material at the air-water interface.

For those line items associated with Generic Note E, GALL Report AMP XI.M36 recommends using periodic visual inspections to manage loss of material for these items. In its review of components associated with Item 3.3.1-58, for which the applicant cited Generic Note E, the staff noted that the Supplemental Piping/Tank Inspection Program proposes to manage the aging of steel, gray cast iron, and stainless steel components that are exposed to moist air environments, particularly the aggressive alternate wet and dry environment that exists at air water interfaces or air spaces of susceptible piping and tanks using a combination of volumetric and visual one-time inspections of the internal and external surfaces to identify evidence of a loss of material. The staff noted that the applicant is also managing the external surfaces of the steel pump casings exposed to indoor uncontrolled air using the External Surfaces Monitoring Program in other line items in the same tables.

The staff's evaluation of the applicant's Supplemental Piping/Tank Inspection Program is documented in SER Section 3.0.3.1.29. In its review of components associated with line Item 3.3.1-56, the staff finds the applicant's proposal to manage aging for the external surfaces of these components using the Supplemental Piping/Tank Inspection Program acceptable because the program includes a combination of volumetric and visual one-time inspections, which are capable of identifying evidence of a loss of material. Additionally, the components are being managed by the External Surfaces Monitoring Program, which includes periodic visual inspections for loss of material in other line items.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

LRA Table 3.3.1, Item 3.3.1-58, addresses external steel piping and pump surfaces exposed to air-indoor uncontrolled, which are being managed for loss of material due to general corrosion. The LRA credits the External Surfaces Monitoring Program to manage the aging effects for the air-indoor uncontrolled environment. In LRA Tables 3.3.2-9, 3.3.2-21, 3.3.2-22, 3.3.2-24, 3.3.2-42, and 3.3.2-43, the applicant cites plant-specific Note 303, which states that "the Supplemental Piping/Tank Inspection will manage loss of material at the air-water interface." The GALL Report recommends GALL Report AMP XI.M36 "External Surfaces Monitoring" Program to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M36 recommends using periodic visual inspections to manage the aging of these line items. In its review of components associated with Item 3.2.1-58, for which the applicant cited Generic Note E, the staff noted that the applicant proposes to use the Supplemental Piping and Tank Inspection Program to manage the aging of steel piping and tanks at the air-water interface through the use visual examination techniques during a one-time inspection of a representative sample of susceptible components. Based on the results of this one-time inspection, severity of degradation will be used to determine if increased sample size and sample location is required.

The staff's evaluations of the applicant's External Surfaces Monitoring Program and Supplemental Piping and Tank Inspection Program are documented in SER Sections 3.0.3.2.6 and 3.0.3.1.29, respectively. The staff noted that the applicant's plant-specific Note 303 is not clear on whether only the Supplemental Piping and Tank Inspection Program will be used or if it will be used in conjunction with the External Surfaces Monitoring Program for external surfaces at the air-water interface zone. By letter dated November 1, 2010, the staff issued RAI 3.3.2.1.Y-1 requesting that the applicant state whether the external surfaces within the air-water interface will be inspected by both programs. If only the Supplemental Piping and Tank Inspection Program will be used, the staff asked the applicant to justify why a One-Time Inspection Program is acceptable when the GALL Report recommends a Periodic Inspection Program.

In its response dated January 14, 2010, the applicant stated that, for those aforementioned systems, the External Surfaces Monitoring Program will be used to manage the effects of aging for surfaces exposed to an air-indoor uncontrolled environment. The Supplemental Piping/Tank Inspection Program will be used to address the air-water interface that has a potentially aggressive environment due to wetting and drying on a one-time confirmatory basis to demonstrate that other programs adequately manage the aging effects. The applicant further stated that other programs (depending on the system) will address the surfaces below the water line. For example, the BWR Water Chemistry and Chemistry Program Effectiveness Programs are used to address the treated water environment in the treated water environment in the containment vacuum breaker system. The staff's evaluations of the applicant's BWR Water Chemistry and Chemistry Program Effectiveness Programs are documented in Sections 3.0.3.1.7 and 3.0.3.1.8, respectively.

The staff finds the applicant's response acceptable because the applicant's approach to manage the aging effects of the aforementioned systems is consistent with the GALL Report recommendations. First, the staff notes the applicant manages aging effects of the surfaces exposed to an air-indoor uncontrolled environment with its External Surfaces Monitoring Program, which includes periodic inspections that are consistent with the GALL Report recommendation. Next, the staff notes that the applicant confirms the aging effects at the air-water interface on a one-time basis with its Supplemental Piping/Tank Inspection Program. The staff further notes the applicant manages the aging effects below the water line with additional AMPs applicable to that environment. For instance, the applicant's approach of managing the aging effects of its EDR systems with the BWR Water Chemistry Program supplemented by a one-time inspection (under the Chemistry Program Effectiveness Program) of representative areas to confirm the effectiveness of the BWR Water Chemistry Program is consistent with the GALL Report recommendation. The staff's concern described in RAI 3.3.2.1.Y-1 is resolved.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.1.10 Reduction of Heat Transfer Due to Fouling

LRA Table 3.3.1, Item 3.3.1-52, addresses steel, stainless steel, and copper alloy heat exchanger tubes exposed to closed-cycle cooling water, which are being managed for reduction of heat transfer due to fouling. The LRA credits the Closed Cooling Water Chemistry and Heat Exchangers Inspection Programs to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M21 "Closed-Cycle Cooling Water System" to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M21 recommends using chemistry control with guidance from the EPRI closed cooling water chemistry guidelines Report. In addition, the GALL Report AMP XI.M21 program recommends performance monitoring techniques for pumps and heat exchangers to manage the aging of these line items. In its review of components associated with Item 3.3.1-52, for which the applicant cited Generic Note E, the staff noted that the Closed Cooling Water Chemistry and Heat Exchangers Inspection Programs proposes to manage the aging of steel, stainless steel, and copper alloy heat exchanger tubes through the use of chemistry control, corrosion rate measurements, and one-time inspections.

The staff's evaluations of the applicant's Closed Cooling Water Chemistry and Heat Exchangers Inspection Programs are documented in SER Sections 3.0.3.2.4 and 3.0.3.1.17, respectively. In its review of components associated with line Item 3.3.1-52, the staff finds the applicant's proposal to manage aging using the Closed Cooling Water Chemistry and Heat Exchangers Inspection Programs acceptable because the applicant is supplementing the GALL Report's recommended program with a One-Time Inspection Program, which will identify whether, and to what extent, a reduction of heat transfer due to fouling has occurred.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2 AMR Results that are Consistent with the GALL Report, for which Further Evaluation is Recommended

LRA Section 3.3.2.2 provides further evaluation of aging management, as recommended by the GALL Report, for the auxiliary systems components. The applicant provided information concerning how it will manage the following aging effects:

- cumulative fatigue damage
- reduction of heat transfer due to fouling
- cracking due to SCC
- cracking due to SCC and cyclic loading
- hardening and loss of strength due to elastomer degradation
- reduction of neutron-absorbing capacity and loss of material due to general corrosion
- loss of material due to general, pitting, and crevice corrosion
- loss of material due to general, pitting, crevice, and MIC
- loss of material due to general, pitting, crevice, and MIC and fouling
- loss of material due to pitting and crevice corrosion
- loss of material due to pitting, crevice, and galvanic corrosion
- loss of material due to pitting, crevice, and MIC
- loss of material due to wear
- loss of material due to cladding breach

For component groups evaluated in the GALL Report for which the applicant claimed consistency with the GALL Report and for which the GALL Report recommends further evaluation, the staff audited and reviewed the applicant's evaluations to determine if it adequately address those issues. In addition, the staff reviewed the applicant's further evaluations against the criteria in SRP-LR Section 3.3.2.2. The staff's review of the applicant's further evaluation follows.

3.3.2.2.1 Cumulative Fatigue Damage

LRA Section 3.3.2.2.1 is associated with LRA Table 3.3.1, items 3.3.1-01 and 3.3.1-02, which respectively address how steel cranes structural girders exposed to uncontrolled, indoor air, and steel and stainless steel piping, piping components, piping elements, and heat exchanger components exposed to uncontrolled, indoor air, treated borated water or treated water are being managed for cumulative fatigue damage in auxiliary system components. The applicant addressed the further evaluation criteria of the SRP-LR by stating that fatigue is a TLAA, as defined in 10 CFR 54.3, and are required to be evaluated in accordance with 10 CFR 54.21(c). The applicant stated that its evaluation of the TLAA is addressed separately in LRA Section 4.3.

The staff reviewed LRA Section 3.3.2.2.1 against the criteria in SRP-LR Section 3.3.2.2.1, which states that fatigue of these auxiliary system components is a TLAA as defined in 10 CFR 54.3, and that these TLAAs are to be evaluated in accordance with the TLAA acceptance criteria requirements in 10 CFR 54.21(c)(1) and in accordance with SRP-LR Section 4.3, "Metal Fatigue Analysis," or Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses." The staff reviewed the applicant's AMR line items and finds that the AMR results are consistent with the recommendations of the GALL Report and SRP-LR, for managing cumulative fatigue damage in steel cranes structural girders exposed to air-indoor uncontrolled (external), and steel and stainless steel piping, piping components, piping elements, and heat exchanger components, except as identified below.

With regard to the applicant's metal fatigue AMR assessment, LRA Table 3.3.1, Item 3.3.1-01, for the steel cranes structural girders the staff noted that the applicant stated that there is no TLAA associated with crane load cycles as it does not involve any time-limited assumptions defined by the current 40-year operating term, as defined by 10 CFR 54.3(a). By letter dated October 5, 2011, and supplemented by letter dated November 16, 2011, the applicant amended its LRA to include a TLAA for crane load cycle limits. The applicant also included the applicable AMR line items associated with steel monorails, hoists, and miscellaneous cranes subject to cumulative fatigue damage and exposed to air-indoor that are managed by the TLAA, consistent with the recommendations in SRP-LR Section 3.3.2.2.1. The staff's reviews are documented in SER Sections 4.1.2.10 and 4.7.5.

With regard to the applicant's metal fatigue AMR assessment LRA Table 3.3.1, Item 3.3.1-02, for its auxiliary systems, the staff noted that AMR Item 3.3.1-02 is not included in the LRA tables that list the AMR results for its auxiliary systems. Therefore, as part of the RAI, "Cumulative Fatigue Damage AMR," the staff asked the applicant to justify why LRA Tables 3.3.2-1–3.3.2-47 for auxiliary subsystem components do not include any AMR items related to TLAA for managing cumulative fatigue damage in the steel and stainless steel piping, piping components, piping elements, and heat exchanger components. The applicant's response to the RAI and the staff's evaluation and acceptance of the RAI response is documented in SER Section 3.2.2.2.1.

Based on the staff's review, it concludes that the applicant met the SRP-LR Section 3.3.2.2.1 criteria. For those line items that apply to LRA Section 3.3.2.2.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). SER Sections 4.3 and 4.7.5 document the staff's review of the applicant's evaluation of the TLAA for these components.

3.3.2.2.2 Reduction of Heat Transfer Due to Fouling

LRA Section 3.3.2.2.2 refers to LRA Table 3.3.1, Item 3.3.1-03, and addresses stainless steel heat exchanger tubes exposed to treated water, which are being managed for reduction in heat transfer due to fouling by the BWR Water Chemistry and Heat Exchangers Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the BWR Water Chemistry Program manages the reduction of heat transfer for these components in the fuel pool cooling and RHR systems, and the Heat Exchangers Inspection Program will be implemented to verify the effectiveness of the BWR Water Chemistry Program.

The staff reviewed LRA Section 3.3.2.2.2 against the criteria in SRP-LR Section 3.3.2.2.2, which states that reduction of heat transfer due to fouling could occur for stainless steel heat exchanger tubes exposed to treated water. The SRP-LR also states that the existing program relies on control of water chemistry to manage reduction of heat transfer due to fouling; however, since control may have been inadequate, the effectiveness of the Water Chemistry Control Program should be verified. The SRP-LR also states that a one-time inspection is an acceptable method to ensure that reduction of heat transfer does not occur.

The staff's evaluations of the applicant's BWR Water Chemistry Program and Heat Exchangers Inspection Program are documented in SER Sections 3.0.3.1.7 and 3.0.3.1.17, respectively. In its review of components associated with Item 3.3.1-03, the staff finds the applicant's proposal to manage aging using the above programs acceptable because the BWR Water Chemistry Program provides for periodic sampling of treated water to maintain contaminants at acceptable limits to preclude loss of heat transfer due to fouling, and the Heat Exchangers Inspection Program will verify the effectiveness of the BWR Water Chemistry Program by including inspections at appropriate locations, including low- or stagnant-flow areas.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.2 criteria. For those line items that apply to LRA Section 3.3.2.2.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.3 Cracking Due to Stress-Corrosion Cracking

The staff reviewed LRA Section 3.3.2.2.3 against the criteria in SRP-LR Section 3.3.2.2.3.

(1) LRA Section 3.3.2.2.3.1 refers to LRA Table 3.3.1, item 3.3.1-04 and addresses cracking due to SCC. The applicant stated that this aging effect is not applicable because the stainless steel piping, piping components, and piping elements exposed to sodium pentaborate solution are maintained at a temperature less than 60 °C (140 °F) at Columbia.

SRP-LR Section 3.3.2.2.3.1 states that cracking due to SCC could occur in the stainless steel piping, piping components, and piping elements of the BWR SLC system that are exposed to sodium pentaborate solution greater than 60 °C (140 °F).

The staff reviewed the applicant's UFSAR and finds that SRP-LR Section 3.3.2.2.3, item 1 is not applicable to Columbia because the stainless steel piping, piping components, and piping elements exposed to sodium pentaborate solution are maintained at a temperature less than 60 °C (140 °F) at Columbia, and the staff guidance in this SRP-LR section is only applicable to BWR stainless steel piping, piping components, and piping elements exposed to sodium pentaborate solution greater than 60 °C (140 °F).

(2) LRA Section 3.3.2.2.3.2, associated with LRA Table 3.3.1, Item 3.3.1-5, addresses cracking due to SCC in stainless steel and stainless clad steel heat exchanger components exposed to treated water greater than 60 °C (140 °F). The applicant stated that this item is not applicable to Columbia because there are no stainless steel or stainless clad steel heat exchanger components in the auxiliary systems that are exposed to treated water greater than 60 °C (140 °F). The staff reviewed LRA Sections 2.3.3 and 3.3 and the UFSAR and confirmed that no in-scope stainless steel or stainless clad steel heat exchanger components exposed to treated water greater than 60 °C (140 °F) during normal operations are present in the auxiliary systems; therefore, the staff finds the applicant's determination acceptable.

(3) LRA Section 3.3.2.2.3, Item 3, addresses stainless steel diesel exhaust piping, piping components, and piping elements exposed to diesel exhaust. The GALL Report recommends use of a plant-specific program to manage cracking due to SCC for this component group. The applicant addressed the further evaluation criteria of the SRP-LR by stating that this line item is not applicable because, during normal plant operations, diesel exhaust components are exposed to diesel exhaust infrequently for short durations. The applicant also stated that for the remaining time, these components are exposed internally to outdoor air; therefore, cracking is not identified as an aging effect. The staff recognizes that while there is an initiation period required for SCC to occur, it will also depend on the material and environment. It was not clear to the staff from the information in the LRA how SCC was quantitatively ruled out as potential aging effect.

By letter dated September 16, 2010, the staff issued RAI 3.3.2.2.3.3-1 requesting that the applicant clarify how SCC was quantitatively ruled out by providing additional information on the actual cumulative exposure time that the stainless steel diesel exhaust components are expected to be subjected to diesel exhaust greater than 60 °C (140 °F) during the total period of extended operation. Secondly, the applicant was asked to clarify what type of stainless steel is used in the diesel exhaust and provide the technical basis that substantiates the claim that the diesel exhaust piping, piping components, and piping elements are not susceptible to SCC under the cumulative exposure time during the period of extended operation.

By letter dated October 28, 2010, the applicant responded to RAI 3.3.2.2.3.3-1 by stating that the diesel air compressor is a backup to the electric air compressor and operates infrequently. The applicant further stated it does not track the run time but estimated the expected operation at 45 hours per year. The applicant stated that the HPCS compressor is the only stainless steel component exposed to diesel exhaust and that this flexible connection is Type 304 and 321 stainless steel. The applicant stated that it reviewed plant operating experience and did not identify instances of cracking in the diesel exhaust components. The applicant stated that cracking due to SCC was not an AERM of these stainless steel components, but, to be conservative, it modified the LRA to conduct a one-time inspection with the Diesel Systems Inspection Program to ensure that cracking is not occurring.

The staff finds the applicant's response to RAI 3.3.2.2.3.3-1 acceptable because a review of operating experience has not indicated any cracking in diesel exhaust components, and the applicant modified the LRA to include a one-time inspection, which is appropriate because it includes both volumetric and visual inspection (VT-1) that is capable of detecting cracks. The staff's concern described in RAI 3.3.2.2.3.3-1 is resolved.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.3.3 criteria. For those line items that apply to LRA Section 3.3.2.2.3.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.4 Cracking Due to Stress-Corrosion Cracking and Cyclic Loading

The staff reviewed LRA Section 3.3.2.2.4 against the criteria in SRP-LR Section 3.3.2.2.4.

(1) LRA Section 3.3.2.2.4.1 refers to Table 3.3.1, Item 3.3.1-07, and addresses cracking due to SCC and cyclic loading. The applicant stated that this aging effect is not applicable to Columbia, which is a BWR.

SRP-LR Section 3.3.2.2.4.1 states that cracking due to SCC and cyclic loading could occur in stainless steel PWR non-regenerative heat exchanger components exposed to treated borated water greater than 60 °C (140 °F) in the chemical and volume control system. SRP-LR Table 3.3-1 identifies Item 7 as applicable to PWRs.

The staff verified that SRP-LR Section 3.3.2.2.4.1 is not applicable to Columbia because Columbia is a BWR, and the staff guidance in this SRP-LR section is only applicable to PWR stainless steel non-regenerative heat exchanger components exposed to treated borated water greater than 60 °C (140 °F).

Based on the information above, the staff concludes that the staff's guidance criteria of SRP-LR Section 3.3.2.2.4.1 do not apply to Columbia because the guidance is applicable to PWRs.

(2) LRA Section 3.3.2.2.4.2 refers to Table 3.3.1, Item 3.3.1-08, and addresses cracking due to SCC and cyclic loading. The applicant stated that this aging effect is not applicable to Columbia, which is a BWR.

SRP-LR Section 3.3.2.2.4.2 states that cracking due to SCC and cyclic loading could occur in stainless steel PWR regenerative heat exchanger components exposed to treated borated water greater than 60 °C (140 °F) in the chemical and volume control system. SRP-LR Table 3.3-1 identifies Item 8 as applicable to PWRs.

The staff verified that SRP-LR Section 3.3.2.2.4.2 is not applicable to Columbia because Columbia is a BWR, and the staff guidance in this SRP-LR section is only applicable to PWR stainless steel regenerative heat exchanger components exposed to treated borated water greater than 60 °C (140 °F).

Based on the information above, the staff concludes that the staff's guidance criteria of SRP-LR Section 3.3.2.2.4.2 do not apply to Columbia because the guidance is applicable to PWRs.

(3) LRA Section 3.3.2.2.4.3 is associated with LRA Table 3.3.1, Item 3.3.1-09, and it addresses stainless steel pump casings exposed to treated borated water. SRP-LR Section 3.3.2.2.4, Item 3, indicates the GALL Report recommends use of the Water Chemistry Program and a plant-specific program to manage cracking due to SCC and cyclic loading for this component group. The applicant indicated that the line items associated with SRP-LR Section 3.3.2.2.4, Item 3, are not applicable because these items are only applicable to PWRs. The staff reviewed the GALL Report and SRP-LR and confirmed that this further evaluation described in SRP-LR Section 3.3.2.2.4, Item 3, and associated line items are only applicable to PWRs; therefore, the finds the applicant's determination acceptable because its plant is a BWR design.

(4) LRA Section 3.3.2.2.4.4 refers to Table 3.3.1, Item 3.3.1-10, and addresses cracking due to SCC and cyclic loading. The applicant stated that this aging effect is not applicable because Columbia does not have any high-strength bolting in the auxiliary system.

SRP-LR Table 3.3-1, Item 10. has a related Item A-104, as evaluated in Chapter VII.E1 of the GALL Report. Chapter VII.E1 of the GALL Report discusses a portion of the PWR chemical and volume control system and its aging effect of cracking due to SCC and cyclic loading.

The staff reviewed the applicant's UFSAR and finds that SRP-LR Section 3.3.2.2.4, Item 4, is not applicable to Columbia because Columbia does not have any high-strength bolting in the auxiliary system, and the staff guidance in this SRP-LR section is only applicable to high-strength steel closure bolting exposed to air with steam or water leakage.

3.3.2.2.5 Hardening and Loss of Strength Due to Elastomer Degradation

(1) LRA Section 3.3.2.2.5, Item 1, is referenced by LRA Table 3.3.1, Item 3.3.1-11, and addresses elastomer flexible connections and elastomer mechanical sealants exposed to air-indoor uncontrolled (internal/external), which are being managed for hardening and loss of strength due to elastomer degradation by the Flexible Connection Inspection and External Surfaces Monitoring Programs, respectively. The criteria in SRP-LR Section 3.3.2.2.5, Item 1, states that hardening and loss of strength due to elastomer degradation could occur for elastomer seals and components of heating and ventilation systems exposed to air-indoor uncontrolled (internal and external). The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed. The applicant addressed the further evaluation criteria of the SRP-LR by stating that elastomer mechanical sealants are managed by the External Surfaces Monitoring Program, and flexible connections are managed by the Flexible Connection Inspection Program.

The staff's evaluation of the applicant's External Surfaces Monitoring Program is documented in SER Section 3.0.3.2.6. The staff noted that the External Surfaces Monitoring Program is a Condition Monitoring Program that consists of visual inspections and surveillance activities of external surfaces on a frequency that generally exceeds once per refueling cycle. The staff also noted the program is being enhanced to include physical examination techniques in addition to visual inspection to detect the aging effects. In its review of components associated with line Item 3.3.1-11, the staff finds the applicant proposal to manage the aging using the External Surfaces Monitoring Program acceptable because visual inspections and physical examinations can detect the aging effects due to elastomer degradation. It is expected that, given the similar environments on the internal as well as the external surfaces of the elastomer, that hardening and loss of strength would be detected as readily by an external as internal examination, and the frequency of at least once per refueling cycle ensures the aging effects will be detected before there is a loss of component intended function.

The staff's evaluation of the applicant's Flexible Connection Inspection Program submitted in its original application is documented in SER Section 3.0.3.3.6. The staff noted that in the LRA, submitted by letter dated January 19, 2010, the Flexible Connection Inspection Program was a new One-Time Inspection Program that consisted of visual inspections for evidence of degradation, such as cracking and discoloration, and physical examinations to verify if hardening and loss of strength has occurred. The staff does not believe that it is possible to state that the aging effects of all elastomeric materials meets at least one of the three criteria contained in the "program description" for GALL Report AMP XI. M32, "One-time Inspection Program," in that many elastomers will harden and loose strength over a 60-year period, particularly in the presence of UV light, ozone, or radiation. Additionally, the degradation mechanism is expected to occur, does not necessarily progress slowly, or does not include a long incubation period. By letter dated October 20, 2010, the staff issued RAI requesting that the applicant justify the use of a One-Time Inspection Program for the specific elastomeric material exposed to air-indoor uncontrolled sufficiently to confirm the following:

- An aging effect is not expected to occur, but the data is insufficient to rule it out with reasonable confidence.
- An aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than that generally expected.
- The characteristics of the aging effect include a long incubation period and establish that each component will be capable of meeting its CLB function(s) throughout the period of extended operation.

In its response dated January 20, 2011, the applicant stated that a comprehensive response to this request will be provided in the response to RAI B.2.14-1. In its response to RAI B.2.14-1 dated January 28, 2011, the applicant revised LRA Section B.2.27, Flexible Connections Inspection Program, from a one-time based program to a plant-specific program based on collecting baseline information during the 10-year period prior to the period of extended operation, followed by opportunistic inspections. The staff's evaluation of the new Flexible Connections Inspection Program is documented in SER Section 3.0.3.3.6.

The staff finds the applicant's response acceptable because the applicant revised its Flexible Connections Inspection Program to no longer be a one-time inspection based program. The staff's concern described in RAI 3.2.2-1 is resolved.

In its review of components associated with line Item 3.2.1-11, the staff finds the applicant proposal to manage the aging using the Flexible Connection Inspection Program acceptable for the following reasons:

- Visual inspections can detect signs of elastomer degradation such as cracking, loss of material due to wear, and discoloration.
- Physical examinations can detect hardening and loss of strength.
- Baseline inspections will be conducted in the 10-year period prior to the period of extended operation.
- The applicant committed to ensure that within 5 years of the baseline inspections, the opportunistic inspections will encompass all combinations of material, environment and aging effects.
- Plant-specific operating experience will be used to adjust tracking of follow-on opportunistic inspections.

Based on the programs identified, the staff concludes that the applicant's programs meets SRP-LR Section 3.3.2.2.5, Item 1, criteria. For those line items that apply to LRA Section 3.3.2.2.5.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(2) LRA Section 3.3.2.2.5.2 is referenced by LRA Table 3.3.1, Item 3.3.1-12, and addresses elastomer lining exposed to treated water or treated borated water in SFP systems and clean-up systems that are being managed for hardening and loss of strength due to elastomer degradation. The criteria in SRP-LR Section 3.3.2.2.5, Item 2, states that hardening and loss of strength due to elastomer degradation could occur for elastomer linings of filters, valves, and ion exchangers in spent FPC and cleanup systems exposed to treated water or treated borated water. The GALL Report recommends that a plant-specific AMP be evaluated to determine and assesses the qualified life of the linings in the environment to ensure that these aging effects are adequately managed. The applicant addressed the further evaluation criteria of the SRP-LR by stating that there are no elastomer linings exposed to treated water or treated borated water in the FPC system. The staff reviewed LRA Sections 2.3.3 and 3.3 and the UFSAR and confirmed that there are no in-scope elastomer linings exposed to treated water or treated borated water in the SFP systems and clean-up systems. The applicant also stated that flexible connections in the diesel cooling water system exposed to closed cycle cooling water on the internal surfaces refer to this line item, and the Flexible Connection Inspection Program is credited to detect and characterize hardening and loss of strength for these elastomer components. The applicant cited plant-specific Note 312, which states that treated water is equivalent to closed cooling water for this material and aging effect.

The staff's evaluation of the applicant's Flexible Connection Inspection Program submitted in its original application is documented in SER Section 3.0.3.3.6. The staff noted that in the LRA submitted by letter dated January 19, 2010, the Flexible Connection Inspection Program was a new One-Time Inspection Program that consisted of visual inspections for evidence of degradation, such as cracking and discoloration, and physical examinations to verify if hardening and loss of strength has occurred. In its response to RAI B.2.14-1 dated January 28, 2011, the applicant revised LRA Section B.2.27, Flexible Connections Inspection Program, from a one-time based program to a plant-specific program based on collecting baseline information during the 10-year period prior to the period of extended operation, followed by opportunistic inspections. The staff's evaluation of the new Flexible Connections Inspection Program is documented in SER Section 3.0.3.3.6. In its review of components associated with line Item 3.3.1-12, the staff finds the applicant proposal to manage the aging using the Flexible Connection Inspection Program acceptable because signs of elastomer degradation, such as cracking and discoloration, can be detected by visual inspections and physical examinations, and increased sample size and location would provide data for monitoring and trending.

Based on the programs identified, the staff concludes that the applicant's program meets SRP-LR Section 3.3.2.2.5, Item 2, criteria. For those line items that apply to LRA Section 3.3.2.2.5.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.6 Reduction of Neutron-Absorbing Capacity and Loss of Material Due to General Corrosion

LRA Section 3.3.2.2.6, referenced by LRA Table 3.3.1, Item 3.3.1-13, addresses Boral and boron steel spent fuel storage racks neutron-absorbing sheets exposed to treated water or treated borated water, which are being managed for reduction of neutron-absorbing capacity and loss of material due to general corrosion by the BWR Water Chemistry Program. The applicant addressed the further evaluation criteria of the SRP-LR by stating that B_4C is used as the neutron absorbing material, sealed in stainless steel racks, and is not exposed to treated water. As a result, the applicant stated that there are no AERMs for this neutron absorber material. Additionally, the applicant stated that since the stainless steel around the neutron absorber is exposed to treated water, it is susceptible to loss of material due to crevice and pitting corrosion and is to be managed by the BWR Water Chemistry Program.

The staff reviewed LRA Section 3.3.2.2.6 against the criteria in SRP-LR Section 3.3.2.2.6, which states that reduction of neutron-absorbing capacity and loss of material due to general corrosion could occur in the neutron-absorbing sheets of BWR and PWR spent fuel storage racks exposed to treated water or to treated borated water. The SRP-LR also states that the GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed.

The staff evaluated LRA Section 3.3.2.2.6 and determined that the application of the BWR Water Chemistry Program in addressing the loss of material due to crevice and pitting corrosion on the stainless steel around the neutron absorber is acceptable and is consistent with the GALL Report recommendations. With respect to the AMR on the neutron absorbers, the staff determined that it does not adequately address applicability of recent adverse industry operating experience and staff guidance on neutron absorber materials (i.e., NRC IN 2009-26, "Degradation Of Neutron-Absorbing Materials in the Spent Fuel Pool," and LR-ISG-2009-01). As such, the staff issued an RAI.

By letter dated June 21, 2010, the staff issued RAI 3.3.2.2.6-1 requesting that the applicant discuss how the Columbia plant plans to address the potential effects of loss of material and loss of neutron absorbing capacity of the B_4C neutron absorber material exposed to treated water in the SFP. In its response dated August 19, 2010, the applicant stated that Columbia currently monitors for possible degradation of the B_4C material and uses three forms of monitoring (i.e., visual examination, neutron attenuation testing, and chemical testing). In addition, the applicant stated that the plant-specific B_4C Monitoring Program will be used to monitor for reduction of neutron-absorbing capacity and loss of material due to general corrosion for the neutron absorber material.

The staff's evaluation of the applicant's B_4C Monitoring and BWR Water Chemistry Programs are documented in SER Sections 3.0.3.3.2 and 3.0.3.1.7. In its review of components associated with Item 3.3.1-13, the staff finds the applicant's proposal to manage aging using the B_4C Monitoring and BWR Water Chemistry Programs acceptable because the Water Chemistry Program is consistent with the GALL Report recommendations, and the B_4C Monitoring Program satisfies the acceptance criteria of the SRP-LR and uses inspection techniques (e.g., boron areal density measurement, visual inspections, and chemical testing) that will detect aging effects related to the neutron absorption and dimensional integrity.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.6 criteria. For the line items that apply to LRA Section 3.3.2.2.6, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.7 Loss of Material Due to General, Pitting, and Crevice Corrosion

(1) LRA Section 3.3.2.2.7.1, referenced by LRA Table 3.3.1, item 3.3.1-14, addresses steel piping, piping components, and piping elements, including the tubes, valves, and tanks in the reactor coolant pump oil collection system, exposed to lubricating oil, which are being managed for loss of material due to general, pitting, and crevice corrosion by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that Columbia does not have a reactor coolant pump oil collection system, but that the Lubricating Oil Inspection Program will be used to verify the effectiveness of the Lubricating Oil Analysis Program to manage loss of material due to general, pitting, and crevice corrosion through examination of susceptible locations in steel piping, piping component, and piping elements in the auxiliary systems that are exposed to lubricating oil.

LRA Section 3.3.2.2.7.1, referenced by LRA Table 3.3.1, item 3.3.1-15, addresses steel reactor coolant pump oil collection system piping, tubing, and valve bodies exposed to lubricating oil, which are being managed for loss of material due to general, pitting, and crevice corrosion by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The applicant stated that this item is not applicable because there is no reactor coolant pump oil collection system. The applicant addressed the further evaluation criteria of the SRP-LR by stating that Columbia does not have a reactor coolant pump oil collection system and, therefore, this item is not applicable. The staff reviewed LRA Sections 2.3.3 and 3.3 and the UFSAR and confirmed that no in-scope steel reactor coolant pump oil collection system exposed to lubricating oil present in the auxiliary systems and, therefore, finds the applicant's determination acceptable.

LRA Section 3.3.2.2.7.1, referenced by LRA Table 3.3.1, item 3.3.1-16, addresses steel reactor coolant pump oil collection system tank exposed to lubricating oil, which are being managed for loss of material due to general, pitting, and crevice corrosion by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The applicant stated that this item is not applicable because there is no reactor coolant pump oil collection system. The applicant addressed the further evaluation criteria of the SRP-LR by stating that Columbia does not have a reactor coolant pump oil collection system and, therefore, this item is not applicable. The staff reviewed LRA Sections 2.3.3 and 3.3 and the UFSAR and confirmed that no in-scope steel reactor coolant pump oil collection system piping, tubing, and valve bodies exposed to lubricating oil present in the auxiliary systems and, therefore, finds the applicant's determination acceptable.

The staff reviewed LRA Section 3.3.2.2.7.1 against the criteria in SRP-LR Section 3.3.2.2.7 item 1, which states that loss of material due to general, pitting, and crevice corrosion could occur in steel piping, piping components, and piping elements, including the tubing, valves, and tanks in the reactor coolant pump oil collection system, exposed to lubricating oil (as part of the fire protection system). The SRP-LR also stated that the existing AMP relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. The SRP-LR further states that control of lubricating oil contaminants may not always have been adequate to preclude corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The SRP-LR also states that the GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lubricating oil chemistry control program for which a one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

In addition, the SRP-LR states that corrosion may occur at locations in the reactor coolant pump oil collection tank where water from wash downs may accumulate; therefore, the effectiveness of the program should be verified to ensure that corrosion does not occur. The SRP-LR also states that the GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion, to include determining the thickness of the lower portion of the tank for which a one-time inspection is an acceptable method to ensure that corrosion does not occur and that the component's intended function will be maintained during the period of extended operation.

The staff reviewed the UFSAR to verify that there is no reactor coolant pump oil collection system among the auxiliary systems. The staff's evaluation of the applicant's Lubricating Oil Analysis and Lubricating Oil Inspection Programs is documented in SER Sections 3.0.3.2.13 and 3.0.3.1.22, respectively. In its review of components associated with line item 3.3.1-14, the staff finds the applicant's proposal to manage the applicable aging using the Lubricating Oil Inspection Program to verify the effectiveness of the Lubricating Oil Analysis Program acceptable because the Lubricating Oil Analysis program was determined to be consistent with the GALL Report and the applicant stated that the Lubricating Oil Inspection Program will be used to examine steel piping and piping components to verify the effectiveness of the Lubricating Oil Analysis program. This satisfies the acceptance criteria in SRP-LR Section 3.3.2.2.7, item 1, and therefore the applicant's AMR is consistent with the one under GALL Report items VII.C2-13, VII.F1-19, VII.H2-20 and VII.G-22.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.7, item 1 criteria. For the line items that apply to LRA Section 3.3.2.2.7.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant has demonstrated that the effect of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(2) LRA Section 3.3.2.2.7.2 refers to LRA Table 3.3.1, Item 3.3.1-17, and addresses steel piping, piping components, piping elements, accumulators, tanks, and heat exchangers exposed to treated water, which are being managed for loss of material due to general, pitting, and crevice corrosion by the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that its Water Chemistry Program, BWR Water Chemistry Program, manages aging effects using control of contaminants and periodic inspections and that its Chemistry Program Effectiveness Inspection Program will verify the effectiveness of the BWR Water Chemistry Program in stagnant-flow areas.

The applicant also stated that loss of material for steel piping and piping components in the EDR system will be managed by the Monitoring and Collection Systems Inspection Program, which is a new One-Time Inspection Program.

The staff reviewed LRA Section 3.3.2.2.7.2 against the criteria in SRP-LR Section 3.3.2.2.7, Item 2, which states that loss of material due to general, pitting, and crevice corrosion could occur in steel piping, piping components, and piping elements in the BWR RWCU and shutdown cooling systems exposed to treated water. The SRP-LR also states that the existing AMP relies on monitoring and control of water chemistry for BWRs to mitigate degradation. However, control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant-flow conditions. Further, the SRP-LR states that the GALL Report recommends a one-time inspection of select components at susceptible locations as an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly, such that the component's intended function will be maintained during the period of extended operation.

The staff's evaluation of the applicant's BWR Water Chemistry Program is documented in SER Section 3.0.3.1.7, and its Chemistry Program Effectiveness Inspection Program is documented in Section 3.0.3.1.8. The staff notes that, as part of the BWR Water Chemistry Program, the applicant committed to implement its One-Time Inspection Program, Chemistry Program Effectiveness Inspection Program, to characterize and detect loss of material due to crevice, general, galvanic or pitting corrosion in stagnant-flow areas managed by the BWR Water Chemistry Program. The staff finds that the applicant's proposal to use the BWR Water Chemistry and Chemistry Program Effectiveness Programs to manage loss of material due to general, pitting, and crevice corrosion for these components in treated water acceptable because the material and environment combinations are the same as those addressed by the SRP-LR, such that the aging effect will be adequately managed by the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs. Further, in its review of components associated with Item 3.3.1-17, excluding the EDR system, the staff finds the applicant's proposal to manage aging using the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs acceptable because the BWR Water Chemistry Program will mitigate the loss of material due to general, pitting, and crevice corrosion by managing containments ingress into the systems below the levels known to cause loss of material. Further, the staff notes that the Chemistry Program Effectiveness Inspection Program will verify the effectiveness of the BWR Water

Chemistry Program such that components' intended functions will be maintained during the period of extended operation.

During its review of components associated with Item 3.3.1-17, contained in the EDR system, the staff noted that the GALL Report Volume 1, Table 3, Item ID17, recommends that steel piping exposed to treated water be managed for loss of material by a Water Chemistry Program and a One-Time Inspection Program to ensure the effectiveness of the chemistry control. The staff noted that the applicant stated that no Water Chemistry Program would be applied to the EDR system for steel piping, sight glass, and valve bodies exposed to treated water. Rather, the applicant will rely only on a one-time inspection, in accordance with the Monitoring and Collection Systems Inspections Program. By letter dated August 26, 2010, the staff issued RAI-3.3.2.2.7.2-1 requesting that the applicant justify why it is not using a Water Chemistry Program to manage steel piping, piping components, tanks, and heat exchangers exposed to treated water in the EDR system.

In its response dated January 28, 2011, the applicant stated that it would clarify this program as a plant-specific AMP and perform periodic inspections of each material exposed to each environment prior to the period of extended operation. The applicant also stated it would describe sample population selection, limits, and acceptance criteria in this AMP. The applicant further stated that the program would include opportunistic inspection of components with the scope of the program during the maintenance, repair or surveillance activities through the period of extended operation, and trending of the inspection results to ensure each material and environment combination has been examined via opportunistic inspection within a 5-year period. Finally, the applicant stated that if opportunistic inspections have not occurred with the 5-year interval, then it would take appropriate actions to ensure the completion of the inspections.

The staff's evaluation of the applicant's new periodic Monitoring and Collection Systems Inspection Program is documented in SER Section 3.0.3.3.8. The staff finds the applicant's proposal to manage aging using the BWR Water Chemistry, the Chemistry Program Effectiveness Inspection and the Monitoring and Collection Systems Inspection Programs acceptable because the revised program includes both baseline inspections and opportunistic inspections capable of identifying loss of material in stainless steel components, and appropriate actions will be taken to ensure completion of opportunistic inspections within a 5-year period. The staff's concerns described in RAI 3.3.2.2.7.2-1 are resolved.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.7.2 criteria. For those line items that apply to LRA Section 3.3.2.2.7.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(3) LRA Section 3.3.2.2.7, Item 3, is referenced by LRA Table 3.3.1, Item 3.3.1-18, and addresses steel diesel engine exhaust piping, piping components, and piping elements exposed to diesel exhaust, which are being managed for loss of material by the Diesel Systems Inspection and the Diesel-Driven Fire Pumps Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that, during normal plant operations, the diesel exhaust components are infrequently exposed to

diesel exhaust. The applicant stated that during the remaining time, the components are exposed internally to outdoor air. The applicant stated that it will detect and characterize loss of material using the Diesel Systems Inspection and the Diesel-Driven Fire Pumps Inspection Programs.

The staff reviewed LRA Section 3.3.2.2.7, Item 3, against the criteria in SRP-LR Section 3.3.2.2.7, Item 3, which states that loss of material could occur for stainless steel and steel diesel exhaust piping, piping components, and piping elements exposed to diesel exhaust. The SRP-LR also states that a plant-specific AMP be used to ensure that these aging effects are adequately managed.

In its review of components associated with Item 3.3.1-18, the staff noted that it was not clear how the Diesel System Inspection or the Diesel-Driven Fire Pumps Inspection Programs, which are One-Time Inspection Programs, will appropriately manage this aging effect. In a letter dated September 16, 2010, the staff issued RAI 3.3.2.2.7.3-1 and RAI 3.3.2.2.7.3-2 requesting that the applicant provide additional information on the operating experience of the diesel exhaust piping, piping components, and piping elements to indicate if corrosion has been observed in the past. If the applicant identified any operating experience of corrosion in the diesel exhaust piping, piping components, and piping elements, the applicant was requested to provide additional information on why the Diesel Systems Inspection or the Diesel-Driven Fire Pumps Inspection Programs are appropriate to manage the aging of these components.

By letter dated October 18, 2010, the applicant responded to the RAI 3.3.2.2.7.3-1 by stating that its review of both plant-specific experience and industry-wide operating experience has not identified loss of material as an aging mechanism that has occurred at Columbia or in the nuclear industry.

By letter dated January 28, 2011, the applicant responded to RAI 3.3.2.2.7.3-2 by stating that the Diesel System Inspection and the Diesel-Driven Fire Pumps Inspection Program have been modified to do the following:

- clarify that each program is a plant-specific program
- change the one-time inspection to a baseline inspection of each material exposed to each environment prior to the period of extended operation
- describe sample population selection and limits, as well as acceptance criteria
- include opportunistic inspection of components within the scope of the program during the maintenance, repair, or surveillance activities through the period of extended operation
- include trending of the results of these inspection to ensure that each material and environment combination is examined opportunistically within a 5-year period

The staff finds the applicant’s response acceptable because the applicant committed to modify its program from a one-time inspection to a periodic inspection, which is consistent with the guidance in the GALL Report. The staff’s concerns described in RAIs 3.3.2.2.7.3-1 and 3.3.2.2.7.3-2 are resolved.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.7.3 criteria. For those line items that apply to LRA Section 3.3.2.2.7.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.8 Loss of Material Due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion

LRA Section 3.3.2.2.8 is referenced by LRA Table 3.3.1, Item 3.3.1-19, and addresses steel piping components and the diesel fuel oil storage tank with coatings exposed to soil, which are being managed for loss of material due to general, pitting, crevice, and MIC by the Buried Piping and Tanks Inspection Program. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the Buried Piping and Tanks Inspection Program is credited to manage loss of material of the steel piping components and diesel fuel oil storage tank with coatings.

The staff reviewed LRA Section 3.3.2.2.8 against the criteria in SRP-LR Section 3.3.2.2.8, which states that loss of material due to general, pitting, crevice, and MIC could occur for steel piping, piping components, and piping elements, with or without coating or wrapping, exposed to soil. The SRP-LR also states that the effectiveness of the Buried Piping And Tanks Inspection Program should be verified to evaluate the applicant's inspection frequency and operating experience with buried components, ensuring that loss of material is not occurring.

The staff's evaluation of the applicant's Buried Piping and Tanks Inspection Program is documented in SER Section 3.0.3.2.3. The staff notes that there is no plant-specific operating experience to indicate that the applicant's program would not be effective in managing aging effects during the period of extended operation. In its review of components associated with line Item 3.3.1-19, the staff finds the applicant's proposal to manage aging using the Buried Piping and Tanks Inspection Program acceptable because the proposed program is a combination of a Mitigation Program consisting of protective coating and a Condition Monitoring Program consisting of visual inspections that will detect the loss of material aging effect. Additionally, as discussed in the response and staff evaluation of RAI B.2.5-1, the applicant adjusted the frequency of its inspections based on plant-specific and industry operating experience.

Based on the program identified, the staff concludes that the applicant's program meets SRP-LR Section 3.3.2.2.8 criteria. For those line items that apply to LRA Section 3.3.2.2.8, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.9 Loss of Material Due to General, Pitting, Crevice, and Microbiologically-Influenced Corrosion and Fouling

(1) LRA Section 3.3.2.2.9.1 is referenced by LRA Table 3.3.1, Item 3.3.1-20, and addresses steel piping components and tanks exposed to fuel oil, which are being managed for loss of material due to general, pitting, crevice, and microbiologically MIC by the Fuel Oil Chemistry Program. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the Fuel Oil Chemistry Program, in conjunction with the

Chemistry Program Effectiveness Inspection Program, is implemented to manage loss of material for steel piping components and tanks in the auxiliary systems that are exposed to fuel oil.

The staff reviewed LRA Section 3.3.2.2.9.1 against the criteria in SRP-LR Section 3.3.2.2.9, Item 1, which states that loss of material due to general, pitting, crevice, and MIC, and fouling could occur for steel piping, piping components, piping elements, and tanks exposed to fuel oil. The SRP-LR also states that the Fuel Oil Chemistry Program relies on monitoring and control of fuel oil contamination to mitigate degradation. The SRP-LR further states that a one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the components' intended functions will be maintained during the period of extended operation.

In its review of components associated with Item 3.3.1-20, the staff noted that the GALL Report, under Item VII.H1-10, recommends further evaluation of programs for managing loss of material due to general, pitting, crevice, and MIC, and fouling of steel piping, piping components, piping elements, and tanks exposed to fuel oil. In LRA Section 3.3.2.2.9.1, the applicant states that "fouling is not identified as an aging effect for fuel oil." It is not clear to the staff why fouling is not identified as an aging effect. By letter dated August 6, 2010, the staff issued RAI 3.3.2.2.9-1 requesting that the applicant provide the technical basis for excluding fouling as an aging effect to be managed for steel piping components in a fuel oil environment.

In its response dated September 24, 2010, the applicant stated that, consistent with the description of fouling in the GALL Report, Revision 1, Section IX.F, fouling can result in reduction of heat transfer, loss of material, and reduction in the system flow rate (this is an active function; therefore, it is not in-scope for license renewal) and is, therefore, considered an aging mechanism, not an aging effect, which can contribute to loss of material. The applicant also stated that the components of concern addressed in the RAI (Item 3.3.1-20 in the LRA) do not have any license renewal heat transfer function. The applicant further stated that the Fuel Oil Chemistry Program manages specific contaminants in the fuel oil that could lead to the onset of loss of material due to corrosion, and the conditions that could lead to a loss of material due to corrosion are the same conditions that could lead to loss of material due to fouling.

The staff finds the applicant's response to RAI 3.3.2.2.9-1 acceptable for the following reasons:

- The components discussed in the RAI have no heat transfer function; therefore, reduction of heat transfer due to fouling is not an applicable aging mechanism.
- The preventive measures and inspections performed by the Fuel Oil Chemistry and Chemistry Effectiveness Inspection Programs are effective at managing loss of material due to both corrosion and fouling.
- The applicant's proposal to address loss of material due to corrosion and fouling in steel components is consistent with GALL Report, Item VII.H1-10.

The staff's concern described in RAI 3.3.2.2.9-1 is resolved.

The staff's evaluations of the applicant's Fuel Oil Chemistry and Chemistry Effectiveness Inspection Programs are documented in SER Sections 3.0.3.2.12 and 3.0.3.1.8, respectively. The Fuel Oil Chemistry Program includes periodic monitoring of the fuel oil for contaminants for the purpose of mitigating the effects of aging for the in-scope storage tanks and associated components containing fuel oil by verifying and maintaining the quality of the fuel oil used in the emergency diesel generators and the diesel-driven fire pumps. The Chemistry Program Effectiveness Inspection includes a one-time inspection to detect and characterize the material conditions in representative low-flow and stagnant areas of plant piping systems. In its review of components associated with Item 3.3.1-20, the staff finds the applicant's proposal to manage aging using the Fuel Oil Chemistry and Chemistry Program Effectiveness Inspection Programs acceptable because the Fuel Oil Chemistry Program will mitigate the occurrence of loss of material due to corrosion, and the Chemistry Program Effectiveness Inspection Program will verify the effectiveness of the Fuel Oil Chemistry Program and ensure that there is no significant loss of material leading to loss of intended function of in-scope components within the period of extended operation.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.9, Item 1, criteria. For those line items that apply to LRA Section 3.3.2.2.9.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(2) LRA Section 3.3.2.2.9.2, referenced by LRA Table 3.3.1, Item 3.3.1-21, addresses steel heat exchanger components exposed to lubricating oil, which are being managed for loss of material due to general, pitting, crevice, and MIC, and fouling by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the Lubricating Oil Inspection Program will be used to verify the effectiveness of the Lubricating Oil Analysis Program to manage loss of material through examination of susceptible locations in steel heat exchanger components exposed to lubricating oil.

The staff reviewed LRA Section 3.3.2.2.9.2 against the criteria in SRP-LR Section 3.3.2.2.9, Item 2, which states that loss of material due to general, pitting, crevice, MIC, and fouling could occur for steel heat exchanger components exposed to lubricating oil. The SRP-LR also states that the existing AMP relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. The SRP-LR further states that control of lubricating oil contaminants may not always have been adequate to preclude corrosion; therefore, the effectiveness of lubricating oil contaminant control should be verified to ensure that corrosion is not occurring. The SRP-LR also states that the GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the Lubricating Oil Chemistry Control Program for which a one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

The staff's evaluations of the applicant's Lubricating Oil Analysis and Lubricating Oil Inspection Programs are documented in SER Sections 3.0.3.2.13 and 3.0.3.1.22, respectively. In its review of components associated with line Item 3.3.1-21, the staff finds the applicant's proposal to manage aging using the Lubricating Oil Inspection Program to verify the effectiveness of the Lubricating Oil Analysis Program acceptable because the Lubricating Oil Analysis Program was determined to be consistent with the GALL Report, and the applicant stated that the Lubricating Oil Inspection Program will be used to examine copper alloy piping, piping components, and piping elements to verify the effectiveness of the Lubricating Oil Analysis Program. This satisfies the acceptance criteria in SRP-LR Section 3.3.2.2.9, Item 2; therefore, the applicant's AMR is consistent with the one under GALL Report Items VII.C2-13, VII.F1-19, and VII.H2-5.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.9, Item 2, criteria. For the line items that apply to LRA Section 3.3.2.2.9.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effect of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.10 Loss of Material Due to Pitting and Crevice Corrosion

(1) LRA Section 3.3.2.2.10 associated with LRA Table 3.3.1, Item 3.3.1-22, addresses the loss of material due to pitting and crevice corrosion for steel piping with elastomer lining or stainless steel cladding exposed to treated water or treated borated water. The applicant stated that this item is not applicable because there is no steel piping, piping components, or piping elements with elastomer lining or stainless steel cladding in the auxiliary systems that are exposed to treated water or treated borated water. The staff reviewed LRA Sections 2.3.3 and 3.3 and the UFSAR and confirmed that no in-scope steel piping with elastomer lining or stainless steel cladding exposed to treated water or treated borated water are present in the auxiliary systems; therefore, the staff finds the applicant's determination acceptable.

(2) LRA Section 3.3.2.2.10.2 refers to LRA Table 3.3.1, Items 3.3.1-23 and 3.3.1-24, and addresses stainless steel heat exchanger and piping components and aluminum piping components exposed to treated water, which are being managed for loss of material due to pitting and crevice corrosion by the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection Program. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the BWR Water Chemistry Program manages aging effects through periodic monitoring and control of contaminants. The applicant also stated that the Chemistry Program Effectiveness Inspection Program will provide verification of the effectiveness of the BWR Water Chemistry Program through examination of stainless steel piping components.

The applicant further stated that loss of material for the spent fuel storage rack stainless steel coverings over the B_4C absorbers are managed by BWR Chemistry Program alone because these materials are not in a low-flow or stagnant-flow area. In addition, the applicant stated that one exception is the process sampling radioactive and EDR systems, for which loss of material for piping and components will be managed by the one-time inspection, Monitoring and Collection Systems Inspection Program. Finally, the applicant indicated that there are no aluminum components in the auxiliary systems that are exposed to treated water.

The staff reviewed LRA Section 3.3.2.2.10.2 against the criteria in SRP-LR Section 3.3.2.2.10, Item 2, which states that loss of material due to pitting and crevice corrosion could occur for stainless steel and aluminum piping, piping components, and piping elements and stainless steel heat exchanger components exposed to treated water. The SRP-LR also states that the existing AMP relies on monitoring and control of water chemistry to mitigate degradation and that the effectiveness of the chemistry control should be verified to ensure that corrosion is not occurring by using a one-time inspection of select components at susceptible locations.

In its review of components associated with Item 3.3.1-24, the staff noted that the applicant's Monitoring and Collection Systems Inspection Program is a one-time inspection and does not manage water chemistry. It was not clear to the staff how a one-time inspection would be adequate to manage loss of material for piping and piping components exposed to treated water. By letter dated August 26, 2010, the staff issued RAI 3.3.2.2.10.2-1 requesting that the applicant explain how the Monitoring and Collection Systems Inspection Program will adequately manage loss of material for stainless steel piping during the period of extended operation.

In its response dated January 28, 2011, the applicant stated that the Monitoring and Collection Systems Inspection Program has been modified to do the following:

- clarify that the program is a plant-specific program
- change the one-time inspection to a baseline inspection of each material and environment combination prior to the period of extended operation
- describe sample population selection and acceptance criteria
- include opportunistic inspection of components during the maintenance, repair, or surveillance activities through the period of extended operation
- include trending of the results of these inspections to ensure that each material and environment combination is examined within a 5-year period

The staff finds the applicant's response acceptable because the applicant modified its program from a one-time inspection to a program that includes both a baseline inspection and periodic inspections through the period of extended operation, which is consistent with the guidance in the GALL Report. The staff's concern described in RAI 3.3.2.2.10.2-1 is resolved.

The staff also noted that it was unclear how the use of the fuel pool level and leak chase channel activities would serve to manage loss of material for the SFP gates. The staff further noted that it was unclear why the SFP is not considered a low-flow or stagnant area, where water chemistry control may not be effective. In addition, the staff noted inconsistencies between LRA Section 3.3.2.2.10.2, and Table 3.5.2-2, Item 16, as to whether the SFP gates are stainless steel or aluminum and whether it is subject to aging management using both the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection Program, or just the BWR Water Chemistry Program. By letter dated October 20, 2010, the staff issued RAI 3.3.2.2.10.2-2 requesting that the applicant reconcile the inconsistencies between LRA Section 3.3.2.2.10.2 and Table 3.5.2-2 by stating the material of construction for the SFP gates and the AMP used to manage loss of material. The applicant was also asked to justify how, in the absence of an Effectiveness Verification Program, monitoring of fuel pool level and leak chase channels will manage loss of material for the SFP gates. The applicant was further requested to justify why the SFP is not considered to be a low-flow or stagnant area.

In its response dated January 20, 2011, the applicant stated that the material of construction for the SFP gates is aluminum, and it modified the LRA to correct this inconsistency. The applicant also stated that the AMP to manage the SFP gates for loss of material is being amended to include both the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection Program. The applicant further stated that it revised the LRA to remove the plant-specific note indicating that the fuel pool level and leak change channels are used to manage aging. The applicant stated that the SFP was not considered a low-flow or stagnant area because the FPC system provides cooling and cleaning of the SFP, which normally circulates the pool water in a closed loop. The applicant also stated that, because there are no quantitative measures for when a treated water environment is considered low-flow or stagnant, the plant-specific Note 0514 that refers to this concern has been removed. The staff finds the applicant's response acceptable because the applicant modified the LRA to clarify that the SFP gates are aluminum, it will manage loss of material for these gates using the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection Program, consistent with the guidance in the GALL Report, and it adequately justified why the SFP is not considered to be a low-flow or stagnant area. The staff's concern described in RAI 3.3.2.2.10.2-2 is resolved.

The staff's evaluations of the applicant's BWR Water Chemistry Program, Chemistry Program Effectiveness Inspection Program, and Monitoring and Collection Systems Inspection Program are documented in SER Sections 3.0.3.1.7, 3.0.3.1.8, and 3.0.3.3.8, respectively. In its review of components associated with line Items 3.3.1-23 and 3.3.1-24, the staff finds the applicant's proposal to manage aging using the above specified programs acceptable for the following reasons:

- The BWR Water Chemistry Program will monitor and control plant water chemistry parameters.
- The Chemistry Program Effectiveness Inspection Program will verify the effectiveness of the BWR Water Chemistry Program through a one-time inspection of select components in susceptible locations.
- The applicant modified its Monitoring and Collection Systems Inspection Program to include periodic inspections.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.10.2 criteria. For those line items that apply to LRA Section 3.3.2.2.10.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(3) LRA Section 3.3.2.2.10, Item 3, refers to LRA Table 3.3.1, Item 3.3.1-25, and addresses copper alloy HVAC piping, piping components, and piping elements exposed to condensation (external), which are being managed for loss of material from pitting and crevice corrosion by the External Surfaces Monitoring Program, Open-Cycle Cooling

Water Program, and Cooling Units Inspection Program. The applicant addressed the further evaluation criteria of the SRP-LR by doing the following:

- stating that its External Surfaces Monitoring Program manages the loss of material due to pitting and crevice corrosion of copper alloy piping and in-line components with external surfaces exposed to potential condensation
- crediting its Open-Cycle Cooling Water Program for managing the loss of material of copper alloy heat exchanger tubes exposed to external condensation
- further stating that the one-time inspection under its Cooling Units Inspection Program will detect and characterize the loss of material due to pitting and crevice corrosion of copper alloy (HVAC) heat exchanger tubes with external surfaces exposed to potential condensation

The staff reviewed LRA Section 3.3.2.2.10, Item 3, against the criteria of SRP-LR Section 3.3.2.2.10, Item 3, which states that loss of material due to pitting and crevice corrosion could occur for copper alloy HVAC piping and components exposed to condensation (external). The SRP-LR also states that a plant-specific further evaluation is recommended to ensure that an adequate program will be in place for the management of these aging effects.

The staff's evaluation of the applicant's External Surfaces Monitoring Program, Open-Cycle Cooling Water Program, and Cooling Units Inspection Program are documented in SER Sections 3.0.3.2.6, 3.0.3.2.17, and 3.0.3.3.3 respectively. The staff notes that the External Surfaces Monitoring Program is an existing program that, with enhancement, will be consistent with the GALL Report AMP XI.M36, External Surfaces Monitoring Program. The Open-Cycle Cooling Water Program is an existing program which, with enhancement, will be consistent with the GALL Report AMP XI.M20, Open-Cycle Cooling Water Program. The Cooling Units Inspection Program is a new plant-specific program that will be consistent with the GALL Report AMP XI.M32, One-Time Inspection. The staff also notes that a visual inspection will be capable of identifying degradation on the external surface that will present itself in signs of corrosion, corrosion byproducts, coating degradation, discoloration on the surface, scale/deposits, and pits and surface discontinuities that are indicative of loss of material. In its review of components associated with line Item 3.3.1-25, the staff finds the applicant's proposal to manage aging using the External Surfaces Monitoring Program and the Open-Cycle Cooling Water Program to be acceptable because the programs include periodic visual inspections of external surfaces performed during system walkdowns and at least once during each fuel-cycle, are adequate to manage loss of material due to pitting and crevice corrosion for the HVAC piping, piping components, and piping elements of copper alloys exposed to an external condensation environment. The staff also finds the applicant's proposal to manage aging using the Cooling Units Inspection Program for copper alloy HVAC heat exchanger components exposed to condensation where the internal environment is not open-cycle cooling water acceptable because the program uses a combination of established volumetric (radiographic testing or UT) and visual inspections (VT-1 or VT-3 or equivalent) in addition to a followup engineering evaluation to determine the need for subsequent aging management activities and for monitoring and trending of the results.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.10, Item 3, criteria. For those items that apply to LRA Section 3.3.2.2.10, Item 3, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(4) LRA Section 3.3.2.2.10.4, referenced by LRA Table 3.3.1, Item 3.3.1-26, addresses copper alloy piping, piping components, and piping elements exposed to lubricating oil, which are being managed for loss of material due to pitting and crevice corrosion by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the Lubricating Oil Inspection Program will be used to verify the effectiveness of the Lubricating Oil Analysis Program to manage loss of material due to pitting and crevice corrosion through examination of susceptible locations in copper alloy piping, piping components, and piping elements in the auxiliary systems that are exposed to lubricating oil. In particular, those components that have Zn content greater than 15 percent. The applicant also stated that this item is also applied to copper alloy heat exchanger components with Zn content greater than 15 percent that are exposed to lubricating oil.

The staff reviewed LRA Section 3.3.2.2.10.4 against the criteria in SRP-LR Section 3.3.2.2.10, Item 4, which states that loss of material due to pitting and crevice corrosion could occur for copper alloy piping, piping components, and piping elements exposed to lubricating oil. The SRP-LR also states that the existing AMP relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. The SRP-LR further states that control of lubricating oil contaminants may not always have been adequate to preclude corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur. The SRP-LR also states that the GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of The Lubricating Oil Chemistry Program for which a one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that the component's intended function will be maintained during the period of extended operation.

The staff's evaluations of the applicant's Lubricating Oil Analysis and Lubricating Oil Inspection programs are documented in SER Sections 3.0.3.2.13 and 3.0.3.1.22, respectively. In its review of components associated with Item 3.3.1-26, the staff finds the applicant's proposal to manage aging using the Lubricating Oil Inspection Program to verify the effectiveness of the Lubricating Oil Analysis Program acceptable because the Lubricating Oil Analysis Program was determined to be consistent with the GALL Report, and the applicant stated that the Lubricating Oil Inspection Program will be used to examine copper alloy piping, piping components, and piping elements to verify the effectiveness of the Lubricating Oil Analysis Program. This satisfies the acceptance criteria in SRP-LR Section 3.3.2.2.10, Item 4; therefore, the applicant's AMR is consistent with the one under GALL Report Items VII.C1-8, VII.C2-5, VII.G-11, and VII.H2-10.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.10, Item 4, criteria. For the line items that apply to LRA Section 3.3.2.2.10.4, the staff determines that the LRA is consistent with the GALL

Report and that the applicant demonstrated that the effect of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(5) LRA Section 3.3.2.2.10, Item 5, refers to LRA Table 3.3.1, Item 3.3.1-27, and addresses aluminum HVAC piping, piping components, and piping elements, and stainless steel ducting and components exposed to condensation (external), which are being managed for loss of material from pitting and crevice corrosion by the External Surfaces Monitoring Program, Open-Cycle Cooling Water Program, and Cooling Units Inspection Program. The applicant addressed the further evaluation criteria of the SRP-LR by stating that its External Surfaces Monitoring Program serves as the plant-specific AMP, that is consistent with the GALL Report, to manage loss of material for stainless steel piping, piping components, piping elements and aluminum tanks and heat exchanger components (shells and tubes) in the auxiliary systems exposed to condensation (external). Additionally, its Open-Cycle Cooling Water Program is credited for aluminum heat exchanger components (cooling unit fins) exposed to condensation (external), if the internal environment is open-cycle cooling water. Otherwise, the Cooling Units Inspection Program will detect and characterize the loss of material, including for stainless steel cooling unit drain pans and piping.

The staff reviewed LRA Section 3.3.2.2.10, Item 5, against the criteria of SRP-LR Section 3.3.2.2.10, Item 5, which states that loss of material due to pitting and crevice corrosion could occur for aluminum HVAC piping, piping components, and piping elements, and stainless steel ducting and components exposed to condensation (external). The SRP-LR also states that a plant-specific further evaluation is recommended to ensure that an adequate program will be in place for the management of these aging effects.

The staff's evaluations of the applicant's External Surfaces Monitoring Program, Open-Cycle Cooling Water Program, and Cooling Units Inspection Program are documented in SER Sections 3.0.3.2.6, 3.0.3.2.17, and 3.0.3.3.3, respectively. The staff notes that the External Surfaces Monitoring Program is an existing program that, with enhancement, will be consistent with the GALL Report AMP XI.M36, External Surfaces Monitoring Program. The Open-Cycle Cooling Water Program is an existing program which, with enhancement, will be consistent with the GALL Report AMP XI.M20, Open-Cycle Cooling Water Program. The Cooling Units Inspection Program is a new plant-specific program that will be consistent with the GALL Report AMP XI.M32, One-Time Inspection. The staff also notes that a visual inspection will be capable of identifying degradation on the external surface that will present itself in signs of corrosion, corrosion byproducts, coating degradation, discoloration on the surface, scale/deposits, and pits and surface discontinuities that are indicative of loss of material. In its review of components associated with line Item 3.3.1-27, the staff finds the applicant's proposal to manage aging using the External Surfaces Monitoring Program and the Open-Cycle Cooling Water Program to be acceptable because the programs include periodic visual inspections of external surfaces, performed during system walkdowns and at least once during each fuel-cycle, are adequate to manage loss of material due to pitting and crevice corrosion for the aluminum HVAC piping, piping components, and piping elements, and stainless steel ducting and components exposed to an external condensation environment. The staff also finds the applicant's proposal to manage aging using the Cooling Units Inspection Program for aluminum HVAC piping, piping components, and piping elements, and stainless steel ducting and components exposed to condensation where the internal environment is not open-cycle cooling water acceptable because the program uses a combination of established volumetric (radiographic testing or UT) and visual inspections (VT-1 or VT-3 or equivalent) in addition to a followup engineering evaluation to determine the need for subsequent aging management activities and for monitoring and trending of the results.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.10, Item 5, criteria. For those items that apply to LRA Section 3.3.2.2.10, Item 5, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(6) LRA Section 3.3.2.2.10, Item 6, is associated with LRA Table 3.3-1, Item 3.3.1-28, and addresses copper alloy fire protection piping, piping components, and piping elements exposed to condensation (internal) requiring no aging management for loss of material due to pitting and crevice corrosion. The applicant addressed the further evaluation criteria of the SRP-LR by stating that this item is not applicable because the only copper or copper alloy fire protection system piping components exposed to internal ambient environments are spray nozzles, strainers bodies, and valve bodies. Additionally, the loss of material due to pitting and crevice corrosion is not an AERM for these components because these components are open to local ambient air conditions such that condensation will not occur, and it is not subject to continuous wetting or alternate wetting and drying that would constitute an aggressive environment.

The staff reviewed LRA Section 3.3.2.2.10, Item 6, against the criteria in SRP-LR Section 3.3.2.2.10, Item 6, which states that loss of material due to pitting and crevice corrosion could occur for copper alloy fire protection system piping, piping components, and piping elements exposed to internal condensation. The SRP-LR also states that the GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed.

The staff finds the applicant's determination that this line item is not applicable acceptable because these copper alloy fire protection components are open to local ambient air conditions (i.e., a controlled indoor air environment) in which it does not experience continuous wetting or alternate wetting and drying; therefore, loss of material due to pitting and crevice corrosion is not expected to occur.

(7) LRA Section 3.3.2.2.10.7 associated with LRA Table 3.3.1, Item 3.3.1-29, addresses pitting and crevice corrosion in stainless steel piping, piping components, and piping elements exposed to soil. The applicant stated in its LRA supplement dated July 16, 2010, that the Buried Piping and Tanks Inspection Program, with enhancement, will manage loss of material due to pitting and crevice corrosion and MIC for stainless steel piping and piping components buried in soil.

The staff reviewed LRA Section 3.3.2.2.10.7 against the criteria in SRP-LR Section 3.3.2.2.10, Item 7, which states that loss of material due to pitting and crevice corrosion could occur for stainless steel piping, piping components, and piping elements exposed to soil.

The staff's evaluation of the applicant's Buried Piping and Tanks Inspection Program is documented in SER Section 3.0.3.2.3. The staff notes that there is no plant-specific operating experience to indicate that the applicant's program would not be effective in managing aging effects during the period of extended operation. In its review of components associated with line Item 3.3.1-29, the staff finds the applicant's proposal to manage aging using the Buried Piping and Tanks Inspection Program acceptable because the proposed program is a combination of a Mitigation Program consisting of protective coating and a Condition Monitoring Program consisting of visual inspections that will detect the loss of material aging effect. Additionally, as discussed in the response and staff evaluation of RAI B.2.5-1, the applicant adjusted the frequency of its inspections based on plant-specific and industry operating experience.

Based on the program identified, the staff concludes that the applicant's program meets SRP-LR Section 3.3.2.2.10, Item 7 criteria. For those line items that apply to LRA Section 3.3.2.2.10.7, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(8) LRA Section 3.3.2.2.10.8 refers to LRA Table 3.3.1, Item 3.3.1-30, and addresses stainless steel piping, piping components, and piping elements exposed to sodium pentaborate solutions, which are being managed for loss of material due to pitting and crevice corrosion by the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the BWR Water Chemistry Program manages aging effects using control of contaminants and periodic inspections and that its Chemistry Program Effectiveness Inspection Program will verify the effectiveness of the BWR Water Chemistry Program in stagnant-flow areas.

The staff reviewed LRA Section 3.3.2.2.10.8 against the criteria in SRP-LR Section 3.3.2.2.10, Item 8, which states that loss of material due to pitting and crevice corrosion could occur for stainless steel piping, piping components, and piping elements exposed to sodium pentaborate solutions. The SRP-LR also states that the existing AMP relies on monitoring and control of water chemistry for BWRs to mitigate degradation. However, control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant-flow conditions. Further, the SRP-LR states that the GALL Report recommends a one-time inspection of select components at susceptible locations as an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly, such that the component's intended function will be maintained during the period of extended operation.

The staff's evaluation of the applicant's BWR Water Chemistry Program is documented in SER Section 3.0.3.1.7, and its evaluation of the Chemistry Program Effectiveness Inspection Program is documented in Section 3.0.3.1.8. The staff notes that as part of the BWR Water Chemistry Program, the applicant committed to implement its One-Time Inspection Program, Chemistry Program Effectiveness Inspection Program, to characterize and detect loss of material due to crevice, general, galvanic, or pitting corrosion in stagnant-flow areas managed by the BWR Water Chemistry Program. In its review of components associated with Item 3.3.1-30, the staff finds the applicant's proposal to manage aging using the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs acceptable because the BWR Water Chemistry Program will mitigate the occurrence of loss of material due to general, pitting, and crevice corrosion by managing containments ingress into the systems below the levels known to cause loss of material. Additionally, the Chemistry Program Effectiveness Inspection Program will verify the effectiveness of the BWR Water Chemistry Program, such that components' intended functions will be maintained during the period of extended operation.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.10.8 criteria. For those line items that apply to LRA Section 3.3.2.2.10, Item 8, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.11 Loss of Material Due to Pitting, Crevice, and Galvanic Corrosion

LRA Section 3.3.2.2.11 refers to LRA Table 3.3.1, Item 3.3.1-31, and addresses copper alloy piping, piping components, and piping elements exposed to treated water. The applicant stated in its LRA supplement dated July 16, 2010, that the loss of material due to pitting, crevice, and galvanic corrosion for copper alloy piping, piping components, or piping elements exposed to treated water will be managed by the BWR Water Chemistry Program and Chemistry Program Effectiveness Inspection. The BWR Water Chemistry Program manages aging effects through using control of contaminants and periodic inspections and that its Chemistry Program Effectiveness Inspection Program will verify the effectiveness of the BWR Water Chemistry Program in stagnant-flow areas.

The staff reviewed LRA Section 3.3.2.2.11 against the criteria in SRP-LR Section 3.3.2.2.11, which states that loss of material due to pitting, crevice, and galvanic corrosion could occur for copper alloy piping, piping components, and piping elements exposed to treated water. Therefore, the GALL Report recommends that the effectiveness of the water chemistry control program should be verified to ensure this aging is not occurring. A one-time inspection of select components at susceptible locations is an acceptable method to ensure that loss of material due to pitting and crevice corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

The staff's evaluation of the applicant's BWR Water Chemistry Program is documented in SER Section 3.0.3.1.7, and its evaluation of the Chemistry Program Effectiveness Inspection Program is documented in Section 3.0.3.1.8. The staff notes that as part of the BWR Water Chemistry Program, the applicant committed to implement its One-Time Inspection Program, Chemistry Program Effectiveness Inspection Program, to characterize and detect loss of material due to crevice, general, galvanic, or pitting corrosion in stagnant-flow areas managed by the BWR Water Chemistry Program. In its review of components associated with Item 3.3.1-31, the staff finds the applicant's proposal to manage aging using the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs acceptable because the BWR Water Chemistry Program will mitigate the occurrence of loss of material due to pitting, crevice, and galvanic corrosion by managing containments ingress into the systems below the levels known to cause loss of material. Additionally, the Chemistry Program Effectiveness Inspection Program will verify the effectiveness of the BWR Water Chemistry Program, such that components' intended functions will be maintained during the period of extended operation.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.11 criteria. For those line items that apply to LRA Section 3.3.2.2.11, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.12 Loss of Material Due to Pitting, Crevice, and Microbiologically-Influenced Corrosion

(1) LRA Section 3.3.2.2.12.1, referenced in Table 3.3.1, Item 3.3.1-32, addresses stainless steel, aluminum and copper alloy piping, piping components, and piping elements exposed to fuel oil, which are being managed for loss of material due to pitting, crevice, and MIC by the Fuel Oil Chemistry and Chemistry Program Effectiveness Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the Chemistry Program Effectiveness Inspection Program will be used to verify the effectiveness of the Fuel Oil Chemistry Program to manage loss of material due to pitting, crevice, and MIC through examination of susceptible locations in stainless steel, aluminum and copper alloy piping, piping components, and piping elements exposed to fuel oil.

The staff reviewed LRA Section 3.3.2.2.12.1 against the criteria in SRP-LR Section 3.3.2.2.12, Item 1, which states loss of material due to pitting, crevice, and MIC could occur in stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to fuel oil. The SRP-LR also states that the existing AMP relies on the Fuel Oil Chemistry Program for monitoring and control of fuel oil contamination to manage loss of material due to corrosion. Corrosion may occur at locations where contaminants accumulate. The effectiveness of fuel oil chemistry control should be verified to ensure that corrosion does not occur. The SRP-LR also states that the GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the Fuel Oil Chemistry Control Program for which a one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

The staff's evaluations of the applicant's Fuel Oil Chemistry and Chemistry Program Effectiveness Inspection Programs are documented in SER Sections 3.0.3.2.12 and 3.0.3.1.8, respectively. In its review of components associated with Item 3.3.1-32, the staff finds the applicant's proposal to manage aging using the Chemistry Program Effectiveness Inspection Program to verify the effectiveness of the Fuel Oil Chemistry Program acceptable because the Fuel Oil Chemistry Program was determined to be consistent with the GALL Report, and the applicant stated that the Chemistry Program Effectiveness Inspection Program will be used to examine stainless steel, aluminum and copper alloy piping, piping components, and piping elements to verify the effectiveness of the Fuel Oil Chemistry Program. This satisfies the acceptance criteria in SRP-LR Section 3.3.2.2.12, Item 1; therefore the applicant's AMR is consistent with the one under GALL Report Items VII.G-10, VII.H1-3, and VII.H1-6

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.12, Item 1, criteria. For the line items that apply to LRA Section 3.3.2.2.12.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effect of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(2) LRA Section 3.3.2.2.12.2, referenced in Table 3.3.1, Item 3.3.1-33, addresses stainless steel piping, piping components, and piping elements exposed to lubricating oil, which are being managed for loss of material due to pitting, crevice, and MIC by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the Lubricating Oil Inspection Program will be used to verify the effectiveness of the Lubricating Oil Analysis Program to manage loss of material through examination of susceptible locations in stainless steel piping, piping components, and piping elements exposed to lubricating oil.

The staff reviewed LRA Section 3.3.2.2.12.2 against the criteria in SRP-LR Section 3.3.2.2.12, Item 2, which states that loss of material due to pitting, crevice, and MIC could occur in stainless steel piping, piping components, and piping elements exposed to lubricating oil. The SRP-LR also states that the existing AMP relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby an environment that is not conducive to corrosion. The SRP-LR further states that control of lubricating oil contaminants may not always have been adequate to preclude corrosion; therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion does not occur. The SRP-LR also states that the GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the Lubricating Oil Analysis Program for which a one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion does not occur and that the component's intended function will be maintained during the period of extended operation.

The staff's evaluations of the applicant's Lubricating Oil Analysis and Lubricating Oil Inspection Programs are documented in SER Sections 3.0.3.2.13 and 3.0.3.1.22, respectively. In its review of components associated with Item 3.3.1-33, the staff finds the applicant's proposal to manage aging using the Lubricating Oil Inspection Program to verify the effectiveness of the Lubricating Oil Analysis Program acceptable because the Lubricating Oil Analysis Program was determined to be consistent with the GALL Report, and the applicant stated that the Lubricating Oil Inspection Program will be used to examine stainless steel piping, piping components, piping elements, and heat exchanger components to verify the effectiveness of the Lubricating Oil Analysis Program. This satisfies the acceptance criteria in SRP-LR Section 3.3.2.2.12, Item 2; therefore, the applicant's AMR is consistent with the one under GALL Report Items VII.C1-14, VII.G-18 and VII.H2-17.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.3.2.2.12, Item 2, criteria. For the line items that apply to LRA Section 3.3.2.2.12.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effect of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.13 Loss of Material Due to Wear

LRA Section 3.3.2.2.13, referenced by LRA Table 3.3.1, Item 3.3.1-34, addresses loss of material due to wear for elastomer seals and components exposed to air-indoor uncontrolled (internal or external). The criteria in SRP-LR Section 3.3.2.2.13 states that loss of material due to wear could occur in the elastomer seals and components of ventilation systems exposed to air-indoor uncontrolled (internal or external). The GALL Report recommends further evaluation to ensure that these aging effects are adequately managed. The staff noted that, in the LRA submitted by letter dated January 19, 2010, the applicant addressed the further evaluation criteria of the SRP-LR by stating that wear of elastomer seals and components exposed to air-indoor was not identified as an AERM. The applicant also stated that loss of material due to wear is the result of relative motion between two surfaces in contact, and wear occurs during the performance of an active function as a result of improper design, application, or operation, or to a very small degree with insignificant consequences. Therefore, loss of material due to wear is not an AERM for elastomers exposed to air-indoor uncontrolled.

The staff noted that GALL Report Section IX.F states that wear could occur due to relative motion between two surfaces, under the influence of hard abrasive particles, frequent manipulation, or in clamped joints where relative motion is not intended but may occur due to a loss of the clamping force. By letter dated July 15, 2010, the staff issued RAI 3.3.2.2.13-1, requesting that the applicant justify why improper design, application, or operation resulting in the loss of material due to wear for elastomer seals and components in HVAC systems exposed to air-indoor uncontrolled (internal or external) is not considered an aging effect requiring aging management during the extended period of operation.

In its response dated September 13, 2010, the applicant stated:

> Consistent with the Statements of Consideration for 10 CFR 54, Section III.d.(1), improper design, faulty manufacturing processes, improper application, faulty maintenance, improper operation, or personal errors may cause events that result in significant wear of components, but this cause of degradation is not aging related. Therefore, loss of material due to wear is not an applicable aging effect for the elastomeric components that are subjects to an-air-indoor uncontrolled environment.

The staff noted that the statement that the applicant excerpted from the 10 CFR Part 54 Statements of Consideration was written in a context of why it was acceptable for the rule to focus the integrated plant assessment on aging effects versus aging mechanisms. The associated text from the Statements of Consideration is as follows:

> The corrective actions that should be taken following identification of functional degradation logically include determination of the cause of the degradation, which could involve mechanisms other than aging (e.g., faulty manufacturing processes, faulty maintenance, improper operation, or personnel errors). If one or more aging mechanisms are the cause of functional degradation, corrective actions should focus, as appropriate, on prevention, elimination, or management of the effects caused by the mechanism(s) in the future. Licensees are required by current regulations to develop and implement programs that ensure that conditions adverse to quality, including degraded system, structure, and component function, are promptly identified and corrected.

The staff noted that the above excerpt was not directly related to wear as might be inferred by the applicant’s response to RAI 3.3.2.2.13-1; however, the staff acknowledges that there are other mechanisms beyond age-related mechanisms that can cause a loss of material, including those that cause wear. Nevertheless, within the definition of the term “wear” in GALL Report Section IX.F, as excerpted above, there are three factors to consider that could cause age-related wear due to the design of the joint. The staff does not find the applicant’s response acceptable because the staff lacks sufficient information to evaluate whether there are any in-scope components that are designed in such a way that it could be impacted by wear as defined within GALL Report Section IX. By letter dated October 20, 2010, the staff issued RAI 3.3.2.2.13-2 requesting that the applicant state whether there are any in-scope elastomeric HVAC components that do the following:

- are designed with relative motion that are exposed to an internal or external environment that includes hard abrasive particles
- are susceptible to wear that over time, due to its frequent manipulation could challenge the CLB function(s) of the component
- have clamped joints where relative motion is not intended but may occur due to a loss of the clamping force over time causing wear that could challenge the CLB function(s) of the component

In its response dated January 20, 2011, the applicant stated the following:

- No in-scope HVAC components are exposed to an internal or external environment that contains hard abrasive particles because all elastomeric HVAC components are located indoors in the air-indoor uncontrolled environment.
- No in-scope HVAC components are subject to wear due to frequent manipulation. A review of plant records indicates that fan replacements have occurred infrequently.
- No in-scope HVAC components have clamped joints where relative motion may occur due to a loss of clamping force over time. All of the suction and discharge boots are bonded to angle iron which is attached to the HVAC components with bolting.

The applicant also stated that tears have been found on several suction and discharge boots in the corners of the flexible connectors where it is creased and wrinkled. In response to RAI B.2.14-1 dated January 28, 2011, the applicant revised its Flexible Connections Inspection Program in the LRA to include managing the loss of material due to wear based on this plant-specific operating experience. The staff's concern described in RAI 3.3.2.2.13-2 is resolved.

The staff finds the applicant's response and proposal acceptable for the following reasons:

- A review of wear related aging mechanisms demonstrated that based on the configuration and plant-specific operating experience, the flexible connectors are not subject to wear due to hard abrasive particles, frequent manipulation, or relative motion.
- The applicant used plant-specific operating experience to include the Flexible Connection Program to manage aging due to the tears it has observed in the creased and wrinkled portion of the HVAC boots.
- The visual and physical manipulation inspections included in the program can detect loss of material due to wear.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations addressed in the GALL Report. The staff determines that the applicant emonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.2.14 Loss of Material Due to Cladding Breach

LRA Section 3.3.2.2.14, associated with LRA Table 3.3.1, Item 3.3.1-35, addresses steel pump casings with stainless steel cladding exposed to treated borated water. The applicant stated that associated items are only applicable to PWRs. The staff reviewed the SRP-LR, confirmed this item only applies to PWRs, and finds this item is not applicable to Columbia.

3.3.2.2.15 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA Program.

3.3.2.3 AMR Results that are Not Consistent with or Not Addressed in the GALL Report

In LRA Tables 3.3.2-1 through 3.3.2-47, the staff reviewed additional details of AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

In LRA Tables 3.3.2-1 through 3.3.2-47, the applicant indicated, via notes F through J, that the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report. The applicant provided further information concerning how the aging effects will be managed. Specifically, Note F indicates that the material for the AMR line item component is not evaluated in the GALL Report. Note G indicates that the environment for the AMR line item component and material is not evaluated in the GALL Report. Note H indicates that the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report. Note I indicates that the aging effect identified in the GALL Report for the line item component, material, and environment combination is not applicable. Note J indicates that neither the component nor the material and environment combination for the line item is evaluated in the GALL Report.

For component type, material, and environment combinations not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine if the applicant demonstrated that the aging effects will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation. The staff's evaluation is discussed in the following sections.

3.3.2.3.1 Auxiliary Systems—Circulating Water System—Summary of Aging Management Evaluation—LRA Table 3.3.2-1

In LRA Tables 3.2.2-1 and 3.3.2-1, the applicant stated that the steel bolting exposed to condensation (external) and outdoor air (external) are being managed for cracking, loss of material, and loss of preload by the Bolting Integrity Program. The AMR line items associated with cracking and loss of material cite Generic Note G. The AMR line items associated with loss of preload cite Generic Note H.

The staff reviewed all AMR result line items in the GALL Report where the component and material is steel bolting exposed to condensation (external) and outdoor air (external) and confirmed that there are no loss of preload aging effect entries in the GALL Report for this component, material, and environment combination.

The staff's evaluation of the applicant's Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The staff noted that the applicant's Bolting Integrity Program includes proper selection of bolting materials and assembly in accordance with EPRI guidelines and the periodic inspections of bolting for indications of degradation such as leakage, loss of material due to corrosion, loss of pre-load, and cracking due to SCC and fatigue. The staff finds the applicant's proposal to manage aging using the Bolting Integrity Program acceptable because proper selection and assembly of bolting will prevent loss of preload and the periodic inspections performed under this program will ensure that any cracking, loss of material, or loss of preload will be detected prior to loss of function.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-1, the applicant stated that, for concrete piping of the circulating water system exposed to a raw water (internal) environment, there is no aging effect, and no AMP is proposed. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and noted that the applicant did not reference the GALL Report AMR, Items III.A6-6 and III.A6-7, in Table 3.3.2 for increase in porosity and permeability, loss of strength due to leaching of calcium hydroxide, and loss of material due to abrasion and cavitation in concrete piping components. By letter dated August 26, 2010, the staff issued RAI 3.3.2.3.1-1 asking that the applicant justify why it did not reference an AMP for the internal surfaces of concrete piping of the circulating water system.

In it response dated November 11, 2010, the applicant stated that the relevant conditions do not exist in the raw water environment of the circulating water system for the applicable aging effects to occur. The applicant stated that the raw water in the system did not exceed the limits for aggressive water. The applicant further stated that the concrete piping was designed in accordance with ACI 318 and ACI 301 with materials conforming to ASTM standards. Following these standards resulted in low permeability concrete effectively protected against leaching and chemical attack. The applicant also stated that the aggregates were tested for reactivity and found acceptable prior to use. In its response, the applicant explained that abrasion and cavitation is an aging effect for concrete only if the water contains abrasives and has a closed conduit flow greater than 25 feet per second (fps). The applicant stated that the circulating water system is filtered of most abrasives, and the flow velocity remains below 9 fps.

The staff reviewed the applicant's response and found it acceptable because the concrete was designed in accordance with ACI 318 and constructed in accordance with ACI 301, which provides a relatively low permeability concrete with sufficient cover to prevent corrosion. The low permeability also protects the concrete from leaching and chemical attack. In addition, the water is not aggressive, and, by following the design guidelines in ACI 318, appropriate air content and water-to-cement ratios were met for the concrete piping. Finally, the staff finds that abrasion is not an AERM because the water does not contain large abrasive particles and the flow is relatively slow. Since the applicant has met the recommendations of the GALL Report regarding aging effects for inaccessible concrete and has adequately addressed the applicable aging effects for concrete exposed to flowing water, the staff finds the RAI response and the AMR line items acceptable. The staff's concern described in RAI 3.3.2.3.1-1 is resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these

components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-1, the applicant stated that, for concrete piping of the circulating water system exposed to a soil (external) environment, there is no aging effect, and no AMP is proposed. The AMR line items cite Generic Note I, and plant-specific Note 301, which states that "cracking due to settlement was determined not to be an aging effect requiring management for concrete exposed to soil because all Columbia plant concrete components are supported by backfill. The backfill provides safe bearing for the components, and settlements are estimated to be minimal."

The staff reviewed the associated line items in the LRA and noted that the GALL Report, under Item III.A6-4, recommends the program described in GALL Report Section XI.S6, "Structures Monitoring Program," for managing cracks and distortion due to increased stress levels from settlement. However, in LRA Table 3.3.2-1 the applicant did not propose to use an AMP. In addition, the GALL Report discusses several other aging mechanisms for concrete in a soil environment. Therefore, by letter dated August 26, 2010, the staff issued RAI 3.3.2.3.1-2 requesting that the applicant justify why it did not reference an AMP for aging of concrete piping of the circulating water system.

In it response dated November 11, 2010, the applicant stated that the relevant conditions do not exist in the soil environment of the circulating water system for the applicable aging effects to occur. The applicant stated that the concrete piping was designed in accordance with ACI 318 and constructed in accordance with ACI 301 with materials conforming to ASTM standards. Following these standards resulted in low permeability concrete with appropriate cover, which is effectively protected from chemical attack, leaching, and corrosion of steel reinforcement. The applicant also stated that the aggregates were tested for reactivity and found acceptable prior to use, which protects the concrete from cracking due to reaction with aggregates. The applicant further stated that cracking due to settlement was not an AERM because the measured differential settlements are well within the estimated differential settlements.

The staff reviewed the applicant's response and found it unacceptable. Recent industry operating experience with buried piping has demonstrated that piping failures may occur, regardless of the construction specifications used. Therefore, confirmatory excavations and visual inspections are necessary at least every 10 years during the period of extended operation to verify that degradation is not occurring.

By letter dated January 28, 2011, the applicant included an LRA supplement to credit the Buried Piping and Tanks Inspection Program to verify that degradation is not occurring to concrete piping exposed to a soil (external) environment. The staff's review and resolution of concerns regarding buried piping, including buried concrete piping and these AMR line items, is covered in the staff's review of the applicant's Buried Piping and Tanks Inspection Program, SER Section 3.0.3.2.3.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.2 Auxiliary Systems—Condensate Processing Radioactive (Demineralizer) System—Summary of Aging Management Evaluation—LRA Table 3.3.2-2

The staff reviewed LRA Table 3.3.2-2, which summarizes the results of AMR evaluations for the condensate processing radioactive (demineralizer) system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.3 Auxiliary Systems—Containment Atmosphere Control System—Summary of Aging Management Evaluation—LRA Table 3.3.2-3

The staff reviewed LRA Table 3.3.2-3, which summarizes the results of AMR evaluations for the containment atmosphere control system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J, whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.4 Auxiliary Systems—Containment Exhaust Purge and Containment Supply Purge Systems—Summary of Aging Management Evaluation—LRA Table 3.3.2-4

In LRA Table 3.3.2-4, the applicant stated that the elastomer flexible connection exposed to gas (internal) and dried air (internal) are being managed for hardening and loss of strength due to elastomer degradation by the Flexible Connection Inspection Program. The AMR line items cite Generic Note H.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because hardening and loss of strength is an all encompassing term that refers to degradation of elastic properties of the elastomer, manifested by cracking, crazing, breakdown, and change in material composition detectable by probing the component.

The staff's reviewed the applicant's Flexible Connection Inspection Program and its evaluation is documented in SER Section 3.0.3.3.6. The staff noted that the Flexible Connection Inspection Program is a new plant-specific program that consists of visual inspections for evidence of degradation, such as cracking and discoloration, and physical examinations to verify whether hardening and loss of strength has occurred. The staff also noted that the program is based on collecting baseline information during the 10-year period prior to the period of extended operation, followed by opportunistic inspections. The staff further noted that the environmental conditions on the inside of the flexible connection exposed to gas (internal) and dried air (internal) is encompassed by the external environment of uncontrolled air-external, addressed in LRA Section 3.3.2.2.5, Item 1. The staff finds the applicant proposal to manage aging using the Flexible Connection Inspection Program acceptable because signs of elastomer degradation, such as cracking and discoloration, can be detected by visual inspections and physical examinations, the baseline inspections coupled with opportunistic inspections will provide an adequate sample of inspections, and similarity of internal and external environments, inspection from the external surfaces would be as effective as internal inspection.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.3.2-4, 3.3.2-5, 3.3.2-11, 3.3.2-14, 3.3.2-16, 3.3.2-17, 3.3.2-20, 3.3.2-22, 3.3.2-34, 3.3.2-36, and 3.3.2-37, the applicant stated that for copper alloy and copper alloy (greater than 15 percent zinc) components exposed to air (internal) or air-indoor uncontrolled (internal and external), there is no aging effect, and no AMP is proposed. The AMR line items cite Generic Note G, indicating that, for these line items, the environment is not in the GALL Report for these components and materials.

The staff reviewed all AMR result line items in the GALL Report where the material is copper and the aging and mechanism effect is loss of material and confirmed that for this environment. The staff confirmed there are no entries in the GALL Report for these components and materials in the auxiliary system. However, the GALL Report Item VIII.I-2 (SP-6) is for copper alloy piping elements and components in the steam and power conversion system and does not have an aging effect or AMP listed.

The staff reviewed Table IX.C of the GALL Report that states that copper alloys (greater than 15 percent zinc) are susceptible to aging effects, such as SCC, selective leaching, pitting, and crevice corrosion. The environments of interest, air-indoor uncontrolled (internal and external), would not induce SCC in copper alloys (greater than 15 percent zinc) and would not result in loss of material due to pitting, crevice, or selective leaching. The staff finds the applicant’s proposal acceptable because no aging effect is expected for copper exposed to air.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.5 Auxiliary Systems—Containment Instrument Air System—Summary of Aging Management Evaluation—LRA Table 3.3.2-5

The staff’s evaluation for copper alloy and copper alloy (greater than 15 percent zinc) components exposed to air (internal) or air-indoor uncontrolled (internal and external) have no proposed aging effect and no AMP is proposed with a Generic Note G is documented in SER Section 3.3.2.3.4.

3.3.2.3.6 Auxiliary Systems—Containment Monitoring System—Summary of Aging Management Evaluation—LRA Table 3.3.2-6

The staff’s evaluation for stainless steel bolting exposed to air-indoor uncontrolled (external), being managed for loss of pre-load by the Bolting Integrity Program with Generic Note F, is documented in SER Section 3.2.2.3.2.

3.3.2.3.7 Auxiliary Systems—Containment Nitrogen Systems—Summary of Aging Management Evaluation—LRA Table 3.3.2-7

In LRA Table 3.3.2-7, the applicant stated that the steel cryogenic nitrogen storage tank (CN-TK-1) exposed to air (internal) is being managed for loss of material by the External Surfaces Monitoring Program. The related AMR line item cites Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because, consistent with the GALL Report, steel components exposed to an air environment are subject to loss of material. The staff noted that the conditions required for cracking due to a variety of mechanisms (SCC, PWSCC, IASCC, and IGSCC) to occur, such as being exposed to an aqueous solution (reactor coolant or other corrosive solutions) and high temperatures, do not exist on the surfaces of this component when exposed to air-outdoor or air. Therefore, the staff finds cracking is not an AERM for this component.

The staff's evaluation of the applicant's External Surfaces Monitoring Program is documented in SER Section 3.0.3.2.6. However, the applicant stated, in plant-specific Note 0323, that the internal environment will be conservatively evaluated as air instead of as a vacuum. The applicant also stated that the external surface is exposed to the more aggressive outdoor air environment; therefore, aging effects will occur on the external surface before it occurs on the internal surface. The staff noted that the detection of loss of material on the external surface is conservative for assessing the aging effect of the internal surface because the external environment is more aggressive than the internal environment. The staff noted that the same component with exposure to air-outdoor (external) the GALL Item VII.I-9 indicates that the loss of material is adequately managed by GALL Report AMP XI.M36 "External Surfaces Monitoring Program." GALL Report AMP XI.M36 states this program may be credited with managing loss of material from internal surfaces, for situations in which material and environment combinations are the same for internal and external surfaces such that external surface condition is representative of internal surface condition. The staff noted that, since the external environment (outdoor air environment) is more aggressive than the internal environment (a vacuum) and the internal and external surface component-material-environment combinations are the same, the applicant's proposal to manage the external surface as being representative of the internal surface is acceptable and conservative. The staff noted that this program will include periodic visual inspection of external surfaces performed during system walkdowns at specified frequencies. The staff also noted that age-related degradation of steel components, such as loss of material, can be detected by a visual inspection by evidence of material wastage, surface discontinuities, and discoloration. The staff finds the applicant's proposal to manage aging using External Surfaces Monitoring Program acceptable because periodic visual inspections being performed during system walkdowns are capable of detecting loss of material, and the external surface is representative of the internal surface, as discussed above.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-7, the applicant stated that the aluminum heat exchanger shell and tubes exposed to external condensation are being managed for cracking by the External Surfaces Monitoring Program. The AMR line items cite Generic Note F.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because, based on the GALL Report, cracking may occur when aluminum is exposed to condensation, which will be detected by visual inspections or volumetric examinations conducted by the External Surfaces Monitoring Program.

The staff's evaluation of the applicant's External Surfaces Monitoring Program is documented in SER Section 3.0.3.2.6. Staff reviewed the GALL Report, and no cracking aging effects were identified for external condensation environment. However, certain aluminum alloys may be subject to SCC if the temperature regime is sufficient. Thus, the applicant's use of the cracking aging effect is appropriate. The staff finds that the applicant's proposal to manage aging using the External Surfaces Monitoring Program acceptable because the program uses visual inspections and surveillance activities to detect cracking effects that could result in a loss of component functionality due to cracking.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-7, the applicant stated that the steel bolting exposed to air-outdoor (external) are being managed for loss of pre-load by the Bolting Integrity Program. The AMR line item cites Generic Note G.

The staff notes that LRA Table 3.3.2-7 has other line items associated with steel bolting exposed to air-outdoor (external), which address cracking and loss of material. The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because Table VIII.H of the GALL Report states that loss of preload due to thermal effects, gasket creep, and self-loosing is an aging effect for steel bolting exposed to air-indoor uncontrolled (external), and the GALL Report recommends XI.M18, "Bolting Integrity," for managing the aging effect.

The staff's evaluation of the applicant's Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The staff finds the applicant's proposal to manage aging using the Bolting Integrity Program acceptable because the Bolting Integrity Program consists of the periodic inspection of bolting for indications of loss of pre-load, and the preventive measures in the program will preclude or minimize loss of pre-load.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.3.2-7 and 3.3.2-37, the applicant stated that steel heat exchanger channels, shells, and headers, as well as piping and valve bodies exposed to steam (internal), are being managed for loss of material by the BWR Water Chemistry, Chemistry Program Effectiveness Inspection, and Flow-Accelerated Corrosion Programs. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because the GALL Report states that steel components exposed to steam are subject to loss of material due to general, pitting, and crevice corrosion and flow-accelerated corrosion. The staff noted that although the applicant stated that this environment is not in the GALL Report for these components and materials, the GALL Report does contain items for steel piping exposed to steam and recommends that GALL Report AMPs XI.M2, "Water Chemistry," XI.M17, "Flow-Accelerated Corrosion," and Chapter XI.M32, "One-Time Inspection" be used to manage the aging effects.

The staff's evaluations of the applicant's BWR Water Chemistry, Chemistry Program Effectiveness Inspection, and Flow-Accelerated Corrosion Programs are documented in SER Sections 3.0.3.1.7, 3.0.3.1.8, and 3.0.3.2.11, respectively. The staff noted that the applicant's BWR Water Chemistry Program is an ongoing program that manages the loss of material due to corrosion or erosion through the control of coolant water impurity levels and pH, consistent with the current EPRI water chemistry guidelines. The staff also noted that the applicant's Chemistry Program Effectiveness Inspection Program is a new program that detects and characterizes, through visual and volumetric examinations, the material conditions in representative low-flow and stagnant areas of plant systems influenced by the BWR Water Chemistry Program to detect whether, and to what extent, a loss of material due to crevice, general, galvanic, or pitting corrosion in treated water has occurred. The staff further noted that the applicant's Flow-Accelerated Corrosion Program is an ongoing program that follows EPRI guidelines to manage the loss of material for steel and gray cast iron components located in the treated water environment, including steam, of systems that are susceptible to flow-accelerated corrosion. The staff finds the applicant's proposal to manage aging using the BWR Water Chemistry, Chemistry Program Effectiveness Inspection, and Flow-Accelerated Corrosion Programs acceptable because these programs incorporate established chemistry control, inspection, and erosion-corrosion control procedures and techniques that have been demonstrated to be effective in controlling and detecting loss of material due to general, pitting, and crevice corrosion and flow-accelerated corrosion in components in contact with steam (internal) through visual and volumetric examination methodologies.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.3.2-7, 3.3.2-29, and 3.3.2-32, the applicant stated that the copper alloy (greater than 15 percent zinc) valve bodies, piping, pump casing, strainer, and tubing exposed to condensation (external) are being managed for loss of material by the Selective Leaching Inspection Program. The AMR line items cite Generic Note G, indicating that for these line items the environment is not in the GALL Report for these components and materials.

The staff reviewed all AMR result line items in the GALL Report where the material is copper and the aging effect and mechanism is loss of material and confirmed that for this environment, there are no entries in the GALL Report for these components and materials. The GALL Report Item VII.F1-16 (A-46) recommends using a plant-specific AMP to manage loss of material in this environment; however, the AMP was additionally covered by the applicant in another line item in the LRA and in this report.

The staff reviewed the applicant's Selective Leaching Inspection Program, and its evaluation is documented in SER Section 3.0.3.1.26. The staff reviewed Table IX.C of the GALL Report that states that copper alloys (greater than 15 percent zinc) are susceptible to aging effects, such as SCC, selective leaching, pitting, and crevice corrosion. Thus, the applicant's use of loss of material as the aging effect is appropriate. The staff finds that the applicant's proposal to manage aging using the Selective Leaching Inspection Program is acceptable because the program uses visual inspections as well as hardness testing in order to detect aging effects that could result in a loss of component intended function due to loss of material.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.8 Auxiliary Systems—Containment Return Air System—Summary of Aging Management Evaluation—LRA Table 3.3.2-8

The staff reviewed LRA Table 3.3.2-8, which summarizes the results of AMR evaluations for the containment return air system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J, whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.9 Auxiliary Systems—Containment Vacuum Breaker System—Summary of Aging Management Evaluation—LRA Table 3.3.2-9

The staff reviewed LRA Table 3.3.2-9, which summarizes the results of AMR evaluations for the containment vacuum breaker system component groups.

The staff's review did not find any line items indicating plant-specific notes F through J, whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.10 Auxiliary Systems—Control Air System—Summary of Aging Management Evaluation—LRA Table 3.3.2-10

The staff reviewed LRA Table 3.3.2-10, which summarizes the results of AMR evaluations for the control air system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J, whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.11 Auxiliary Systems—Control Rod Drive System—Summary of Aging Management Evaluation—LRA Table 3.3.2-11

The staff's evaluation for copper alloy and copper alloy (greater than 15 percent zinc) components exposed to air (internal) or air-indoor uncontrolled (internal and external) have no proposed aging effect and no AMP is proposed with a Generic Note G is documented in SER Section 3.3.2.3.4.

3.3.2.3.12 Auxiliary Systems—Control Room Chilled Water System—Summary of Aging Management Evaluation—LRA Table 3.3.2-12

In LRA Table 3.3.2-12, the applicant stated that for glass sight glass exposed to gas (internal), there is no aging effect, and no AMP is proposed. The AMR line item cites Generic Note G.

The staff notes that the LRA defines the gas environment as compressed gas such as CO_2, halon, hydrogen, nitrogen, freon, or other refrigeration gases, which are dry and free of contaminants. The staff reviewed the associated line items in the LRA and confirmed that no aging effect is applicable for this component, material, and environmental combination and finds the applicant's proposal acceptable because the gas environment is similar to the air and air-indoor uncontrolled environment addressed in the GALL Report for which there is no recommended aging effect or AMP.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-12, the applicant stated that for glass sight glass exposed to condensation (external) there is no aging effect and no AMP is proposed. The AMR line item cites Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that no aging effect is applicable for this component, material and environmental combination and finds the applicant's proposal acceptable because the condensation (external) environment is similar to the raw water environment addressed in the GALL Report for which there is no recommended aging effect or AMP.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.3.2-12 and 3.3.2-17, the applicant stated that the aluminum alloy pump casing (chiller high speed and low speed lubricating oil pump) and oil fog lubricators exposed to internal lubricating oil are being managed for loss of material by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environment combination because based on the GALL Report, pitting, crevice corrosion, and MIC may occur when aluminum is exposed to fuel oil (an equivalent environment to lubricating oil).

The staff's evaluations of the applicant's Inspection of Lubricating Oil Analysis and Lubricating Oil Inspection Programs are documented in SER Sections 3.0.3.2.13 and 3.0.3.1.22, respectively. The staff finds that the applicant's proposal to manage aging using the Lubricating Oil Analysis and Lubricating Oil Inspection Programs acceptable, because the Lubricating Oil Analysis Program will maintain the quality of the oil environment to ensure that lubricating oil contaminates are within acceptable limits, and the Lubricating Oil Inspection Program will include a one-time visual inspection to determine the effectiveness of the Lubricating Oil Analysis Program.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.3.2-12, 3.3.2-17, and 3.4.2-4, the applicant stated that for aluminum alloy pump casing (chiller high speed and low speed lubricating oil pump), heat exchanger components, oil fog lubricators, manifold, and valve bodies exposed to internal air or external uncontrolled indoor air, there is no aging effect, and no AMP is proposed. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because, based on the GALL Report where the material is aluminum and the aging effect/mechanism is loss of material, there are no entries for these components and materials exposed to internal air or external uncontrolled indoor air.

The staff noted that, even though the GALL Report recommends no AERMs for aluminum alloy pump casing (chiller high speed and low speed lubricating oil pump), heat exchanger components, oil fog lubricators, manifold, and valve bodies in an internal air or external uncontrolled indoor air environment, the GALL Report, under Item VII.J-2 (AP-37), indicates that aluminum piping exposed to gas does not list an AERM or AMP. The staff finds the applicant's proposal acceptable because no aging effect is expected to occur for aluminum in gas.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.3.2-12 and 3.3.2-22, the applicant stated that the steel and stainless steel heat exchanger tubes exposed to lubricating oil (internal) are being managed for reduction in heat transfer by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The AMR line items cite Generic Note H.

The staff reviewed all AMR result line items in the GALL Report where the component and material is steel heat exchanger tubes exposed to lubricating oil and identified two entries, Items

V.D2-11 and V.D2-14, which are applicable to BWRs for this component, material, environment, and aging effect combination. The GALL Report recommends that this aging effect be managed using GALL Report AMP XI.M39, “Lubricating Oil Analysis,” augmented by a verification program such as GALL Report AMP XI.M32, “One-Time Inspection.”

The staff’s evaluations of the applicant’s Lubricating Oil Analysis and Lubricating Oil Inspection Programs are documented in SER Sections 3.0.3.2.13 and 3.0.3.1.22, respectively. The staff noted that the applicant’s Lubricating Oil Analysis Program includes monitoring the lubricating oil for particulates, water, and other parameters to manage loss of material and reduction of heat transfer. The staff also noted that the applicant’s Lubricating Oil Inspection Program is consistent with GALL Report AMP XI.M32, and its application here satisfies the GALL Report recommendation concerning verification of the effectiveness of the Lubricating Oil Analysis Program’s chemistry control at managing this aging effect. The staff finds the applicant’s proposal to manage aging using the Lubricating Oil Analysis and Lubricating Oil Inspection Programs acceptable because the application of these two programs is consistent with the GALL Report recommendations in GALL Report Items V.D2-11 and V.D2-14.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results for these material, environment, AERM, and AMP combinations. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.3.2-12, 3.3.2-14, 3.3.2-18, 3.3.2-22, 3.3.2-25, 3.3.2-27, 3.3.2-28, 3.3.2-32, 3.3.2-34, 3.3.2-35, 3.3.2-36, 3.3.2-37, 3.3.2-42, and 3.3.2-43, the applicant stated that the steel and stainless steel bolting exposed to condensation (external), air-outdoor (external), or treated water (external) are being managed for cracking, and loss of pre-load or material, by the Bolting Integrity AMP. The related AMR line items cite Generic Note H, indicating that the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed all AMR result line items in the GALL Report where component and material is steel or stainless steel bolting exposed to condensation (external), air-outdoor (external), or treated water (external), and it confirmed that there are no aging effect entries (for cracking, loss of pre-load or material) in the GALL Report for this component, material, and environment combination.

The staff’s evaluation of the applicant’s Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The staff finds the applicant’s proposal to manage aging using the Bolting Integrity Program acceptable because the staff’s review confirmed that the aging effects identified are appropriate for these component, material, and environment combinations and that the proposed aging related inspections under the applicant’s Bolting Integrity Program will be adequate to detect this aging.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.13 Auxiliary Systems—Demineralized Water System—Summary of Aging Management Evaluation—LRA Table 3.3.2-13

The staff reviewed LRA Table 3.3.2-13, which summarizes the results of AMR evaluations for the demineralized water system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.14 Auxiliary Systems—Diesel Building HVAC System—Summary of Aging Management Evaluation—LRA Table 3.3.2-14

In LRA Tables 3.3.2-14, 3.3.2-29, 3.3.2-34, 3.3.2-36, and 3.3.2-37, the applicant stated that the aluminum alloy heat exchanger fins, tank shell, and end caps exposed to external condensation are being managed for cracking by the Open Cycle Cooling Water, External Surfaces Monitoring, and Cooling Units Inspection Programs. The AMR line items cite Generic Note H.

However, with regard to the Open-Cycle Cooling Water Program, in its response to RAI B.2.42-1, dated September 24, 2010, and discussed further in SER Section 3.0.3.2.17, the applicant stated that Amendment 1 to the LRA, dated July 16, 2010, removed the aging effect of cracking of aluminum alloy components from the Open-Cycle Cooling Water Program. The applicant stated that all the associated aluminum components being managed for cracking by the Open-Cycle Cooling Water Program are for aluminum heat exchanger fins on the cooling coils in various systems exposed to condensation which have been conservatively considered susceptible to cracking. After further evaluation, the applicant concluded the aluminum components were not susceptible to cracking because of the alloy content. As discussed in SER Section 3.0.3.2.17, the staff finds the response acceptable because, with the associated changes provided by the applicant in Amendment 1 to the LRA, the scope of the Open-Cycle Cooling Water Program is consistent with the "scope of program" program element in GALL Report AMP XI.M20. The staff's concern described in RAI B.2.42-1 is resolved. On the basis of its review, the staff finds that the applicant's removal of the AMR items for aluminum alloy heat exchanger fins exposed to external condensation being managed for cracking by the Open-Cycle Cooling Water Program is appropriate.

With regard to the aluminum alloy components being managed for cracking by the External Surfaces Monitoring and Cooling Units Inspection Programs, the staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because, based on the GALL Report, cracking may occur when aluminum is exposed to condensation, which will be detected by visual inspections or volumetric examinations conducted by the External Surfaces Monitoring and Cooling Units Inspection Programs.

The staff's evaluations of the applicant's External Surfaces Monitoring and Cooling Units Inspection Programs are documented in SER Sections 3.0.3.2.6 and 3.0.3.3.3, respectively. The staff reviewed the GALL Report, and the cracking aging effect was not identified in combination with aluminum. However, certain aluminum alloys may be subject to SCC if the temperature regime is sufficient. Thus, the applicant's use of the cracking aging effect is appropriate. Aluminum alloys are also subject to loss of material, which was covered by the applicant in another line item. The staff finds that the applicant's proposal to manage aging using the External Surfaces Monitoring and Cooling Units Inspection Programs acceptable because the programs use inspections and surveillance activities as well as chemical testing of the fluid to detect contaminants. It also uses visual inspections and surveillance activities to identify aging effects and loss of component intended function due to cracking.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for copper alloy and copper alloy (greater than 15 percent zinc) components exposed to air (internal) or air-indoor uncontrolled (internal and external) that have no proposed aging effect and no AMP proposed with a Generic Note G is documented in SER Section 3.3.2.3.4.

The staff's evaluation for steel and stainless steel bolting exposed to condensation (external), air-outdoor (external), or treated water (external) that are being managed for cracking, and loss of pre-load or material, by the Bolting Integrity Program, proposed with a Generic Note H, is documented in SER Section 3.3.2.3.12.

In LRA Tables 3.3.2-14, 3.3.2-34, 3.3.2-36, and 3.3.2-37, the applicant stated that the copper alloy heat exchanger tubes exposed to condensation (external) are being managed for reduction of heat transfer by the Open-Cycle Cooling Water Program. The AMR line item cites Generic Note H, indicating that, for these line items, the aging effect is not mentioned in the GALL Report for these component, material, and environment combinations.

The staff reviewed all AMR result line items in the GALL Report where the components and materials are copper alloy heat exchanger tubes exposed to condensation (external) and confirmed that there are no aging effect entries in the GALL Report for these component, material, and environment combinations in the diesel building HVAC system. However, the GALL Report Item VII.F2-14 (A-46) is for copper alloy piping elements and components in the auxiliary and radwaste area ventilation system, and the GALL Report does indicate that for copper alloy piping components exposed to condensation (external), a plant-specific AMP is to be evaluated.

The staff reviewed the applicant's Open-Cycle Cooling Water Program, and its evaluation is documented in SER Section 3.0.3.2.17. The staff reviewed Table IX.C of the GALL Report that states that copper alloys (less than 15 percent zinc) are generally resistant to other aging effects, such as SCC, selective leaching, pitting, and crevice corrosion. However, the components are part of a heat exchanger where the potential for contaminant build up is possible. Thus, the applicant's use of reduction of heat transfer as an aging effect is appropriate. The staff finds that the applicant's proposal to manage aging using the Open-Cycle Cooling Water Program is acceptable because the program uses visual inspections, surveillance activities, and testing of water chemistry in order to detect aging effects that could result in a loss of component intended function due to reduction in heat transfer.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these

components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.3.2-14, 3.3.2-34, 3.3.2-36, and 3.3.2-37, the applicant stated that the stainless steel bolting exposed to air-indoor uncontrolled (external) is being managed for loss of pre-load by the Bolting Integrity AMP. The related AMR line item cites Generic Note F, indicating that the material is not in the GALL Report for the aging effect of this component.

The staff reviewed all AMR result line items in the GALL Report where the environment is air-indoor uncontrolled (external) and the aging effect and mechanism is loss of pre-load, and confirmed that there are no entries for this component and material.

The staff's evaluation of the applicant's Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The AMP is adequate for managing loss of pre-load for the bolting because this component and aging mechanism combination is of primary control under the maintenance practices of the Bolting Integrity Program. The periodic inspections and walkdowns will identify the potential loss of pre-load and the maintenance practices include the corrective actions to assess or manage the situation as needed.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.15 Auxiliary Systems—Diesel Cooling Water System—Summary of Aging Management Evaluation—LRA Table 3.3.2-15

In LRA Tables 3.3.2-15, 3.3.2-20, 3.3.2-22, and 3.3.2-42, the applicant stated that the copper alloy heat exchanger tubes exposed to lubricating oil (external) are being managed for reduction of heat transfer by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The AMR line item cites Generic Note H, indicating that, for these line items, the aging effect is not in the GALL Report for these component, material, and environment combinations.

The staff reviewed all AMR result line items in the GALL Report where the components and materials are copper alloy heat exchanger components exposed to lubricating oil (external) and confirmed that there are no aging effect entries in the GALL Report for these component, material, and environment combinations.

The staff reviewed the applicant's Lubricating Oil Analysis and Lubricating Oil Inspection Programs, and its evaluations are documented in SER Sections 3.0.3.2.13 and 3.0.3.1.22, respectively. The staff reviewed Table IX.C of the GALL Report that states that copper alloys (less than 15 percent zinc) are generally resistant to other aging effects, such as SCC, selective leaching, pitting, and crevice corrosion. However, the components are part of a heat exchanger where the potential for contaminant build up is possible. Thus, the applicant's use of the reduction in heat transfer aging effect is appropriate. The staff finds that the applicant's proposal to manage aging using the Lubricating Oil Analysis Program is acceptable because the program uses visual inspections to determine the effect of aging. The Lubricating Oil Inspection Program uses testing of fluid chemistry to detect aging effects that could result in a loss of component intended function due to reduction in heat transfer.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.16 Auxiliary Systems—Diesel (Engine) Exhaust System—Summary of Aging Management Evaluation—LRA Table 3.3.2-16

In LRA Tables 3.3.2-16, 3.3.2-42, and 3.4.2-3, the applicant stated that, for stainless steel flexible connections, nozzles, orifices, piping, valve bodies, and tubing exposed to air-outdoor (internal and external), there is no aging effect, and no AMP is proposed. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and cannot confirm that the applicant identified the correct aging effects for this component, material, and environmental combination, as discussed in the RAI below. The staff noted that the GALL Report does not address stainless steel components in an outdoor air environment; however, given the stations location in proximity to arid land, agriculture, and cooling tower vapor, trace compounds (e.g., chlorides) could be contained within the outside air supply to these components.

By letter dated October 14, 2010, the staff issued RAI 3.3.2.3.16-1 requesting that the applicant state why the outside air environment does not contain trace compounds that could cause loss of material in stainless steel components.

In its response dated January 18, 2010, the applicant stated that while the components may be exposed to small amounts of contaminants in the air, the components are normally drained such that it is not subject to a wetted environment and therefore the aging effects are not applicable. The applicant also stated that flexible connection DE-FLX-5 is periodically exposed to diesel exhaust and will be inspected by the Diesel Systems Inspection Program. The applicant further stated that for completeness, the LRA is amended to include rows with an environment of moist air (internal) for the stainless steel still well piping and tubing in the level sensing lines for the condensate tanks which are being managed for loss of material by the Supplemental Piping/Tank Inspection Program to address aging at the air-water interface.

The staff reviewed the applicant’s response and noted that maintaining components in a normally drained state does not preclude condensation and, therefore, does not preclude the potential for aging. In a conference call held January 24, 2011, the staff requested that the applicant supplement its response to RAI 3.3.2.3.16-1 to justify why the components exposed to outdoor air are not subject to condensation-related aging effects. In its supplemental response dated April 21, 2011, the applicant amended the LRA to manage aging for these stainless steel components exposed to outdoor air, both internally and externally, using the External Surfaces Monitoring Program. The staff finds the applicant’s response acceptable because the applicant revised the LRA to manage aging for stainless steel flexible connections, nozzles, orifices, piping, valve bodies, and tubing exposed to outdoor air, both internally and externally, using appropriate programs, as discussed below. The staff’s concern described in RAI 3.3.2.3.16-1 is resolved.

The staff’s evaluations of the applicant’s Diesel Systems Inspection and External Surfaces Monitoring Programs are documented in SER Sections 3.0.3.3.5 and 3.0.3.2.6. The staff noted that aging of an internal surface exposed to outdoor air can be extrapolated by examining the external surface of a component of the same material exposed to the same environment. The staff also noted that the applicant's External Surfaces Monitoring Program manages aging for both the external and internal surfaces of components. The staff finds the applicant's proposal to manage aging for stainless steel components exposed to outdoor air, both internally and externally, using the Diesel Systems Inspection or External Surfaces Monitoring Programs acceptable because both programs include visual inspections, which are capable of detecting loss of material in the subject components.

The staff's evaluation of the applicant's Supplemental Piping/Tank Inspection Program is documented in SER Section 3.0.3.1.29. The staff noted that the applicant's Supplemental Piping/Tank Inspection Program is a new One-Time Inspection Program that will detect and characterize the material condition of stainless steel components exposed to moist air environments, particularly the aggressive alternate wet and dry environment that exists at air-water interfaces, using a combination of established visual and volumetric examination techniques that are consistent with GALL Report AMP XI.M32, "One-Time Inspection." The staff finds the applicant's proposal to manage loss of material at the air-water interface of the stainless steel still well piping and tubing in the level sensing lines for the condensate tanks exposed to moist air using the Supplemental Piping/Tank Inspection Program acceptable for the following reasons:

- The program includes inspections of the internal surfaces of components, which can identify loss of material.
- The one-time inspection is being performed to confirm aging is not occurring at the air-water interface.
- Other AMPs are being used to manage aging above and below the air-water interface.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.3.2-16 and 3.3.2-20, the applicant stated that for elastomer flexible connections exposed to air-indoor uncontrolled (internal and external), there is no aging effect, and no AMP is proposed. The applicant stated:

> During normal plant operations, elastomer components in the Diesel (Engine) Exhaust System and the Diesel Lubricating Oil System are not exposed to high temperatures, radiation or ozone; therefore, no aging effects were identified as requiring management for the air-indoor uncontrolled environment."

The staff noted that, based on review of technical literature (e.g., Roff, W.J., *Fibres, Plastics, and Rubbers: A Handbook of Common Polymers*, Academic Press Inc., New York, 1956) and current industry research and operating experience related to elastomers, in the absence of specific environmental stressors such as UV light, high radiation, or ozone concentrations, components made of these materials do not exhibit aging effects of concern during the period of extended operation. The staff reviewed the associated line item(s) in the LRA and could not confirm that no aging effect is applicable for this component, material, and environmental combination because the applicant did not state if the components are exposed to UV light or high temperature. By letter dated October 20, 2010, the staff issued RAI 3.3.2-1 requesting that the applicant justify why the polymeric components are not exposed to high temperature or UV light levels specific to its locations that would lead to aging effects during the period of extended operation.

In its response dated January 20, 2011, the applicant stated that the flexible connections in LRA Table 3.3.2-16 are constructed of neoprene, and those in LRA Table 3.3.2-20 are constructed of either Buna-N or fluoroelastomer rubber. It also stated that these elastomeric materials are not susceptible to aging due to UV light. The applicant further stated that the flexible connectors are located in the diesel generator building which has a highest normal operating temperature of 95 °F.

The staff noted that the Elder Rubber Company website contains a file, http://www.elderrubber.com/material.htm, which discusses environmental impacts on neoprene and states that it has good resistance to UV light and has a temperature range of negative 40 °F to 250 °F. The staff also noted that the Atlantic Gasket Corporation website, http://www.atlanticgasket.com/materials/nitrile-buna-n-gasket-material.html, states that Buna-N® (i.e., nitrile) has excellent UV resistance and a temperature range of negative 40 °F to 200 °F. The staff further noted that DuPont Elastomer data sheet, available through Knovel, states that Viton® (fluoroelastomer rubber) has exceptional good resistance to atmospheric oxidation, sun, and weather and a temperature range of negative 18 °C to 204 °C (negative 0.4 °F to 399 °F).

The staff finds the applicant's response and proposal acceptable because, based on industry data, each of the materials used in construction of these components has good UV resistance, and its maximum temperature range exceeds that of the diesel generator building, which has a highest normal operating temperature of 95 °F. The staff's concern described in RAI 3.3.2-1 is resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for copper alloy and copper alloy (greater than 15 percent zinc) components exposed to air (internal) or air-indoor uncontrolled (internal and external) that have no proposed aging effect and no AMP proposed with a Generic Note G is documented in SER Section 3.3.2.3.4.

3.3.2.3.17 Auxiliary Systems—Diesel Engine Starting Air System—Summary of Aging Management Evaluation—LRA Table 3.3.2-17

In LRA Tables 3.3.2-12 and 3.3.2-17, the applicant stated that the aluminum alloy pump casing (chiller high speed and low speed lubricating oil pump) and oil fog lubricators exposed to internal lubricating oil are being managed for loss of material by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environment combination because, based on the GALL Report, pitting, crevice corrosion, and MIC may occur when aluminum is exposed to fuel oil (an equivalent environment to lubricating oil).

The staff's evaluations of the applicant's Inspection of Lubricating Oil Analysis and Lubricating Oil Inspection Programs are documented in SER Sections 3.0.3.2.13 and 3.0.3.1.22, respectively. The staff finds that the applicant's proposal to manage aging using the Lubricating Oil Analysis and Lubricating Oil Inspection Program acceptable because the Lubricating Oil Analysis Program will maintain the quality of the oil environment to ensure that lubricating oil contaminates are within acceptable limits, and the Lubricating Oil Inspection Program will include a one-time visual inspection to determine the effectiveness of the Lubricating Oil Analysis Program.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.3.2-12, 3.3.2-17, and 3.4.2-4, the applicant stated that for aluminum alloy pump casing (chiller high speed and low speed lubricating oil pump), heat exchanger components, oil fog lubricators, manifold, and valve bodies exposed to internal air or external uncontrolled indoor air, there is no aging effect, and no AMP is proposed. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because, based on the GALL Report where the material is aluminum and the aging effect/mechanism is loss of material, there are no entries for these components and materials exposed to internal air or external uncontrolled indoor air.

The staff noted that, even though the GALL Report recommends no AERMs for aluminum alloy pump casing (chiller high speed and low speed lubricating oil pump), heat exchanger components, oil fog lubricators, manifold, and valve bodies in an internal air or external uncontrolled indoor air environment, the GALL Report, under Item VII.J-2 (AP-37), indicates that aluminum piping exposed to gas does not list an AERM or AMP. The staff finds that the applicant's proposal acceptable because no aging effect is expected to occur for aluminum in gas.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-17, the applicant stated that steel piping and valve bodies exposed to air (internal) are being managed for loss of material by the Air Quality Sampling Program. The AMR line item cites Generic Note G. Line items associated with piping and valve bodies in LRA Table 3.3.2-17 also cite plant-specific Note 0314, which states that The Diesel Starting Air Inspection Program is not credited for piping and piping components that are located upstream from the air receiver tanks.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because the GALL Report states in Items V-D2-1, V.D2-2, and numerous other places, that steel components exposed to air-indoor uncontrolled are subject to loss of material due to general corrosion.

The staff's evaluation of the applicant's Air Quality Sampling Program is documented in SER Section 3.0.3.3.1. The staff noted that the applicant's Air Quality Sampling Program is a plant-specific program that mitigates degradation due to loss of material for carbon steel components in the diesel starting air system that contain compressed air. The staff noted that this program also ensures that the CAS remains dry and free of contaminants. The staff further notes that the Air Quality Sampling Program was developed in response to NRC GL 88-14 and comprises periodic air quality sampling and corresponding actions to remove moisture and particulates from the air systems as well as periodic visual and ultrasonic inspections of diesel starting air system air receivers to ensure the pressure boundary integrity is maintained. The staff finds the applicant's proposal to manage aging using the Air Quality Sampling Program acceptable for the following reasons:

- It monitors air quality to ensure it remains dry and free of contaminants with failures to meet air quality requirements resulting in actions to restore the out of specification value to meeting the requirements.
- Ultrasonic thickness measurements of the air receivers are conducted on a biennial basis, and the results are trended.
- The trending of air receiver wall thickness is an effective indicator of overall corrosion in the system because the tanks are a stagnant-flow location for the majority of its service life.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-17, the applicant stated that steel filter bodies, piping, strainer bodies, tanks, and valve bodies exposed to air (internal) are being managed for loss of material by the Air Quality Sampling and Diesel Starting Air Inspection Programs. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because the GALL Report states, in Items V-D2-1, V.D2-2 and numerous other places, that steel components exposed to air-indoor uncontrolled are subject to loss of material due to general corrosion.

The staff's evaluations of the applicant's Air Quality Sampling and Diesel Starting Air Inspection Programs are documented in SER Sections 3.0.3.3.1 and 3.0.3.1.11, respectively. The staff noted that the applicant's Air Quality Sampling Program is a plant-specific program that mitigates degradation due to loss of material for carbon steel components in the diesel starting air system that contain compressed air and are within the scope of license renewal, and it ensures that the CAS remains dry and free of contaminants. The staff also noted that the Air Quality Sampling Program was developed in response to NRC GL 88-14 and comprises periodic air quality sampling and corresponding actions to remove moisture and particulates from the air systems as well as periodic visual and ultrasonic inspections of diesel starting air system air receivers to ensure the pressure boundary integrity is maintained. The staff further noted that the applicant's Diesel Starting Air Inspection Program is a new one-time inspection that will detect and characterize the material condition of the air dryers and downstream stainless steel and steel piping and components in the diesel starting air system (excluding the air receivers) using visual and volumetric inspection techniques to detect loss of material due to corrosion, which are consistent with GALL Section XI.M32, "One-Time Inspection."

The staff finds the applicant's proposal to manage aging using the Air Quality Sampling and Diesel Starting Air Inspection Programs acceptable because the Air Quality Sampling Program monitors air quality to ensure it remains dry and free of contaminants with failures to meet air quality requirements resulting in actions to restore the out of specification value to meeting the requirements. Additionally, ultrasonic thickness measurements of the air receivers are conducted on a biennial basis and the results are trended, the trending of air receiver wall thickness is an effective indicator of overall corrosion in the system because the tanks are a stagnant-flow location for the majority of its service life. Further, the Diesel Starting Air Inspection Program conducts internal visual inspections for general corrosion or wall thickness measurements of a representative sample of the diesel starting air system dryers and downstream. Given the inspections and air quality monitoring conducted by the Air Quality Sampling Program, the staff finds the use of a one-time inspection, to verify that general corrosion is not occurring in other portions of the system constructed of similar materials in a similar environment, acceptable.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.3.2-17 and 3.3.2-41, the applicant stated that, for stainless steel filter bodies, flexible connections, piping, strainer screens, tubing, and valve bodies exposed to air (internal), there is no aging effect, and no AMP is proposed. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and was not able to confirm that the applicant identified the correct aging effects for this component, material, and environmental combination because LRA Table 3.0-1 states that air can "process air in locations where condensation, water pooling, or accumulation of contaminants could occur (moisture content is enough to facilitate crevice and pitting corrosion in various metals, as well as general corrosion of steel)." The GALL Report states that, for stainless steel components exposed to condensation, a plant-specific AMP is to be evaluated to address pitting and crevice corrosion. By letter dated October 20, 2010, the staff issued RAI 3.3.2.3.17-2 requesting that the applicant justify that the air environment for these components does not contain moisture or specify an AMP to manage the aging effect.

In its response dated January 27, 2011, the applicant stated that the subject components in LRA Table 3.3.2-17 are not exposed to condensation, water pooling, or an accumulation of contaminants because it is in the diesel starting air system, which is configured such that any moisture in the air system will collect in the air receivers, as supported by site operating experience, and moisture is removed from the air receivers once per shift. The applicant also stated that the subject components in LRA Table 3.3.2-41 are exposed to compressed air from the service air system, which is expected to be dry and free of contaminants but may contain some amount of moisture due to operational considerations such as occasional use of compressors without dryers. The applicant also stated that the subject components are normally isolated and are not in a location where moisture is expected to condense or collect; therefore, there are no AERMs for these components. The applicant revised LRA Table 3.0-1 to remove the sentence that stated that condensation, water pooling, or accumulation of contaminants could occur in air because the applicant used an internal environment of raw water when condensation, water pooling, or accumulation of contaminants could occur.

The staff finds the applicant's response acceptable because the GALL Report states that stainless steel components exposed to indoor air are not expected to experience aging effects, and the subject components are exposed to diesel starting air or service air, which is expected to be dry and free of contaminants due to the configuration of the air systems and, therefore, is similar to indoor air. The staff's concern described in RAI 3.3.2.3.17-2 is resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.18 Auxiliary Systems—Diesel Fuel Oil System—Summary of Aging Management Evaluation—LRA Table 3.3.2-18

In LRA Tables 3.3.2-18 and 3.3.2-22, the applicant stated that, for aluminum alloy flame arrestor exposed to air-outdoor (internal and external), there is no aging effect, and no AMP is proposed. The LRA line items cite Generic Note G.

The staff reviewed all AMR result line items in the GALL Report where the material is aluminum alloy and the aging effect is loss of material due to pitting and crevice corrosion in outdoor air. The staff noted that the GALL Report, under Items III.B2-7 and III.B4-7, identifies loss of material due to pitting and crevice corrosion as an applicable aging effect for aluminum support members exposed to air-outdoor and recommends GALL Report AMP XI.S6, "Structures Monitoring Program," to manage the effects of aging. The staff also noted that loss of material due to pitting and crevice corrosion is also identified in the GALL Report, under Item VII.G-8, as an applicable aging effect for aluminum piping, piping components, and piping elements exposed to raw water, and recommends GALL Report AMP XI.M26, "Fire Protection," to manage the effects of aging.

By letter dated August 3, 2010, the staff issued RAI 3.3.2.3-02, requesting that the applicant justify why loss of material due to pitting and crevice corrosion is not an AERM during the extended period of operation for aluminum alloy flame arrestors exposed to air-outdoor (internal and external) or provide an AMP to mange this aging effect.

In its response dated September 27, 2010, the applicant stated that the outdoor environment at Columbia does not provide the elements that support loss of material due to pitting and crevice corrosion and that it has no plant-specific operating experience counter to that assumption. The applicant also stated that EPRI TR-1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4," states that loss of material is only a concern for aluminum in wetted outdoor environments and when salt, sulfur dioxide, and acid rain are present. The applicant further stated that, as discussed in LRA Section 3.5.2.2.2, the site does not have an aggressive outdoor environment and receives less than 7 in. of rainfall per year. The staff noted that LRA Section 3.5.2.2.2 states that the pH of local rainwater is 5.4, which is close to the normal pH for rainwater and only mildly acidic. The staff also noted that, according to "Weather Underground" (www.wunderground.com), the station is located in an area with low average yearly rainfall (less than 7 in.), humidity (less than 60 percent), and dew point (less than 45 °F); therefore, aging effects due to condensation in the outdoor environment are minimized. The staff further noted that, according to "Corrosion of Aluminum" (Christian Vargal, 2004), aluminum alloy components do not experience significant corrosion in environments with less than 66 percent relative humidity (RH) without the presence of contaminants because of the formation of a protective oxide layer on the outer surface.

The staff finds the applicant's response acceptable because the outdoor environment at the station does not contain aggressive contaminants, the station experiences low average yearly rainfall, humidity, and dew point, and aluminum is resistant to atmospheric corrosion due to its protective oxide layer. The staff's concern described in RAI 3.3.2.3-2 is resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff determines the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.3.2-18 and 3.3.2-22, the applicant stated that gray cast iron filter bodies, strainer bodies and pump casings exposed to fuel oil (internal) are being managed for loss of material by the Selective Leaching Inspection Program. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environment combination because the GALL Report, Section XI.F, states that grey cast iron is susceptible to selective leaching and loss of material, and loss of material is being managed for these components in other line items in the same tables.

The staff's evaluation of the applicant's Selective Leaching Inspection Program is documented in SER Section 3.0.3.1.26. The staff noted that the Selective Leaching Program is a new program that is designed to detect and characterize the conditions on the internal and external surfaces of components that are exposed to raw water, treated water, fuel oil, soil, and moist air (including condensation) environments. The staff also noted that this One-Time Inspection Program includes a combination of visual examination and material hardness testing, or NRC-approved alternative, and it provides direct evidence of whether, and to what extent, loss of material due to selective leaching has occurred or is likely to occur that could result in a loss of intended function. The staff finds the applicant's proposal acceptable because the program includes visual examinations and hardness testing, which are appropriate methods for determining whether loss of material due to selective leaching is occurring.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-18, the applicant stated that, for stainless steel pump casings exposed to air-outdoor (external), there is no aging effect, and no AMP is proposed. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and cannot confirm that the applicant identified the correct aging effects for this component, material, and environmental combination, as discussed in the RAI below. The staff noted that the GALL Report does not address stainless steel components in an outdoor air environment; however, given the station's proximity to arid land, agriculture, and cooling tower vapor, trace compounds (e.g., chlorides) could be contained within the outside air supply to these components. By letter dated October 14, 2010, the staff issued RAI 3.3.2.3.16-1 requesting that the applicant justify why the outside air environment does not contain trace compounds that could cause loss of material in stainless steel components.

In its response dated January 18, 2010, the applicant stated that, while the components may be exposed to small amounts of contaminants in the air, the components are normally drained such that it is not subject to a wetted environment; therefore, the aging effects are not applicable. The staff reviewed the applicant's response and noted that maintaining components in a normally drained state does not preclude condensation and, therefore, does not preclude the potential for aging. In a conference call held January 24, 2011, the staff requested that the applicant supplement its response to RAI 3.3.2.3.16-1 to justify why the components exposed to outdoor-air are not subject to condensation-related aging effects. In its supplemental response dated April 21, 2011, the applicant stated that the stainless steel pump casings exposed to outdoor-air are located inside storage tanks above the air-oil interface. The applicant also stated that the outdoor air environment is a result of the storage tank being vented to atmosphere, but the tank is vented through a flame arrestor, which prevents the free flow of outdoor air into the tank. The applicant further stated that the inlet to the flame arrestor is pointed downward and has a weather hood, therefore minimizing the introduction of contaminants into the storage tank. The staff finds the applicant's response, and its conclusion that the pumps casings exposed externally to outdoor air have no AERM, acceptable because the air in the storage tank is not frequently exchanged, the pump casings are not exposed to weather that would contain moisture, and any moisture that enters the tank would be identified by the Fuel Oil Chemistry Program, which is managing aging for the portion of the pump casing exposed to fuel oil. The staff's concern described in RAI 3.3.2.3.16-1 is resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for steel and stainless steel bolting exposed to condensation (external), air-outdoor (external), or treated water (external) that are being managed for cracking, and loss of pre-load or material, by the Bolting Integrity Program, proposed with a Generic Note H, is documented in SER Section 3.3.2.3.12.

In LRA Table 3.3.2-18, the applicant stated that the copper alloy (greater than 15 percent zinc) strainer screen exposed to fuel oil (external) are being managed for loss of material by the Selective Leaching Inspection Program. The AMR line items cite Generic Note G, indicating that, for these line items, the environment is not in the GALL Report for these components and materials.

The staff reviewed all AMR result line items in the GALL Report where the material is copper and the aging effect and mechanism is loss of material and confirmed that for this environment, there is an entry, Item VII.H1-3, in the GALL Report for these components and materials. The applicant also included the Fuel Oil Chemistry Program and the Chemistry Effectiveness Inspection to manage for loss of material. Consistent with the recommendations in the GALL Report, the Fuel Oil Chemistry Program includes periodic monitoring of the fuel oil for contaminants for the purpose of mitigating the effects of aging. The Chemistry Program Effectiveness Inspection includes a one-time inspection to detect and characterize the material conditions in representative low-flow and stagnant areas.

The staff reviewed the applicant's Selective Leaching Inspection Program, Fuel Oil Chemistry Program, and Chemistry Effectiveness Inspection and its evaluation are documented in SER Sections 3.0.3.1.26, 3.0.3.2.12, and 3.0.3.1.8, respectively. The staff reviewed Table IX.C of the GALL Report that states that copper alloys (greater than 15 percent zinc) are susceptible to aging effects, such as SCC, selective leaching, pitting, and crevice corrosion. The applicant addressed the issues of cracking and reduction in heat transfer aging effect in other line items in this table. The staff finds that the applicant's proposal to manage aging using the Selective Leaching Inspection Program is acceptable because the program uses visual inspections as well as testing of fuel oil chemistry in order to detect aging effects that could result in a loss of component intended function due to loss of material.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-18, the applicant stated that the copper alloy (greater than 15 percent zinc) strainer exposed to fuel oil (external) are being managed for cracking due to SCC by the Chemistry Program Effectiveness Inspection and Fuel Oil Chemistry Programs. The AMR line item cites Generic Note H, indicating that, for this line item, the aging effect is not in the GALL Report for this component, material, and environment combinations.

The staff reviewed all AMR result line items in the GALL Report where the components and materials are copper alloy strainer exposed to fuel oil (external) and confirmed that there are no aging effect entries in the GALL Report for these component, material, and environment combinations.

The staff reviewed the applicant's Chemistry Program Effectiveness Inspection and Fuel Oil Chemistry Programs, and its evaluations are documented in SER Sections 3.0.3.1.8 and 3.0.3.2.12, respectively. The staff reviewed Table IX.C of the GALL Report that states that copper alloys (greater than 15 percent zinc) are susceptible to aging effects, such as SCC, selective leaching, pitting, and crevice corrosion. The applicant addressed the loss of material in another line item in the applicant LRA. Thus, the applicant's use of the cracking aging effect is appropriate. The staff finds that the applicant's proposal to manage aging using the Chemistry Program Effectiveness Inspection is acceptable because the program uses a one-time visual inspection, volumetric analysis, and surface inspection techniques to determine the effect of aging. The Fuel Oil Chemistry Program monitors and controls fuel oil contamination by periodic sampling of the fluid chemistry in order to detect aging effects that could result in a loss of component intended function.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these

components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.19 Auxiliary Systems—Diesel Generator System—Summary of Aging Management Evaluation—LRA Table 3.3.2-19

In LRA Table 3.3.2-19, the applicant stated that, for copper sight glass exposed to air-indoor uncontrolled (internal and external), there is no aging effect and no AMP proposed. The AMR line item cites Generic Note G, indicating that, for this line item, the environment is evaluated in the GALL Report for the component and material.

The staff reviewed all AMR result line items in the GALL Report where the component and material is copper and confirmed that there are no entries in the GALL Report for these components and materials where there is no aging effect exposed to this environment.

The staff reviewed Table IX.C of the GALL Report that states that copper alloys (less than 15 percent zinc) are generally resistant to other aging effects, such as SCC, selective leaching, pitting, and crevice corrosion. The environments of interest, air-indoor uncontrolled (internal and external), would not induce SCC in copper alloys (greater than 15 percent zinc) and would not result in loss of material due to pitting, crevice, or selective leaching. The staff finds the applicant's proposal acceptable because no aging effect is expected for copper alloy exposed to air-indoor uncontrolled (internal and external).

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.20 Auxiliary Systems—Diesel Lubricating Oil System—Summary of Aging Management Evaluation—LRA Table 3.3.2-20

In LRA Tables 3.3.2-20 and 3.3.2-22, the applicant stated that, for elastomer flexible connections exposed to lubricating oil (internal) and fuel oil (internal) in the diesel lubricating oil and the fire protection systems, there is no aging effect, and no AMP is proposed. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and could not confirm that no aging effect is applicable for this component, material, and environmental combination. The staff noted that the resistance of natural rubber to lubricating oil and fuel oil is poor (P.A. Schweitzer, *Corrosion Resistance Tables—Metals, Nonmetals, Coatings, Mortars, Plastics, Elastomers and Linings, and Fabrics*, Fifth Edition, Marcel Dekker, 2004). The staff does not have sufficient information to determine that there is no aging effect for this material and environment combination. By letter dated July 15, 2010, the staff issued RAI 3.3.2.3-1 requesting that the applicant provide additional information (e.g., elastomer material type) that would demonstrate that the plant-specific applications for the elastomer and fuel or lubrication oil environment does not have an AERM during the extended period of operation or provide an AMP to manage any applicable aging effect.

In its response dated September 13, 2010, the applicant stated that flexible connections in the lubricating oil system are made of either Buna-N or fluoroelastomer rubber and steel, and the flexible connections in the fire protection system are made of Viton, a fluorpolymer elastomer.

The applicant also stated that these synthetic elastomers have a good resistance to lubricating oil and fuel oil based on industry literatures.

The staff finds the applicant's response to RAI 3.3.2.3-1 acceptable because the applicant clarified that the flexible connections in the lubrication oil and fire protection systems are made of synthetic elastomers that have good resistance to lubrication oil and fuel oil. An independent check of the *O-Ring Design and Material Guide* (RL Hudson and Company), confirmed that Buna-N, fluoroelastomer rubber, and Viton products have good resistance to fuel and oil products. The staff's concern described in RAI 3.3.2.3-1 is resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for elastomeric flexible connections exposed to air-indoor uncontrolled (internal and external) with Generic Note I is documented in 3.3.2.3.16.

The staff's evaluation for copper alloy and copper alloy (greater than 15 percent zinc) components exposed to air (internal) or air-indoor uncontrolled (internal and external) that have no proposed aging effect and no AMP proposed with a Generic Note G is documented in SER Section 3.3.2.3.4.

The staff's evaluation for copper alloy heat exchanger tubes exposed to lubricating oil (external) that are being managed for reduction in heat transfer by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs with a Generic Note H is documented in SER Section 3.3.2.3.15.

3.3.2.3.21 Auxiliary Systems—Equipment Drains Radioactive Systems—Summary of Aging Management Evaluation—LRA Table 3.3.2-21

The staff reviewed LRA Table 3.3.2-21, which summarizes the results of AMR evaluations for the EDR systems component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.22 Auxiliary Systems—Fire Protection System—Summary of Aging Management Evaluation—LRA Table 3.3.2-22

In LRA Tables 3.3.2-22 and 3.3.2-32, the applicant stated that for polymer piping exposed to raw water (internal) there is no aging effect and no AMP is proposed. The AMR line items cite Generic Note F.

The staff reviewed the associated line items in the LRA and confirmed that no aging effect is applicable for this component, material and environmental combination because polymers are resistant to raw water (P.A. Schweitzer, "Corrosion Resistance Tables—Metals, Nonmetals, Coatings, Mortars, Plastics, Elastomers and Linings, and Fabrics," Fifth Edition, Part A, Marcel Dekker, 2004), therefore the staff finds the applicant's proposal acceptable.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-22, the applicant stated that for polymer piping exposed to soil (external) there is no aging effect and no AMP is proposed. The AMR line item cites Generic Note F.

The staff reviewed the associated line items in the LRA and could not confirm that no aging effect is applicable for this component, material and environmental combination. The staff noted that the applicant stated that the below-ground water environment is non-aggressive (i.e., pH >6.9, chlorides < 36 ppm, and sulfate < 323 ppm) and its Structuring Monitoring Program will continue to review the site groundwater chemistry to validate that the below-ground environment remaining non-aggressive during the period of extended operation.

The staff noted that polymer pipe exposed to soil can be damaged if the backfill contains large or sharp rocks due to migration of the objects to the outside wall of the pipe caused by normal ground movement, resulting in wear of the external surface of the pipe. By letter dated October 20, 2010, the staff issued RAI 3.3.2-2 requesting that the applicant provide data on the quality of the backfill in the vicinity of buried polymer pipe that would support that aging will not occur due to large or sharp material contained in the backfill.

In its response dated January 20, 2011, the applicant stated that backfill specifications require that the bedding around buried piping be free of trash, roots, organic, frozen or other unsuitable materials, and the maximum sized material is 3/8 in. The applicant also stated in its January 28, 2011, reply to RAI B.2.5-2 that it will conduct four inspections of buried piping not containing hazardous material, including polymeric buried pipe, and two percent of buried piping containing hazardous materials every ten years starting ten years prior to the period of extended operation.

The staff finds the applicant's response acceptable because it has specifications that restrict the type and size of material that can be used in buried pipe bedding material such that damage to coatings or uncoated pipe would not be expected, and confirmatory excavated buried piping inspections will be conducted as part of the Buried Piping and Tanks Inspection Program. The staff's concern described in RAI 3.3.2-2 is resolved.

In Amendment 25 to the LRA, dated January 28, 2011, the applicant cited plant-specific Note 0330 which states, "No applicable aging effects have been identified for concrete or polymer piping exposed to soil. However, the Buried Piping and Tanks Inspection Program is credited with confirming the absence of significant aging effects during the period of extended operation." The staff noted that the applicant did not revise LRA Table 3.3.2-22 to include any aging effects requirement management for this item but did credit the Buried Piping and Tanks Inspection Program for this item. The staff does not agree with plant-specific Note 0330 in that concrete and some polymeric materials are susceptible to aging effects when buried in soil; however, in Commitment No. 5, the applicant clarified that the polymeric material is PVC piping. The staff also noted that GALL Item SP-153 states that there are no recommended aging effects or AMP for PVC exposed to condensation. The staff further noted the condensation and buried soil environments are similar enough in quantity of moisture exposure to the piping. The staff finds the applicant's proposal to use the Buried Piping and Tanks Inspection Program acceptable because the soil environment is non-aggressive, the moisture content of the soil will not degrade the PVC piping, and backfill quality is sufficient to not damage the piping, and the applicant proposes to perform one of polymeric material every ten years starting ten years prior to the period of extended operation.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for elastomer flexible connection exposed to lubricating oil (internal) and fuel oil (internal) in the diesel lubricating oil and the fire protection systems with Generic Note G is documented in 3.3.2.3.20.

In LRA Tables 3.3.2-18 and 3.3.2-22, the applicant stated that, for aluminum alloy flame arrestor exposed to air-outdoor (internal and external), there is no aging effect, and no AMP is proposed. The LRA line items cite Generic Note G.

The staff reviewed all AMR result line items in the GALL Report where the material is aluminum alloy and the aging effect is loss of material due to pitting and crevice corrosion in outdoor air. The staff noted that the GALL Report, under Items III.B2-7 and III.B4-7, identifies loss of material due to pitting and crevice corrosion as an applicable aging effect for aluminum support members exposed to air-outdoor and recommends GALL Report AMP XI.S6, "Structures Monitoring Program," to manage the effects of aging. The staff also noted that loss of material due to pitting and crevice corrosion is also identified in the GALL Report, under Item VII.G-8, as an applicable aging effect for aluminum piping, piping components, and piping elements exposed to raw water, and recommends GALL Report AMP XI.M26, "Fire Protection," to manage the effects of aging. By letter dated August 3, 2010, the staff issued RAI 3.3.2.3-02, requesting that the applicant justify why loss of material due to pitting and crevice corrosion is not an AERM during the extended period of operation for aluminum alloy flame arrestors exposed to air-outdoor (internal and external) or provide an AMP to mange this aging effect.

In its response dated September 27, 2010, the applicant stated that the outdoor environment at Columbia does not provide the elements that support loss of material due to pitting and crevice corrosion, and it has no plant-specific operating experience counter to that assumption. The applicant also stated that EPRI TR-1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools Revision 4," states that loss of material is only a concern for aluminum in wetted outdoor environments and when salt, sulfur dioxide, and acid rain are present. The applicant further stated that, as discussed in LRA Section 3.5.2.2.2, the site does not have an aggressive outdoor environment and receives less than 7 in. of rainfall per year. The staff noted that LRA Section 3.5.2.2.2 states that the pH of local rainwater is 5.4, which is close to the normal pH for rainwater and only mildly acidic. The staff also noted that, according to "Weather Underground" (www.wunderground.com), the station is located in an area with low average yearly rainfall (less than 7 in.), humidity (less than 60 percent), and dew point (less than 45 °F); therefore, aging effects due to condensation in the outdoor environment are minimized. The staff further noted that, according to "Corrosion of Aluminum" (Christian Vargal, 2004), aluminum alloy components do not experience significant corrosion in environments with less than 66 percent relative humidity without the presence of contaminants because of the formation of a protective oxide layer on the outer surface.

The staff finds the applicant's response acceptable because the outdoor environment at the station does not contain aggressive contaminants, the station experiences low average yearly rainfall, humidity, and dew point, and aluminum is resistant to atmospheric corrosion due to its protective oxide layer. The staff's concern described in RAI 3.3.2.3-2 is resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff determines the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.3.2-18 and 3.3.2-22, the applicant stated that gray cast iron filter bodies, strainer bodies and pump casings exposed to fuel oil (internal) are being managed for loss of material by the Selective Leaching Inspection Program. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environment combination because the GALL Report, Section XI.F, states that grey cast iron is susceptible to selective leaching and loss of material, and loss of material is being managed for these components in other line items in the same tables.

The staff's evaluation of the applicant's Selective Leaching Inspection Program is documented in SER Section 3.0.3.1.26. The staff noted that the Selective Leaching Program is a new program that is designed to detect and characterize the conditions on the internal and external surfaces of components that are exposed to raw water, treated water, fuel oil, soil, and moist air (including condensation) environments. The staff also noted that this One-Time Inspection Program includes a combination of visual examination and material hardness testing, or NRC-approved alternative. It also provides direct evidence of whether, and to what extent, loss of material due to selective leaching has occurred or is likely to occur that could result in a loss of intended function. The staff finds the applicant's proposal acceptable because the program includes visual examinations and hardness testing, which are appropriate methods for determining whether loss of material due to selective leaching is occurring.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for steel and stainless steel heat exchanger tubes exposed to lubricating oil (internal), which are being managed for reduction in heat transfer by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs and cite Generic Note H, is documented in SER Section 3.3.2.3.12.

In LRA Table 3.3.2-22, the applicant stated that, for elastomeric flexible connections exposed to raw water, there is no aging effect, and no AMP is proposed. The AMR line item cites Generic Note I.

The staff reviewed all AMR result line items in the GALL Report where the component and material is flexible connections made of elastomer and identified Item VII.C1-1, which indicates that elastomer components exposed to raw water can undergo hardening and loss of strength.

It is not clear to the staff why the applicant states that flexible elastomer connections do not have any aging effects. By letter dated August 26, 2010, the staff issued RAI 3.3.2.1-Y1 requesting that the applicant provide technical justification substantiating the claim that hardening and loss of strength is not an applicable aging effect for the elastomeric flexible connections exposed to raw water.

In its response dated November 23, 2010, the applicant stated that specific elastomer flexible connections are in the piping between FP-P-1 and FP-ENG-1 and are constructed of Viton. The applicant stated that the piping, which contains the flexible connections, provides cooling water flow to the diesel-driven FP-P-1 gearbox. The applicant stated that the primary fire protection water supply is drawn from the circulating water basin by three fire pumps, including the diesel driven pump (FP-P-1). The applicant stated that the FP-P-1 pump is operated during surveillance testing, which is performed every 30 days for a minimum of 30 minutes, and the diesel-driven fire pump is not normally in continuous operation. The applicant stated that loss of material due to erosion is not an applicable aging effect because of the minimal continuous operation of the diesel-driven fire pump.

The applicant also stated that the flexible connections are not susceptible to hardening or loss of strength because the conditions do not exist for this aging effect in the raw fire water. The applicant stated that the elastomers in the fire protection system were subject to evaluation of the aging effects of change in material properties and cracking due to ionizing radiation, thermal exposure, and UV radiation and ozone. The applicant stated that these aging effects do not exist in the raw water environment. The applicant stated that ionizing radiation is applicable when radiation exceeds 10^6 rads total integrated dose, which would not occur in the circulating water pumphouse. The applicant also stated that thermal exposure can lead to changes in elastomer properties when the temperature exceeds 35 °C (95 °F); however, the applicant further stated that the normal operating temperature in the fire protection system is 29 °C (85 °F). Finally, the applicant stated that UV radiation or ozone are only applicable to materials made of natural rubber and not applicable to fluroelastomers such as Viton. The staff finds the applicant's response acceptable because loss of material due to erosion would not occur because of the low-flow rates, and the flexible connection material and environmental conditions would not lead to hardening or loss of strength. The staff's concern described in RAI 3.3.2.1-Y1 is resolved.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for copper alloy and copper alloy (greater than 15 percent zinc) components exposed to air (internal) or air-indoor uncontrolled (internal and external) that have no proposed aging effect and no AMP proposed with a Generic Note G is documented in SER Section 3.3.2.3.4.

The staff's evaluation for copper alloy heat exchanger tubes exposed to lubricating oil (external) that are being managed for reduction in heat transfer by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs with a Generic Note H is documented in SER Section 3.3.2.3.15.

The staff's evaluation for steel and stainless steel bolting exposed to condensation (external), air-outdoor (external), or treated water (external) that are being managed for cracking, and loss of pre-load or material, by the Bolting Integrity Program, proposed with a Generic Note H, is documented in SER Section 3.3.2.3.12.

In LRA Tables 3.3.2-22 and 3.3.2-32, the applicant stated that the copper alloy (greater than 15 percent zinc) heat exchanger shell, spray nozzle, strainer, and valve bodies exposed to raw water (internal) are being managed for cracking due to SCC by the Diesel Driven Fire Pumps Inspection, Fire Water, and Open-Cycle Cooling Water Programs. The AMR line item cites Generic Note H, indicating that, for these line items, the aging effect is not in the GALL Report for these component, material, and environment combinations.

The staff reviewed all AMR result line items in the GALL Report where the components and materials are copper alloy components exposed to raw water (internal) and confirmed that there are no aging effect entries in the GALL Report for these component, material, and environment combinations. Also, in its response to RAI B.2.42-1, dated September 24, 2010, and discussed further in SER Section 3.0.3.2.17, the applicant stated that Amendment 1 to the LRA, dated July 16, 2010, removed cracking of aluminum and copper alloy components as an aging effect being managed by the Open-Cycle Cooling Water Program. The applicant stated that the associated copper alloy components will now be managed for cracking by the Monitoring and Collection Systems Inspection Program instead of the Open-Cycle Cooling Water Program. The staff finds the response acceptable because, with the changes provided by the applicant, the scope of the Open-Cycle Cooling Water Program is consistent with the "scope of program" program element in GALL Report AMP XI.M20. The staff's concern described in RAI B.2.42-1 is resolved.

The staff reviewed the applicant's Diesel Driven Fire Pumps Inspection, Fire Water, and Monitoring and Collection Systems Inspection Program, and its evaluations are documented in SER Sections 3.0.3.3.4, 3.0.3.2.9 and 3.0.3.3.8, respectively. The staff reviewed Table IX.C of the GALL Report that states that copper alloys (greater than 15 percent zinc) are susceptible to aging effects, such as SCC, selective leaching, pitting, and crevice corrosion. The applicant addressed the loss of material in another line item in the applicant LRA. Thus, the applicant's use of the cracking aging effect is appropriate.

The staff finds that the applicant's proposal to manage aging using the Diesel Driven Fire Pumps Inspection program is acceptable because the program uses a opportunistic visual inspection, wall thickness, and NDE inspection techniques to determine the effect of aging. The Fire Water Program performs periodic inspection and testing of water based fire suppression systems in order to detect aging effects. The Monitoring and Collection Systems Inspection Program uses NDE techniques including visual or enhanced visual, surface, and volumetric techniques to detect aging effects that could result in a loss of component intended function.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.23 Auxiliary Systems—Floor Drains System—Summary of Aging Management Evaluation—LRA Table 3.3.2-23

The staff reviewed LRA Table 3.3.2-23, which summarizes the results of AMR evaluations for the floor drains system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.24 Auxiliary Systems—Floor Drains Radioactive System—Summary of Aging Management Evaluation—LRA Table 3.3.2-24

The staff reviewed LRA Table 3.3.2-24, which summarizes the results of AMR evaluations for the floor drains radioactive system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.25 Auxiliary Systems—Fuel Pool Cooling System—Summary of Aging Management Evaluation—LRA Table 3.3.2-25

In LRA Table 3.3.2-25, the applicant stated that the stainless steel piping (fuel pool cooling spent fuel pool return lines) exposed to uncontrolled indoor air (external) is being managed for loss of material by the Supplemental Piping/Tank Inspection Program. This AMR line item cites Generic Note H and plant-specific Note 0320, which states that the subject component has an air-water interface that constitutes an aggressive environment.

The reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environment combination because the GALL Report recommends that stainless steel piping exposed to air has no AERMs, even if the air contains water leakage.

The staff's evaluation of the applicant's Supplemental Piping/Tank Inspection Program is documented in SER Section 3.0.3.1.29. The staff noted that the Supplemental Piping/Tank Inspection Program is consistent with GALL Report AMP XI.M32, "One-Time Inspection." The staff finds the applicant's proposal to manage aging using the Supplemental Piping/Tank Inspection Program acceptable because loss of material in stainless steel components at an indoor air-water interface is unlikely, but the one-time inspection performed under the program will ensure that any such aging effect will be detected.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for steel and stainless steel bolting exposed to condensation (external), air-outdoor (external), or treated water (external) that are being managed for cracking, and loss of pre-load or material, by the Bolting Integrity Program, proposed with a Generic Note H, is documented in SER Section 3.3.2.3.12.

3.3.2.3.26 Auxiliary Systems—Miscellaneous Waste Radioactive System—Summary of Aging Management Evaluation—LRA Table 3.3.2-26

The staff reviewed LRA Table 3.3.2-26, which summarizes the results of AMR evaluations for the miscellaneous waste radioactive system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.27 Auxiliary Systems—Plant Sanitary Drains System—Summary of Aging Management Evaluation—LRA Table 3.3.2-27

The staff's evaluation for steel and stainless steel bolting exposed to condensation (external), air-outdoor (external), or treated water (external) that is being managed for cracking, and loss of pre-load or material, by the Bolting Integrity Program, proposed with a Generic Note H, is documented in SER Section 3.3.2.3.12.

3.3.2.3.28 Auxiliary Systems—Plant Service Water Systems—Summary of Aging Management Evaluation—LRA Table 3.3.2-28

In LRA Tables 3.3.2-28, 3.3.2-29, and 3.3.2-35, the applicant stated that the gray cast iron valve bodies, tank bushings and strainer bodies exposed to condensation (external) are being managed for loss of material by the Selective Leaching Inspection Program. The AMR line items cite Generic Note G, indicating that, for the line items, the environment is not in the GALL Report for this component and material.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this components, material, and environmental combination because even though the gray cast iron exposed to condensation (external) is not specifically addressed in the GALL Report. However, Section XI.M33, "Selective Leaching of Materials," which states that gray cast iron may be susceptible to selective leaching, and loss of material is being managed for these components in other line items in the same tables.

The staff's evaluation of the applicant's Selective Leaching Inspection Program is documented in SER Section 3.0.3.1.26. The staff noted that the Selective Leaching Program is a new program that is designed to detect and characterize the conditions on internal and external surfaces of components that are exposed to raw water, treated water (including closed cycle cooling water and steam), fuel oil, soil (buried), and moist air (including condensation) environments. The staff also noted that this One-Time Inspection Program is a combination of visual examination and material hardness testing, or NRC-approved alternative, and it provides direct evidence of whether, and to what extent, loss of material due to selective leaching has occurred or is likely to occur that could result in a loss of intended function. The staff finds the applicant's proposal acceptable because the program includes visual examinations and hardness testing, which are appropriate methods for determining whether loss of material due to selective leaching is occurring.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL

Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for steel and stainless steel bolting exposed to condensation (external), air-outdoor (external), or treated water (external) that are being managed for cracking, and loss of pre-load or material, by the Bolting Integrity Program, proposed with a Generic Note H, is documented in SER Section 3.3.2.3.12.

3.3.2.3.29 Auxiliary Systems—Potable Cold Water Systems—Summary of Aging Management Evaluation—LRA Table 3.3.2-29

The staff's evaluation for aluminum alloy heat exchanger fins, tank shell, and end caps exposed to external condensation that are being managed for cracking by the External Surfaces Monitoring and Cooling Units Inspection Programs with a Generic Note H is documented in SER Section 3.3.2.3.14.

The staff's evaluation for gray cast iron valve bodies, tank bushings and strainer bodies exposed to condensation (external) that are being managed for loss of material by the Selective Leaching Inspection Program with a Generic Note G is documented in SER Section 3.3.2.3.28.

The staff's evaluation for copper alloy (greater than 15 percent zinc) components exposed to condensation (external) that are being managed for loss of material by the Selective Leaching Inspection Program with a Generic Note G is documented in SER Section 3.3.2.3.7.

3.3.2.3.30 Auxiliary Systems—Potable Hot Water System—Summary of Aging Management Evaluation—LRA Table 3.3.2-30

The staff reviewed LRA Table 3.3.2-30, which summarizes the results of AMR evaluations for the potable hot water system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.31 Auxiliary Systems—Primary Containment System—Summary of Aging Management Evaluation—LRA Table 3.3.2-31

The staff reviewed LRA Table 3.3.2-31, which summarizes the results of AMR evaluations for the primary containment system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.32 Auxiliary Systems—Process Sampling System—Summary of Aging Management Evaluation—LRA Table 3.3.2-32

The staff's evaluation for polymer piping exposed to raw water (internal) with Generic Note F is documented in SER Section 3.3.2.3.22.

In LRA Table 3.3.2-32, the applicant stated that, for polymer piping exposed to condensation (external), there is no aging effect, and no AMP is proposed. The AMR line item cites Generic Note F.

The staff reviewed the associated line items in the LRA and confirmed that no aging effect is applicable for this component, material, and environmental combination because polymer materials are resistant to water (P.A. Schweitzer, *Corrosion Resistance Tables—Metals, Nonmetals, Coatings, Mortars, Plastics, Elastomers and Linings, and Fabrics*, Fifth Edition, Part A, Marcel Dekker, 2004); therefore, the staff finds the applicant's proposal acceptable.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for steel and stainless steel bolting exposed to condensation (external), air-outdoor (external), or treated water (external) that are being managed for cracking, and loss of pre-load or material, by the Bolting Integrity Program, proposed with a Generic Note H, is documented in SER Section 3.3.2.3.12.

The staff's evaluation for copper alloy (greater than 15 percent zinc) components exposed to condensation (external) that are being managed for loss of material by the Selective Leaching Inspection Program with a Generic Note G is documented in SER Section 3.3.2.3.7.

The staff's evaluation for copper alloy (greater than 15 percent zinc) valve bodies exposed to raw water (internal) that are being managed for cracking due to SCC by the Monitoring and Collection Systems Inspection Program with a Generic Note H is documented in SER Section 3.3.2.3.22.

3.3.2.3.33 Auxiliary Systems—Process Sampling Radioactive System—Summary of Aging Management Evaluation—LRA Table 3.3.2-33

In LRA Table 3.3.2-33, the applicant stated that stainless steel piping exposed to air-indoor uncontrolled (external) is being managed for loss of material by the Supplemental Piping/Tank Inspection Program. The AMR line item cites Generic Note G. The line item associated with piping in LRA Table 3.3.2-33 also cites plant-specific Note 0303, which states that the Supplemental Piping/Tank Inspection Program will manage loss of material at the air-water interface.

The staff reviewed the associated line item in the LRA and cannot confirm that the applicant identified the correct aging effects for this component, material, and environmental combination because, even though the GALL Report states that stainless steel exposed to air-indoor uncontrolled (external) is not subject to any aging effects, the plant-specific note states that this item is associated with an air-water interface. The GALL Report recommends that stainless steel exposed to air-indoor uncontrolled (external) is not subject to any aging effects; however, the plant-specific note states that this item is associated with an air-water interface. The GALL Report recommends that stainless steel exposed to treated water be managed by GALL Report AMP XI.M2, "Water Chemistry" and the XI.M32, "One-Time Inspection" Programs. Raw water should be managed by GALL Report AMP XI.M20, "Open-Cycle Cooling Water System" Program. Condensation should be managed by a plant-specific AMP. By letter dated October 20, 2010, the staff issued RAI 3.3.2.3.33-1 requesting that the applicant state what water environment occurs at the air-water interface and justify why the Supplemental Piping/Tank Inspection Program is sufficient to manage aging of the stainless steel piping at the air-water interface.

In its response dated January 27, 2011, the applicant stated that the subject component in LRA Table 3.3.2-33 is a sample line from the suppression pool for which the portion of the piping above the air-water interface is exposed to indoor uncontrolled air and the portion of the piping below the air-water interface is exposed to treated water. The applicant also stated that the portion of the piping exposed to indoor uncontrolled air does not have any AERMs, and the portion of piping exposed to treated water is being managed for loss of material by the BWR Water Chemistry Program and Chemistry Program Effectiveness Inspection. The applicant further stated that plant operating experience has not indicated the air-water interface has any aging effects, and the inspection will provide confirmation of the absence of aging effects. The staff finds the applicant's response acceptable because the surfaces of the subject component above and below the air-water interface are being managed for aging consistent with the recommendations in the GALL Report, and application of the Supplemental Piping/Tank Inspection Program is an additional inspection to confirm aging is not occurring at the potentially aggressive air-water interface.

The staff's evaluation of the applicant's Supplemental Piping/Tank Inspection Program is documented in SER Section 3.0.3.1.29. The staff noted that the applicant's Supplemental Piping/Tank Inspection Program is a new one-time inspection that will detect and characterize the material condition of steel, gray cast iron, and stainless steel components that are exposed to moist air environments, particularly the aggressive alternate wet and dry environment that exists at air-water interfaces or air spaces of susceptible piping and tanks. The staff also noted that this inspection provides direct evidence as to whether, and to what extent, loss of material due to crevice, galvanic, general, and pitting corrosion, or MIC has occurred, or is likely to occur, that could result in a loss of intended function of the subject components. The staff further notes that the Supplemental Piping/Tank Inspection Program will use a combination of established visual and volumetric examination techniques that are consistent with GALL Report AMP XI.M32, "One-Time Inspection." The staff finds the applicant's proposal to manage aging using the Supplemental Piping/Tank Inspection Program acceptable because this program inspects the external and internal surfaces of components subject to AMR including verifying that the aging effect, loss of material, will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.34 Auxiliary Systems—Pump House HVAC System—Summary of Aging Management Evaluation—LRA Table 3.3.2-34

The staff's evaluation for aluminum alloy heat exchanger fins, tank shell, and end caps exposed to external condensation are being managed for cracking by the External Surfaces Monitoring and Cooling Units Inspection Programs with a Generic Note H is documented in SER Section 3.3.2.3.14.

The staff's evaluation for aluminum alloy heat exchanger fins exposed to external condensation are being managed for reduction in heat transfer by the Open-Cycle Cooling Water and Cooling Units Inspection Programs with a Generic Note H is documented in SER Section 3.3.2.3.14.

The staff's evaluation for copper alloy and copper alloy (greater than 15 percent zinc) components exposed to air (internal) or air-indoor uncontrolled (internal and external) that have no proposed aging effect and no AMP, proposed with a Generic Note G, is documented in SER Section 3.3.2.3.4.

The staff's evaluation for copper alloy heat exchanger tubes exposed to condensation (external) that are being managed for reduction in heat transfer by the Open-Cycle Cooling Water Program with a Generic Note H is documented in SER Section 3.3.2.3.14.

The staff's evaluation for stainless steel bolting exposed to air-indoor uncontrolled (external) that is being managed for loss of pre-load by the Bolting Integrity Program with a Generic Note F is documented in SER Section 3.3.2.3.14.

3.3.2.3.35 Auxiliary Systems—Radwaste Building Chilled Water System—Summary of Aging Management Evaluation—LRA Table 3.3.2-35

In LRA Tables 3.3.2-35, 3.3.2-36, and 3.3.2-37, the applicant stated that copper alloy (greater than 15 percent Zn) components exposed to condensate (external) are being managed for loss of material by the Selective Leaching Inspection Program. The AMR line items cite Generic Note G.

The staff reviewed the applicant's Selective Leaching Inspection Program, and its evaluation is documented in SER Section 3.0.3.1.26. The staff finds the applicant's currently proposed AMP acceptable because the environment, condensate (external), while not explicitly addressed in the GALL Report, poses no features or attributes that would initiate or aggravate the aging effect of selective leaching, beyond what would be expected for a typical untreated water environment such as raw water (for which the GALL Report does make recommendations for selective leaching). Thus, the staff finds the use of the Selective Leaching Inspection Program will be effective in identifying selective leaching in copper alloy (greater than 15 percent Zn) exposed to condensate (external) because the condensate environment is similar to a raw water environment, for which the Selective Leaching Inspection Program should be effective in preventing the loss of intended function caused by selective leaching of materials.

In LRA Tables 3.3.2-35 and 3.3.2-37, the applicant stated that gray cast iron components exposed to condensate (external) are being managed for loss of material by the Selective Leaching Inspection Program. The AMR line items cite Generic Note G.

The staff reviewed the applicant's Selective Leaching Inspection Program, and its evaluation is documented in SER Section 3.0.3.1.26. The staff finds the applicant's currently proposed AMP acceptable because the environment, condensate (external), while not explicitly addressed in the GALL Report, poses no features or attributes that would initiate or aggravate the aging effect of selective leaching, beyond what would be expected for a typical untreated water environment, such as raw water (for which the GALL Report does make recommendations for selective leaching). Thus, staff finds the use of Selective Leaching Inspection Program will be effective in identifying selective leaching in grey cast iron exposed to condensate (external) because the condensate environment is similar to a raw water environment, for which the Selective Leaching Inspection Program should be effective in preventing the loss of intended function caused by selective leaching of materials.

In LRA Tables 3.3.2-28, 3.3.2-29, and 3.3.2-35, the applicant stated that the gray cast iron valve bodies, tank bushings and strainer bodies exposed to condensation (external) are being managed for loss of material by the Selective Leaching Inspection Program. The AMR line items cite Generic Note G, indicating that, for the line items, the environment is not in the GALL Report for this component and material.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this components, material, and environmental combination because, even though the gray cast iron exposed to condensation (external) is not specifically addressed in the GALL Report, Section XI.M33 “Selective Leaching of Materials” AMP of the GALL Report states that gray cast iron may be susceptible to selective leaching, and loss of material is being managed for these components in other line items in the same tables.

The staff’s evaluation of the applicant’s Selective Leaching Inspection Program is documented in SER Section 3.0.3.1.26. The staff noted that the Selective Leaching Program is a new program that is designed to detect and characterize the conditions on internal and external surfaces of components that are exposed to raw water, treated water (including closed cycle cooling water and steam), fuel oil, soil (buried), and moist air (including condensation) environments. The staff also noted that this One-Time Inspection Program is a combination of visual examination and material hardness testing, or NRC-approved alternative, and it provides direct evidence of whether, and to what extent, loss of material due to selective leaching has occurred or is likely to occur that could result in a loss of intended function. The staff finds the applicant’s proposal acceptable because the program includes visual examinations and hardness testing, which are appropriate methods for determining whether loss of material due to selective leaching is occurring.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.36 Auxiliary Systems—Radwaste Building HVAC System—Summary of Aging Management Evaluation—LRA Table 3.3.2-36

The staff’s evaluation for copper alloy (greater than 15 percent zinc) components exposed to condensate (external) are being managed for loss of material by the Selective Leaching Inspection Program with a Generic Note G is documented in SER Section 3.3.2.3.35.

The staff’s evaluation for aluminum alloy heat exchanger fins, tank shell, and end caps exposed to external condensation are being managed for cracking by the External Surfaces Monitoring and Cooling Units Inspection Programs with a Generic Note H is documented in SER Section 3.3.2.3.14.

In LRA Table 3.3.2-36, the applicant stated that the stainless steel piping exposed to condensation (external) is being managed for cracking due to an unspecified aging mechanism by the External Surfaces Monitoring Program. This AMR line item cites Generic Note H.

The staff reviewed the associated line items in the LRA and confirmed that the applicant has identified the correct aging effects for this component, material, and environment combination because the GALL Report, in Table IX.C states that stainless steel is susceptible to loss of material and cracking, and the applicant is managing loss of material in another AMR line in LRA Table 3.3.2-36.

The staff's evaluation of the applicant's External Surfaces Monitoring Program is documented in SER Section 3.0.3.2.6. The staff noted that the applicant's External Surfaces Monitoring Program is consistent with GALL Report AMP XI.M36, "External Surfaces Monitoring" and includes periodic visual inspections of the external surfaces of components. The staff finds the applicant's proposal to manage aging using the External Surfaces Monitoring Program acceptable because cracking in stainless steel components exposed to condensation (external), though unlikely can be detected by periodic visual inspections.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM and AMP combinations not addressed in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-36 the applicant stated that the steel bolting exposed to condensation (external) is being managed for cracking and loss of pre-load, by the Bolting Integrity AMP. The related AMR line item cites Generic Note G, indicating that the environment is not in the GALL Report for this component and material combination.

The staff reviewed all AMR result line items in the GALL Report where the material is steel and the aging effect and mechanism is cracking or loss of pre-load and confirmed that for this environment, there are no entries in the GALL Report for this component and material.

The staff's evaluation of the applicant's Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The staff finds the applicant's proposal to manage aging using the Bolting Integrity Program acceptable because staff's review confirmed that the aging effects identified are appropriate for these component, material, and environment combinations and that the proposed aging related periodic or walkdown inspections under the applicant's Bolting Integrity Program will be adequate to detect this aging.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM and AMP combinations not addressed in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for copper alloy and copper alloy (greater than 15 percent zinc) components exposed to air (internal) or air-indoor uncontrolled (internal and external) that have no proposed aging effect and no AMP proposed with a Generic Note G is documented in SER Section 3.3.2.3.4.

The staff's evaluation for steel and stainless steel bolting exposed to condensation (external), air-outdoor (external), or treated water (external) that are being managed for cracking, and loss of pre-load or material, by the Bolting Integrity Program, proposed with a Generic Note H is documented in SER Section 3.3.2.3.12.

The staff's evaluation for copper alloy heat exchanger tubes exposed to condensation (external) that are being managed for reduction in heat transfer by the Open-Cycle Cooling Water Program with a Generic Note H is documented in SER Section 3.3.2.3.14.

The staff's evaluation for stainless steel bolting exposed to air-indoor uncontrolled (external) that is being managed for loss of pre-load by the Bolting Integrity Program with a Generic Note F is documented in SER Section 3.3.2.3.14.

3.3.2.3.37 Auxiliary Systems—Reactor Building HVAC System—Summary of Aging Management Evaluation—LRA Table 3.3.2-37

The staff's evaluation for copper alloy (greater than 15 percent zinc) components exposed to condensate (external) that are being managed for loss of material by the Selective Leaching Inspection Program with a Generic Note G is documented in SER Section 3.3.2.3.35.

The staff's evaluation for gray cast iron components exposed to condensate (external) that are being managed for loss of material by the Selective Leaching Inspection Program with a Generic Note G is documented in SER Section 3.3.2.3.35.

The staff's evaluation for aluminum alloy heat exchanger fins, tank shell, and end caps exposed to external condensation that are being managed for cracking by the External Surfaces Monitoring and Cooling Units Inspection Programs with a Generic Note H is documented in SER Section 3.3.2.3.14.

The staff's evaluation for aluminum alloy heat exchanger fins exposed to external condensation that are being managed for reduction in heat transfer by the Open-Cycle Cooling Water and Cooling Units Inspection Programs with a Generic Note H is documented in SER Section 3.3.2.3.14.

The staff's evaluation for steel heat exchanger headers, piping, and valve bodies exposed to steam (internal) that are being managed for loss of material by the BWR Water Chemistry, Chemistry Program Effectiveness Inspection, and Flow-Accelerated Corrosion Programs citing Generic Note G is documented in 3.3.2.3.7.

The staff's evaluation for steel and stainless steel bolting exposed to condensation (external), air-outdoor (external), or treated water (external) that are being managed for cracking, and loss of pre-load or material, by the Bolting Integrity Program, proposed with a Generic Note H, is documented in SER Section 3.3.2.3.12.

The staff's evaluation for copper alloy heat exchanger tubes exposed to condensation (external) that are being managed for reduction in heat transfer by the Open-Cycle Cooling Water Program with a Generic Note H is documented in SER Section 3.3.2.3.14.

The staff's evaluation for stainless steel bolting exposed to air-indoor uncontrolled (external) that is being managed for loss of pre-load by the Bolting Integrity Program with a Generic Note F is documented in SER Section 3.3.2.3.14.

3.3.2.3.38 Auxiliary Systems—Reactor Closed Cooling Water System—Summary of Aging Management Evaluation—LRA Table 3.3.2-38

The staff reviewed LRA Table 3.3.2-38, which summarizes the results of AMR evaluations for the reactor closed cooling water system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J, whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.39 Auxiliary Systems—Reactor Water Cleanup System—Summary of Aging Management Evaluation—LRA Table 3.3.2-39

In LRA Table 3.3.2-39, the applicant stated that the steel heat exchanger components, piping, pump casings, and valve bodies exposed to treated water greater than 60 °C (140 °F) (internal) are being managed for loss of material due to flow-accelerated corrosion by the Flow-Accelerated Corrosion Program. The AMR line items cite Generic Note H.

The staff reviewed all AMR result line items in the GALL Report where the component and material is steel heat exchanger components, piping, pump casings, and valve bodies exposed to treated water greater than 60 °C (140 °F) (internal) and identified four entries—Items IV.C1-7, V.D2-34, VIII.D2-8, and VIII.E-35—which are applicable to BWRs for this component, material, environment, and aging effect combination. These items recommend that this aging effect be managed using GALL Report AMP XI.M17, "Flow-Accelerated Corrosion."

The staff's evaluation of the applicant's Flow-Accelerated Corrosion Program is documented in SER Section 3.0.3.2.11. The staff noted that the applicant's Flow-Accelerated Corrosion Program is consistent with GALL Report AMP XI.M17, "Flow-Accelerated Corrosion," with enhancements. The staff finds the applicant's proposal to manage aging using the Flow-Accelerated Corrosion Program acceptable because the application of this AMP is consistent with the GALL Report recommendations under GALL Report Items IV.C1-7, V.D2-34, VIII.D2-8, and VIII.E-35.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results for these material, environment, AERM, and AMP combinations. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.40 Auxiliary Systems—Service Air System—Summary of Aging Management Evaluation—LRA Table 3.3.2-40

In LRA Table 3.3.2-40, the applicant stated that steel piping and valve bodies exposed to air (internal) are being managed for loss of material by the Service Air System Inspection Program. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and noted that the definitions in LRA Table 3.0-1 state that air is susceptible to condensation. The staff also noted that the GALL Report recommends that steel piping exposed to an air-indoor uncontrolled or condensation internal environment be managed by GALL Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components.”

The staff’s evaluation of the applicant’s Service Air System Inspection Program is documented in SER Section 3.0.3.1.27. The staff noted that the applicant’s Service Air System Inspection Program is a new One-Time Inspection Program that will detect and characterize the material condition of piping and valve bodies within the scope of license renewal in the service air system and are exposed to an air (internal) environment. The staff also noted that the Service Air System Inspection will use a combination of established volumetric (radiographic or UT) and visual (VT-3 or equivalent) examination techniques that are consistent with the recommendations in GALL Report AMPXI.M32, “One-Time Inspection.” The staff further noted that the GALL recommended AMP, XI.M38, consists of periodic inspections that are based on the “detection of aging effects” program element, which states that “[i]nspection intervals are established such that it provides timely detection of degradation,” and the “monitoring and trending” program element, which states:

> Maintenance and surveillance activities provide for monitoring and trending of aging degradation. Inspection intervals are dependent on component material and environment, and take into consideration industry and plant-specific operating experience. Results of the periodic inspections are monitored for indications of various corrosion mechanisms and fouling.

It is unclear to the staff how the one-time inspection proposed by the applicant is adequate to manage aging for these components considering GALL Report AMP XI.M38 recommends periodic inspections. However, in its response to RAI B.2.1.14-1 by letter dated January 28, 2011, the applicant revised its Service Air Inspection Program to become a new plant-specific program. The staff noted that the applicant’s revised Service Air Inspection Program includes baseline inspections of each material and environment combination prior to the period of extended operation, opportunistic inspections performed during maintenance, repair, or surveillance activities during the period of extended operation, and trending of inspection results to ensure that each material and environment combination has been examined in a 5-year interval. The applicant committed (Commitment No. 48) to perform the baseline inspections within the 10-year period prior to the period of extended operation. The staff finds the applicant’s revised Service Air Inspection Program acceptable to manage aging for these components because it includes baseline and opportunistic visual, enhanced visual, volumetric or other NDE inspections of the subject components, which are capable of detecting loss of material. The staff’s concern described above is resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.41 Auxiliary Systems—Standby Liquid Control System—Summary of Aging Management Evaluation—LRA Table 3.3.2-41

In LRA Table 3.3.2-41, the applicant stated that, for polymer sight glass exposed to sodium pentaborate solution (internal), there is no aging effect, and no AMP is proposed. The AMR line item cites Generic Note J.

The staff reviewed the associated line items in the LRA and confirmed that no aging effect is applicable for this component, material, and environmental combination because the LRA states that the sodium pentaborate solution contains a mixture of boric acid and borax, and polymer materials are resistant to boric acid and borax (P.A. Schweitzer, *Corrosion Resistance Tables—Metals, Nonmetals, Coatings, Mortars, Plastics, Elastomers and Linings, and Fabrics*, Fifth Edition, Marcel Dekker, 2004). Therefore, the staff finds the applicant's proposal acceptable.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-41, the applicant stated that, for polymer sight glass exposed to moist air (internal) and air-indoor uncontrolled (external), there is no aging effect, and no AMP is proposed. The AMR line items cite Generic Note J.

The staff reviewed the associated line items in the LRA and was not able to confirm that the applicant identified the correct aging effects for this component, material, and environment combination. The staff noted that based on review of technical literature (e.g., Roff, W.J., *Fibres, Plastics, and Rubbers: A Handbook of Common Polymers*, Academic Press, Inc., New York, 1956) and current industry research and operating experience related to Plexiglas and related polymers, in the absence of specific environmental stressors such as UV light, high radiation, or ozone concentrations, components made of these materials do not exhibit aging effects of concern during the period of extended operation. By letter dated October 20, 2010, the staff issued RAI 3.3.2-1 requesting that the applicant justify why the polymeric components are not exposed to radiation, ozone, or UV light levels specific to its locations that would lead to aging effects during the period of extended operation.

In its response dated January 20, 2011, the applicant stated that the sight glass located on the SLC tank is constructed of polycarbonate and is exposed to 57,000 rads through the period of extended operation, and this is below the 700,000 rad threshold provided in EPRI NP-2129. The applicant also stated that ozone is below the threshold level of 1,000 ppm, the highest normal temperature in the reactor building is 130 °F, and, given that the sight glass is located indoors, it is not exposed to enough UV radiation to cause aging as stated in the *American Society of Metals International Materials Handbook*.

The staff finds the applicant's response and proposal acceptable for the following reasons:

- *The Chemical Resistance of Plastics and Elastomers* (3rd Electronic Edition), Plastics Design Library Staff, states that the threshold for radiation damage of polycarbonate components is 10^6 rads.
- *The Chemical Resistance of Plastics and Elastomers* (4th Electronic Edition), Plastics Design Library Staff, listed a variety of polycarbonate materials. Only two of the seven

specific manufacturer applications demonstrated loss of material properties, swelling, or attack and the degradation occurred in 1–3 days. Given that the applicant's sight glasses have been in service for considerably longer than 1–3 days, the staff is provided with a basis to conclude that the CLB function(s) will be met.

- "The Plastic Material Data Sheets," edited by D. O. Kipp, 2004, states that the lowest maximum service temperature of lexan materials is 176 F. In addition, the *Mechanical Engineer's Reference Book*, Edward H Smith, Elsevier (12th Edition), states that polycarbonates have a maximum continuous service rating of 125 °C. Each of these ratings are well above the highest normal operating temperature in the reactor building.
- *The Effect of UV Light and Weather on Plastics and Elastomers*, Plastic Design Library Staff, William Andrew Publishing, 1994, states the only potential aging effect is color change. This effect would be noted by operators during its rounds, and the item would be replaced if it could not read tank level.

The staff's concern described in RAI 3.3.2-1 is resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for stainless steel piping and valve bodies exposed to air (internal) citing Generic Note G for which no aging effect and no AMP are proposed is documented in 3.3.2.3.17

3.3.2.3.42 Auxiliary Systems—Standby Service Water System—Summary of Aging Management Evaluation—LRA Table 3.3.2-42

In LRA Table 3.3.2-42, the applicant stated that the gray cast iron pump casing exposed to moist air (internal) is being managed for loss of material by the Selective Leaching Inspection Program. The AMR line item cites Generic Note H, indicating that, for the line item(s), the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this components, material, and environmental combination because, even though the gray cast iron exposed to moist air (internal) is not specifically addressed in the GALL Report, Section XI.M33 "Selective Leaching of Materials" AMP of the GALL Report states that gray cast iron may be susceptible to selective leaching, and loss of material is being managed for these components in other line items in the same tables.

The staff's evaluation of the applicant's Selective Leaching Inspection Program is documented in SER Section 3.0.3.1.26. The staff noted that the Selective Leaching Program is a new program that is designed to detect and characterize the conditions on internal and external surfaces of components that are exposed to raw water, treated water (including closed cycle cooling water and steam), fuel oil, soil (buried), and moist air (including condensation) environments. The staff also noted that this One-Time Inspection Program is a combination of visual examination and material hardness testing, or NRC-approved alternative, and it provides direct evidence of whether, and to what extent, loss of material due to selective leaching has occurred or is likely to occur that could result in a loss of intended function. The staff finds the applicant's proposal acceptable because the program includes visual examinations and hardness testing, which are appropriate methods for determining whether loss of material due to selective leaching is occurring.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for stainless steel nozzles, orifices, piping, tubing, and valve bodies exposed to air-outdoor (internal) citing Generic Note G for which no aging effect and no AMP are proposed is documented in 3.3.2.3.16.

The staff's evaluation for copper alloy heat exchanger tubes exposed to lubricating oil (external) that are being managed for reduction in heat transfer by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs with a Generic Note H is documented in SER Section 3.3.2.3.15.

The staff's evaluation for steel and stainless steel bolting exposed to condensation (external), air-outdoor (external), or treated water (external) that are being managed for cracking, and loss of pre-load or material, by the Bolting Integrity Program, proposed with a Generic Note H, is documented in SER Section 3.3.2.3.12.

3.3.2.3.43 Auxiliary Systems—Tower Makeup Water System—Summary of Aging Management Evaluation—LRA Table 3.3.2-43

In LRA Tables 3.3.2-43 and 3.4.2-2, the applicant stated that the steel bolting exposed to outdoor air (external) is being managed for loss of preload by the Bolting Integrity Program. The AMR line items cite Generic Note H, indicating that for the line item(s), the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed the associated line items in the LRA and confirmed that the applicant has identified the correct aging effects for this components, material and environmental combination because even though the steel bolting exposed to outdoor air (external) is not specifically addressed in the GALL Report AMP XI.M18, "Bolting Integrity," which recommends following industry guidance and practice to prevent or mitigate degradation and failure of safety-related bolting.

The staff's evaluation of the applicant's Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The staff noted that the Bolting Integrity Program is an existing condition monitoring program that addresses the management of aging for the bolting of mechanical components and structural connections within the scope of license renewal based on industry recommendations. The staff also noted that the Bolting Integrity Program consists of the periodic inspection of bolting for indications of degradation such as leakage, loss of material due to corrosion, loss of pre-load, and cracking due to SCC and fatigue. The staff finds the applicant's proposal acceptable because the applicant's Bolting Integrity Program periodically inspects bolting to manage the aging effect, loss of preload, which is consistent with the GALL Report recommendation.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM and AMP combinations not addressed in the GALL

Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-43, the applicant stated that the steel bolting exposed to condensation (external) is being managed for cracking by the Bolting Integrity Program. The AMR line item cites Generic Note H, indicating that for the line item(s), the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed the associated line items in the LRA and confirmed that the applicant has identified the correct aging effects for this components, material and environmental combination because even though the steel bolting exposed to condensation (external) is not specifically addressed in the GALL Report AMP XI.M18, "Bolting Integrity," which recommends following industry guidance and practice to prevent or mitigate degradation and failure of safety-related bolting.

The staff's evaluation of the applicant's Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The staff noted that the Bolting Integrity Program is an existing condition monitoring program that addresses the management of aging for the bolting of mechanical components and structural connections within the scope of license renewal based on industry recommendations. The staff also noted that the Bolting Integrity Program consists of the periodic inspection of bolting for indications of degradation such as leakage, loss of material due to corrosion, loss of pre-load, and cracking due to SCC and fatigue. The staff finds the applicant's proposal acceptable because the applicant's Bolting Integrity Program periodically inspects bolting to manage the aging effect, loss of preload, which is consistent with the GALL Report recommendation.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM and AMP combinations not addressed in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.3.2.3.44 Auxiliary Systems—Traversing Incore Probe System—Summary of Aging Management Evaluation—LRA Table 3.3.2-44

The staff reviewed LRA Table 3.3.2-44, which summarizes the results of AMR evaluations for the traversing incore probe system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.3.2.1.

3.3.2.3.45 Auxiliary Systems—Heating Steam System—Summary of Aging Management Evaluation—LRA Table 3.3.2-45

The heating steam system was included in an LRA supplement dated July 16, 2010.

In LRA Table 3.3.2-45, the applicant stated that steel and gray cast iron heat exchanger headers and tubes, as well as humidifier, piping, strainer, trap body, tubing, and valve bodies exposed to steam (internal) are being managed for loss of material by the BWR Water Chemistry, Chemistry Program Effectiveness Inspection, and Flow-Accelerated Corrosion Programs. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because the GALL Report states that steel components exposed to steam are subject to loss of material due to general, pitting, and crevice corrosion and flow-accelerated corrosion. The staff noted that although the applicant stated that this environment is not in the GALL Report for these components and materials, the GALL Report does contain items for steel iron piping exposed to steam and recommends that GALL Report AMPs XI.M2, "Water Chemistry," XI.M17, "Flow-Accelerated Corrosion," and Chapter XI.M32, "One-Time Inspection" be used to manage the aging effects.

The staff's evaluations of the applicant's BWR Water Chemistry, Chemistry Program Effectiveness Inspection, and Flow-Accelerated Corrosion Programs are documented in SER Sections 3.0.3.1.7, 3.0.3.1.8, and 3.0.3.2.11, respectively. The staff noted that the applicant's BWR Water Chemistry Program is an ongoing program that manages the loss of material due to corrosion or erosion through the control of coolant water impurity levels and pH consistent with the current EPRI water chemistry guidelines. The staff also noted that the applicant's Chemistry Program Effectiveness Inspection Program is a new program that detects and characterizes, through visual and volumetric examinations, the material conditions in representative low-flow and stagnant areas of plant systems influenced by the BWR Water Chemistry Program to detect whether, and to what extent, a loss of material due to crevice, general, galvanic, or pitting corrosion in treated water has occurred. The staff further noted that the applicant's Flow-Accelerated Corrosion Program is an ongoing program that follows EPRI guidelines to manage the loss of material for steel and gray cast iron components located in the treated water environment, including steam, of systems that are susceptible to flow-accelerated corrosion. The staff finds the applicant's proposal to manage aging using the BWR Water Chemistry, Chemistry Program Effectiveness Inspection, and Flow-Accelerated Corrosion Programs acceptable because these programs incorporate established chemistry control, inspection, and erosion-corrosion control procedures and techniques that have been demonstrated to be effective in controlling and detecting loss of material due to general, pitting, and crevice corrosion and flow-accelerated corrosion in components in contact with steam (internal) through visual and volumetric examination methodologies.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-45, the applicant stated that the gray cast iron humidifier and trap body exposed to steam (internal) is being managed for loss of material the Selective Leaching Inspection Program.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this components, material, and environmental combination because even though the gray cast iron exposed to steam (internal) is not specifically addressed in the GALL Report AMP XI.M33, “Selective Leaching of Materials”—which states that gray cast iron may be susceptible to selective leaching and loss of material—it is being managed for these components in other line items in the same tables.

The staff’s evaluation of the applicant’s Selective Leaching Inspection Program is documented in SER Section 3.0.3.1.26. The staff noted that the Selective Leaching Program is a new program that is designed to detect and characterize the conditions on internal and external surfaces of components that are exposed to raw water, treated water (including closed cycle cooling water and steam), fuel oil, soil (buried), and moist air (including condensation) environments. The staff also noted that this One-Time Inspection Program uses a combination of visual examination and material hardness testing, or NRC-approved alternative, to provide direct evidence of whether, and to what extent, loss of material due to selective leaching has occurred or is likely to occur that could result in a loss of intended function. The staff finds the applicant’s proposal acceptable because the program includes visual examinations and hardness testing, which are appropriate methods for determining whether loss of material due to selective leaching is occurring.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-45, the applicant stated that the stainless steel heat exchanger tubes and tubing exposed to steam (internal) are being managed for cracking and loss of material by the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs. The AMR line items cite Generic Note G.

The staff reviewed all AMR result line items in the GALL Report (Section 3.3 on Auxiliary Systems Aging Management) where components and materials are stainless steel heat exchanger tubes and tubing exposed to steam (internal) and confirmed that there are no aging effect entries (for cracking, loss of material) in the GALL Report for this component, material, and environment combination.

The staff’s evaluations of the applicant’s BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs are documented in SER Sections 3.0.3.1.7 and 3.0.3.1.8, respectively. The staff noted that the applicant’s BWR Water Chemistry Program is an ongoing program that manages the loss of material due to corrosion or erosion through the control of coolant water impurity levels and pH, consistent with the current EPRI water chemistry guidelines. The staff also noted that the applicant’s Chemistry Program Effectiveness Inspection Program is a new program that detects and characterizes, through visual and volumetric examinations, the material conditions in representative low-flow and stagnant areas of plant systems influenced by the BWR Water Chemistry Program to detect whether, and to what extent, a loss of material due to crevice, general, galvanic, or pitting corrosion in treated water has occurred. The staff finds the applicant’s proposal to manage aging using the BWR Water Chemistry and Chemistry Program Effectiveness Inspection acceptable because these programs incorporate established chemistry control and inspection procedures and techniques that have been demonstrated to be effective in controlling and detecting cracking and loss of material due to general, pitting, and crevice corrosion in components in contact with steam (internal) through visual and volumetric examination methodologies.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.3.2-45, the applicant stated that the copper alloy heat exchanger tubes, strainer (body), and valve body exposed to steam (internal) are being managed for loss of material by the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs. The AMR line items cite Generic Note G.

The staff reviewed all AMR result line items in the GALL Report (Section 3.3 on Auxiliary Systems Aging Management)—where components and materials are copper alloy heat exchanger tubes, strainer (body), and valve body exposed to steam (internal)—and confirmed that there are no aging effect entries (for loss of material) in the GALL Report for this component, material, and environment combination.

The staff's evaluations of the applicant's BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs are documented in SER Sections 3.0.3.1.7 and 3.0.3.1.8, respectively. The staff noted that the applicant's BWR Water Chemistry Program is an ongoing program that manages the loss of material due to corrosion or erosion through the control of coolant water impurity levels and pH, consistent with the current EPRI water chemistry guidelines. The staff also noted that the applicant's Chemistry Program Effectiveness Inspection Program is a new program that detects and characterizes, through visual and volumetric examinations, the material conditions in representative low-flow and stagnant areas of plant systems influenced by the BWR Water Chemistry Program to detect whether, and to what extent, a loss of material due to crevice, general, galvanic, or pitting corrosion in treated water has occurred. The staff finds the applicant's proposal to manage aging using the BWR Water Chemistry and Chemistry Program Effectiveness Inspection acceptable because these programs incorporate established chemistry control and inspection procedures and techniques that have been demonstrated to be effective in controlling and detecting loss of material due to general, pitting, and crevice corrosion in components in contact with steam (internal) through visual and volumetric examination methodologies.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for copper alloy and copper alloy (greater than 15 percent zinc) components exposed to air (internal) or air-indoor uncontrolled (internal and external) that have no proposed aging effect and no AMP, proposed with a Generic Note G, is documented in SER Section 3.3.2.3.4.

3.3.2.3.46 Auxiliary Systems—Heating Steam Condensate System—Summary of Aging Management Evaluation—LRA Table 3.3.2-46

The heating steam condensate system was included in an LRA supplement dated July 16, 2010.

The staff's evaluation for steel and gray cast iron heat exchanger headers and tubes, as well as humidifier, piping, strainer, trap body, tubing, and valve bodies exposed to steam (internal), which are being managed for loss of material by the BWR Water Chemistry, Chemistry Program Effectiveness Inspection, and Flow-Accelerated Corrosion Programs with a Generic Note G, is documented in SER Section 3.3.2.3.45.

The staff's evaluation for gray cast iron humidifier and trap body exposed to steam (internal) that is being managed for loss of material the Selective Leaching Inspection Program with a Generic Note G is documented in SER Section 3.3.2.3.45.

The staff's evaluation for stainless steel heat exchanger tubes and tubing exposed to steam (internal) that are being managed for loss of material, by the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs with a Generic Note G is documented in SER Section 3.3.2.3.45.

The staff's evaluation for copper alloy heat exchanger tubes, strainer (body), and valve body exposed to steam (internal) that are being managed for loss of material, by the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs with a Generic Note G is documented in SER Section 3.3.2.3.45.

The staff's evaluation for copper alloy and copper alloy (greater than 15 percent zinc) components exposed to air (internal) or air-indoor uncontrolled (internal and external) that have no proposed aging effect and no AMP, proposed with a Generic Note G, is documented in SER Section 3.3.2.3.4.

3.3.2.3.47 Auxiliary Systems—Heating Steam Vent System—Summary of Aging Management Evaluation—LRA Table 3.3.2-47

The heating steam vent system was included in an LRA supplement dated July 16, 2010.

The staff's evaluation for steel, and gray cast iron heat exchanger headers and tubes, as well as humidifier, piping, strainer, trap body, tubing, and valve bodies exposed to steam (internal), which are being managed for loss of material by the BWR Water Chemistry, Chemistry Program Effectiveness Inspection, and Flow-Accelerated Corrosion Programs with a Generic Note G, is documented in SER Section 3.3.2.3.45.

3.3.3 Conclusion

The staff concludes that the applicant provided sufficient information to demonstrate that the effects of aging for the auxiliary system components within the scope of license renewal and subject to an AMR will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4 <u>Aging Management of Steam and Power Conversion Systems</u>

This section of the SER documents the staff's review of the applicant's AMR results for the steam and power conversion system components and component groups of the following systems:

- Auxiliary Steam System
- Condensate (Auxiliary) System

- Condensate (Nuclear) System
- Main Steam System
- Main Steam Leakage Control System
- Miscellaneous Drain System
- RFW System
- Sealing Steam System

3.4.1 Summary of Technical Information in the Application

LRA Section 3.4 provides AMR results for the steam and power conversion system components and component groups. In LRA Table 3.4.1, "Summary of Aging Management Evaluations for Steam and Power Conversion," the applicant provided a summary comparison of its AMRs to those evaluated in the GALL Report for steam and power conversion system components and component groups.

The applicant's AMRs evaluated and incorporated applicable plant-specific and industry operating experience in the determination of AERMs. The plant-specific evaluation included issue reports and discussions with appropriate site personnel to identify AERMs. The applicant's review of industry operating experience included a review of the GALL Report and operating experience issues identified since the issuance of the GALL Report.

3.4.2 Staff Evaluation

The staff reviewed LRA Section 3.4 to determine if the applicant provided sufficient information to demonstrate that the effects of aging for steam and power conversion system components within the scope of license renewal and subject to an AMR will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff conducted an onsite audit of AMPs to ensure the applicant's claim that certain AMPs were consistent with the GALL Report. The purpose of this audit was to examine the applicant's AMPs and related documentation and to verify the applicant's claim of consistency with the corresponding GALL Report AMPs. The staff did not repeat its review of the matters described in the GALL Report. The staff's evaluations of the AMPs are documented in SER Section 3.0.3.

The staff reviewed the AMRs to confirm the applicant's claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. Details of the staff's evaluation are discussed in SER Sections 3.4.2.1 and 3.4.2.2.

The staff also reviewed the AMRs not consistent with or not addressed in the GALL Report. The review evaluated whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. Details of the staff's evaluation are discussed in SER Section 3.4.2.3.

For components that the applicant claimed were not applicable or required no aging management, the staff reviewed the AMR line items and the plant's operating experience to verify the applicant's claims.

Table 3.4-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.4 and addressed in the GALL Report.

Table 3.4-1 Staff evaluation for steam and power conversion system components in the GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel piping, piping components, and piping elements exposed to steam or treated water (3.4.1-1)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA	Fatigue is a TLAA (See SER Section 3.4.2.2.1)
Steel piping, piping components, and piping elements exposed to steam (3.4.1-2)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.4.2.2.2)
Steel heat exchanger components exposed to treated water (3.4.1-3)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Not applicable	Not applicable to BWRs (See SER Section 3.4.2.2.2)
Steel piping, piping components, and piping elements exposed to treated water (3.4.1-4)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.4.2.2.2)
Steel heat exchanger components exposed to treated water (3.4.1-5)	Loss of material due to general, pitting, crevice, and galvanic corrosion	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.4.2.2.9)
Steel and stainless steel tanks exposed to treated water (3.4.1-6)	Loss of material due to general (steel only), pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.4.2.2.7)
Steel piping, piping components, and piping elements exposed to lubricating oil (3.4.1-7)	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.2.2)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel piping, piping components, and piping elements exposed to raw water (3.4.1-8)	Loss of material due to general, pitting, crevice, and MIC and fouling	Plant-specific	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.2.3)
Stainless steel and copper alloy heat exchanger tubes exposed to treated water (3.4.1-9)	Reduction of heat transfer due to fouling	Water Chemistry and One-Time Inspection	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.2.4)
Steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil (3.4.1-10)	Reduction of heat transfer due to fouling	Lubricating Oil Analysis and One-Time Inspection	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.2.4)
Buried steel piping, piping components, piping elements, and tanks (with or without coating or wrapping) exposed to soil (3.4.1-11)	Loss of material due to general, pitting, crevice, and MIC	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	No Yes	 Buried Piping and Tanks Inspection	 Consistent with GALL Report (See SER Section 3.4.2.2.5)
Steel heat exchanger components exposed to lubricating oil (3.4.1-12)	Loss of material due to general, pitting, crevice, and MIC	Lubricating Oil Analysis and One-Time Inspection	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.2.5)
Stainless steel piping, piping components, and piping elements exposed to steam (3.4.1-13)	Cracking due to SCC	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.4.2.2.6)
Stainless steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water > 60 °C (140 °F) (3.4.1-14)	Cracking due to SCC	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Chemistry Program Effectiveness Inspection Bolting Integrity	Consistent with GALL Report (See SER Section 3.4.2.2.6)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Aluminum and copper alloy piping, piping components, and piping elements exposed to treated water (3.4.1-15)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.2.7)
Stainless steel piping, piping components, and piping elements; tanks and heat exchanger components exposed to treated water (3.4.1-16)	Loss of material due to pitting and crevice corrosion	Water Chemistry and One-Time Inspection	Yes	BWR Water Chemistry and Chemistry Program Effectiveness Inspection Bolting Integrity	Consistent with GALL Report (See SER Section 3.4.2.2.7)
Stainless steel piping, piping components, and piping elements exposed to soil (3.4.1-17)	Loss of material due to pitting and crevice corrosion	Plant-specific	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.2.7)
Copper alloy piping, piping components, and piping elements exposed to lubricating oil (3.4.1-18)	Loss of material due to pitting and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.2.7)
Stainless steel piping, piping components, piping elements, and heat exchanger components exposed to lubricating oil (3.4.1-19)	Loss of material due to pitting, crevice, and MIC	Lubricating Oil Analysis and One-Time Inspection	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.2.8)
Steel tanks exposed to air-outdoor (external) (3.4.1-20)	Loss of material due to general, pitting, and crevice corrosion	Aboveground Steel Tanks	No	Aboveground Steel Tanks Inspection	Consistent with GALL Report
High-strength steel closure bolting exposed to air with steam or water leakage (3.4.1-21)	Cracking due to cyclic loading and SCC	Bolting Integrity	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel bolting and closure bolting exposed to air with steam or water leakage, air-outdoor (external), or air-indoor uncontrolled (external) (3.4.1-22)	Loss of material due to general, pitting, and crevice corrosion; loss of preload due to thermal effects, gasket creep, and self-loosening	Bolting Integrity	No	Bolting Integrity	Consistent with GALL Report
Stainless steel piping, piping components, and piping elements exposed to closed-cycle cooling water > 60 °C (140 °F) (3.4.1-23)	Cracking due to SCC	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)
Steel heat exchanger components exposed to closed-cycle cooling water (3.4.1-24)	Loss of material due to general, pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)
Stainless steel piping, piping components, piping elements, and heat exchanger components exposed to closed-cycle cooling water (3.4.1-25)	Loss of material due to pitting and crevice corrosion	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)
Copper alloy piping, piping components, and piping elements exposed to closed-cycle cooling water (3.4.1-26)	Loss of material due to pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)
Steel, stainless steel, and copper alloy heat exchanger tubes exposed to closed-cycle cooling water (3.4.1-27)	Reduction of heat transfer due to fouling	Closed-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel external surfaces exposed to air-indoor uncontrolled (external), condensation (external), or air-outdoor (external) (3.4.1-28)	Loss of material due to general corrosion	External Surfaces Monitoring	No	External Surfaces Monitoring Buried Piping and Tanks Inspection Program Supplemental Piping/Tank Inspection Bolting Integrity Program	Consistent with GALL Report (See SER Section 3.4.2.1.2)
Steel piping, piping components, and piping elements exposed to steam or treated water (3.4.1-29)	Wall thinning due to flow-accelerated corrosion	Flow-Accelerated Corrosion	No	Flow-Accelerated Corrosion	Consistent with GALL Report
Steel piping, piping components, and piping elements exposed to air-outdoor (internal) or condensation (internal) (3.4.1-30)	Loss of material due to general, pitting, and crevice corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	External Surfaces Monitoring	Consistent with GALL Report (See SER Section 3.4.2.1.3)
Steel heat exchanger components exposed to raw water (3.4.1-31)	Loss of material due to general, pitting, crevice, galvanic, and MIC and fouling	Open-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)
Stainless steel and copper alloy piping, piping components, and piping elements exposed to raw water (3.4.1-32)	Loss of material due to pitting, crevice, and MIC	Open-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)
Stainless steel heat exchanger components exposed to raw water (3.4.1-33)	Loss of material due to pitting, crevice, and MIC and fouling	Open-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)
Steel, stainless steel, and copper alloy heat exchanger tubes exposed to raw water (3.4.1-34)	Reduction of heat transfer due to fouling	Open-Cycle Cooling Water System	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Copper alloy > 15% Zn piping, piping components, and piping elements exposed to closed-cycle cooling water, raw water, or treated water (3.4.1-35)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)
Gray cast iron piping, piping components, and piping elements exposed to soil, treated water, or raw water (3.4.1-36)	Loss of material due to selective leaching	Selective Leaching of Materials	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)
Steel, stainless steel, and nickel-alloy piping, piping components, and piping elements exposed to steam (3.4.1-37)	Loss of material due to pitting and crevice corrosion	Water Chemistry	No	BWR Water Chemistry and Chemistry Program Effectiveness Inspection	Consistent with GALL Report (See SER Section 3.4.2.1.4)
Steel bolting and external surfaces exposed to air with borated water leakage (3.4.1-38)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Not applicable	Not applicable to BWRs (See SER Section 3.4.2.1.1)
Stainless steel piping, piping components, and piping elements exposed to steam (3.4.1-39)	Cracking due to SCC	Water Chemistry	No	Not applicable	Not applicable to BWRs (See SER Section 3.4.2.1.1)
Glass piping elements exposed to air, lubricating oil, raw water, and treated water (3.4.1-40)	None	None	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)
Stainless steel, copper alloy, and nickel-alloy piping, piping components, and piping elements exposed to air-indoor uncontrolled (external) (3.4.1-41)	None	None	No	None	Consistent with GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel piping, piping components, and piping elements exposed to air-indoor controlled (external) (3.4.1-42)	None	None	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)
Steel and stainless steel piping, piping components, and piping elements in concrete (3.4.1-43)	None	None	No	Not applicable	Not applicable to Columbia (See SER Section 3.4.2.1.1)
Steel, stainless steel, aluminum, and copper alloy piping, piping components, and piping elements exposed to gas (3.4.1-44)	None	None	No	None	Consistent with GALL Report

The staff's review of the steam and power conversion system component groups followed several approaches. One approach, documented in SER Section 3.4.2.1, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.4.2.2, discusses the staff's review of AMR results for components the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.4.2.3, discusses the staff's review of AMR results for components the applicant indicated are not consistent with or not addressed in the GALL Report. The staff's review of AMPs credited to manage or monitor aging effects of the steam and power conversion system components is documented in SER Section 3.0.3.

3.4.2.1 AMR Results that are Consistent with the GALL Report

LRA Section 3.4.2.1 identifies materials, environments, AERMs, and the following programs that manage aging effects for the steam and power conversion system components:

- Aboveground Steel Tanks Inspection
- Bolting Integrity Program
- Buried Piping and Tanks Inspection Program
- BWR Water Chemistry Program
- Chemistry Program Effectiveness Inspection
- External Surfaces Monitoring Program
- Flow-Accelerated Corrosion Program
- Selective Leaching Inspection
- Supplemental Piping/Tank Inspection
- TLAA

LRA Tables 3.4.2-1 through 3.4.2-7 summarize the AMRs for the steam and power conversion system components and indicate AMRs claimed to be consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant claimed consistency and for which the GALL Report does not recommend further evaluation, the staff performed an audit and review to determine whether the plant-specific components in these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant provided a note for each AMR line item. The notes describe how the information in the tables aligns with the information in the GALL Report. The staff audited those AMRs with notes A through E, which indicate how the AMR was consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the GALL Report AMP. The staff audited these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report and confirmed that it reviewed and accepted the identified exceptions to the GALL Report AMPs. The staff also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP is consistent with the AMP identified by the GALL Report. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report; however, the applicant identified a different component in the GALL Report that had the same material, environment, aging effect, and AMP as the component under review. The staff audited these line items to verify consistency with the GALL Report and determined whether the AMR line item of the different component applied to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report and confirmed whether the AMR line item of the different component was applicable to the component under review. The staff confirmed whether the applicant reviewed and accepted the exceptions to the GALL Report AMPs. It also determined whether the AMP identified by the applicant was consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The staff audited these line items to verify consistency with the GALL Report and determined whether the identified AMP would manage the aging effect consistent with the AMP identified in the GALL Report and whether the AMR was valid for the site-specific conditions.

The staff audited and reviewed the information in the LRA. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMRs. The staff's evaluation follows.

3.4.2.1.1 AMR Results Identified as Not Applicable

For line items 3.4.1-38 and 3.4.1-39 in LRA Table 3.4.1 the applicant claimed that the corresponding AMR items in the GALL Report are not applicable because the associated line items are only applicable to PWRs. The staff reviewed the SRP-LR, confirmed these line items only applies to PWRs, and finds these line items are not applicable to Columbia.

For line items 3.4.1-21, 3.4.1-23, 3.4.1-24, 3.4.1-25, 3.4.1-26, 3.4.1-27, 3.4.1-31, 3.4.1-32, 3.4.1-33, 3.4.1-34, 3.4.1-35, 3.4.1-36, 3.4.1-42, 3.4.1-43 in LRA Table 3.4.1, the applicant claimed that it was not applicable. The staff reviewed the LRA and UFSAR and confirmed that the applicant's LRA does not have any AMR results that are applicable to these line items.

LRA Table 3.4.1, Item 3.4.1-40, addresses glass piping elements exposed to air, lubricating oil, raw water, and treated water and states that there are no aging effects, aging mechanisms, or AMPs. The GALL Report recommends that there is no aging effect or aging mechanism and that no AMP is recommended for this component group exposed to this environment; therefore, the staff finds the applicant's determination acceptable.

3.4.2.1.2 Loss of Material Due to General Corrosion

LRA Table 3.4.1, Item 3.4.1-28, addresses steel piping exposed to uncontrolled indoor air (external), which is being managed for loss of material due to general corrosion. The LRA credits the Buried Piping and Tanks Inspection Program to manage the aging effect for underground steel piping in LRA Table 3.4.2-3. The GALL Report recommends GALL Report AMP XI.36 "External Surfaces Monitoring" to ensure that these aging effects are adequately managed. The associated AMR line item cites Generic Note E and cites plant-specific Note 0408, which states that the Buried Piping and Tanks Inspection Program will manage loss of material for the carbon steel (steel) piping from the condensate storage tanks that is enclosed in guard pipe and buried.

For that line item associated with Generic Note E in LRA Table 3.4.2-3, GALL Report AMP XI.M36 recommends using periodic visual inspections to manage the aging of the line item. In its review of components associated with Item 3.4.1-28 for which the applicant cited Generic Note E, the staff noted that the Buried Piping and Tanks Inspection Program proposes to manage the aging of external surfaces of piping and tanks exposed to a buried environment. The Buried Piping and Tanks Inspection Program states that the integrity of coatings will be inspected when components are excavated for maintenance or other reasons. The Buried Piping and Tanks Inspection Program also states that if an opportunistic inspection has not occurred between year 30 and year 38, an excavation of a section of buried piping for the purpose of inspection will be performed before year 40. The Buried Piping and Tanks Inspection Program further states that an additional inspection of buried piping will be performed within 10 years after entering the period of extended operation.

The staff's evaluation of the applicant's Buried Piping and Tanks Inspection Program is documented in SER Section 3.0.3.2.3. The staff noted that the applicant's Buried Piping and Tanks Inspection Program provides for scheduled inspections of coating integrity on the external surfaces of buried piping and tanks. The staff also noted that GALL Report AMP XI.36 "External Surfaces Monitoring" calls for the direct visual inspection of the surfaces managed by this program. The staff further noted that the applicant's Buried Piping and Tanks Inspection Program makes no provisions for access to or direct inspection of the external surfaces of buried pipe enclosed in an outer guard pipe. By letter dated September 16, 2010, the staff issued RAI 3.4.2.3-1 requesting that the applicant explain how the external surface of underground piping enclosed in an outer guard pipe will be adequately managed for loss of material.

In its response dated December 21, 2010, the applicant stated that the condensate system piping runs through the condensate storage tank foundation mat before it enters the ground, then runs underground before entering the guard pipe and, finally, runs inside the guard pipe to the service building where a watertight boot seal is provided between the guard pipe and the building wall. The applicant also stated that the guard pipe is sealed at each end to prevent moisture and soil from entering the space between the guard pipe and the condensate pipe. The applicant further stated that the condensate pipe is prevented from contacting the guard pipe by the use of insulating cradles.

To manage aging for the condensate system pipe, the applicant stated that it will revise its program to perform one visual inspection of the external coating of the condensate pipe within the 10-year period prior to the period of extended operation and one similar visual inspection in each 10-year period after entering the period of extended operation. However, by letter dated January 28, 2011, the applicant revised its Buried Piping and Tanks Program to include management of underground piping and replaced the previously discussed visual inspection of the condensate pipe with a commitment (Commitment No. 5) to enhance the program to inspect 2 percent of the buried steel piping and 2 percent of the underground steel piping within the 10-year period prior to the period of extended operation and in each 10-year period after entering the period of extended operation. The staff finds the applicants response, and its proposal to manage aging using the Buried Piping and Tanks Inspection Program, acceptable because the condensate system guard pipe is sealed at each end to prevent water intrusion, insulating cradles prevent contact between the condensate system pipe and the guard pipe, and the applicant committed to perform additional visual inspections of condensate system piping prior to and during the period of extended operation. The staff's concern described in RAI 3.4.2.3-1 is resolved.

LRA Table 3.4.1, Item 3.4.1-28, addresses steel piping exposed to uncontrolled indoor air (external), which is being managed for loss of material due to general corrosion. The LRA credits the Supplemental Piping/Tank Inspection Program to manage the aging effect for steel piping in LRA Table 3.4.2-4. The GALL Report recommends GALL Report AMP XI.36 "External Surfaces Monitoring" to ensure that these aging effects are adequately managed. The associated AMR line item cites Generic Note E and plant-specific Note 0401, which states that The Supplemental Piping/Tank Inspection Program will manage loss of material at the air-water interface on and within the main steam relief valve discharge piping at the surface of the suppression pool.

For that line item associated with Generic Note E, in LRA Table 3.4.2-4, GALL Report AMP XI.M36 recommends using periodic visual inspections to manage the aging of the line item. In its review of components associated with Item 3.4.1-28 for which the applicant cited Generic Note E, the staff noted that the applicant's Supplemental Piping/Tank Inspection Program proposes to manage the aging of steel, gray cast iron, and stainless steel components that are exposed to moist air environments, particularly the aggressive alternate wet and dry environment that exists at air water interfaces or air spaces of susceptible piping and tanks using a combination of volumetric and visual one-time inspections of the internal and external surfaces to identify evidence of a loss of material

The staff's evaluation of the applicant's Supplemental Piping/Tank Inspection Program is documented in SER Section 3.0.3.1.29. In its review of components associated with line Item 3.4.1-28, in LRA Table 3.4.2-4, the staff noted that the component is also being managed for loss of material by the External Surfaces Monitoring Program in another line item in the same table. The staff also noted that the External Surfaces Monitoring Program includes periodic inspections of the external surfaces of components for evidence of loss of material. The staff finds the applicant's proposal to manage aging using the Supplemental Piping/Tank Inspection Program acceptable because the program includes a combination of visual and volumetric examinations, which are capable of detecting loss of material, and the components are also being managed by the External Surfaces Monitoring Program using periodic visual inspections for loss of material.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

LRA Table 3.4.1, Item 3.4.1-28, addresses steel bolting exposed to condensation (external), which is being managed for loss of material due to general corrosion. The LRA credits the Bolting Integrity Program to manage the aging effect for steel bolting in LRA Table 3.4.2-3. The GALL Report recommends GALL Report AMP XI.36, "External Surfaces Monitoring," to ensure that these aging effects are adequately managed. The associated AMR line item cites Generic Note E.

For that line item associated with Generic Note E, in LRA Table 3.4.2-3, GALL Report AMP XI.M36 recommends using periodic visual inspections to manage the aging of the line item. In its review of components associated with Item 3.4.1-28 for which the applicant cited Generic Note E, the staff noted that the applicant's Bolting Integrity Program proposes to manage the aging effect through periodic inspections of the bolting for indications of degradation.

The staff's evaluation of the applicant's Bolting Integrity Program is documented in SER Section 3.0.3.2.2. In its review of components associated with line Item 3.4.1-28, the staff finds the applicant's proposal to manage aging using the Bolting Integrity Program acceptable because the program includes periodic inspections of the bolting for indications of degradation and loss of material.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.1.3 Loss of Material Due to General, Pitting, and Crevice Corrosion

LRA Table 3.4.1, Item 3.4.1-30, addresses steel piping in the condensate (nuclear) system exposed to outdoor air or condensation (internal), which are being managed for loss of material due to general, pitting, and crevice corrosion. The LRA credits the External Surfaces Monitoring Program to manage the aging effect. The GALL Report recommends GALL Report AMP XI.M38 "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components" to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For that line item associated with Generic Note E, GALL Report AMP XI.M38 recommends using periodic visual inspections to manage the aging of that line item. In its review of components associated with Item 3.4.1-30 for which the applicant cited Generic Note E, the staff noted that the External Surfaces Monitoring Program proposes to manage the aging of steel piping through the use of visual inspections and surveillance activities of accessible external surfaces on a frequency that generally exceeds once per fuel cycle. The External Surfaces Monitoring Program states that surfaces that are inaccessible during normal plant operation are inspected during RFOs. The External Surfaces Monitoring Program also states that surfaces that are inaccessible or not readily visible during both plant operations and RFOs, such as surfaces that are insulated, are inspected opportunistically.

The staff reviewed the applicant's External Surfaces Monitoring Program. and its evaluation is documented in SER Section 3.0.3.2.6. The staff noted that the applicant's External Surfaces Monitoring Program provides for periodic visual inspections of external surfaces in a manner similar to the periodic visual inspections of internal surfaces performed under GALL Report AMP XI.M38 "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The staff also noted that the applicant states that the internal surfaces of the steel piping in the condensate (nuclear) system are exposed to the same environment (outdoor air) as the external surfaces. In its review of components associated with line Item 3.4.1-30, the staff finds the applicant's proposal to manage aging using the External Surfaces Monitoring Program acceptable because the proposed periodic visual inspections of the piping external surfaces under this program are equivalent to the periodic visual inspections of internal surfaces recommended under GALL Report AMP XI.38 "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components."

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.1.4 Loss of Material Due to Pitting and Crevice Corrosion

LRA Table 3.4.1, Item 3.4.1-37, addresses steel and stainless steel piping, piping components, and piping elements exposed to steam, which are being managed for loss of material due to pitting and crevice corrosion. The LRA credits the BWR Water Chemistry and the Chemistry Program Effectiveness Inspection Programs to manage the aging effect. The GALL Report recommends GALL Report AMP XI.2 "Water Chemistry" to ensure that these aging effects are adequately managed. The associated AMR line items that credit the Chemistry Program Effectiveness Inspection Program cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M2 recommends using sampling procedures and controls on water chemistry impurity levels, as defined in EPRI TR-103515 or later revisions to manage the aging of these line items. In its review of components associated with Item 3.4.1-37 for which the applicant cited Generic Note E, the staff noted that the BWR Water Chemistry Program proposes to manage the aging of steel, stainless steel, and nickel-based alloy piping, piping components, and piping elements through the use of sampling procedures and controls on water chemistry impurity levels, as defined in the current EPRI guidelines. In addition, the applicant's Chemistry Program Effectiveness Inspection proposes to verify the effectiveness of the BWR Water Chemistry Program through the use of volumetric and visual examination techniques to identify evidence of a loss of material, cracking, and other forms of degradation.

The staff‘s evaluation of the applicant’s BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection Program are documented in SER Sections 3.0.3.1.7 and 3.0.3.1.8. The staff noted that the applicant’s BWR Water Chemistry Program is consistent with the BWR water chemistry portions of GALL Report AMP XI.M2 and the application of the applicant’s BWR Water Chemistry Program to LRA line item 3.4.1-37 is consistent with the GALL Report recommendations. The staff also noted that the applicant’s proposed use of its Chemistry Program Effectiveness Inspection Program provides additional verification of the effectiveness of its BWR Water Chemistry Program. In its review of components associated with line item 3.4.1-37 the staff finds the applicant’s proposal to manage aging using the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs acceptable for the following reasons:

- The BWR Water Chemistry Program establishes the plant water chemistry control parameters and identifies the actions required if the parameters exceed limits.
- The Chemistry Program Effectiveness Inspection Program includes a one-time inspection of select components to verify the effectiveness of the BWR Water Chemistry Program for managing the effects of aging due to SCC in a manner consistent with the GALL Report and SRP-LR.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2 AMR Results that are Consistent with the GALL Report, for Which Further Evaluation is Recommended

LRA Section 3.4.2.2 provides further evaluation of aging management, as recommended by the GALL Report for the steam and power conversion system components. The applicant provided information concerning how it will manage the following aging effects:

- cumulative fatigue damage
- loss of material due to general, pitting, and crevice corrosion
- loss of material due to general, pitting, crevice, and MIC and fouling
- reduction of heat transfer due to fouling
- loss of material due to general, pitting, crevice, and MIC
- cracking due to SCC
- loss of material due to pitting and crevice corrosion
- loss of material due to pitting, crevice, and MIC
- loss of material due to general, pitting, crevice, and galvanic corrosion

For component groups evaluated in the GALL Report for which the applicant claimed consistency with the GALL Report and for which the GALL Report recommends further evaluation, the staff audited and reviewed the applicant’s evaluations to determine whether it adequately address those issues and reviewed the applicant’s further evaluations against the criteria in SRP-LR Section 3.4.2.2. The staff’s review of the applicant’s further evaluations follows.

3.4.2.2.1 Cumulative Fatigue Damage

LRA Section 3.4.2.2.1 associated with LRA Table 3.4.1, Item 3.4.1-1, addresses steel piping, piping components, and piping elements exposed to steam or treated water, which are being managed for cumulative fatigue damage. The applicant addressed the further evaluation criteria of the SRP-LR by stating that fatigue is a TLAA, as defined in 10 CFR 54.3, and is required to be evaluated in accordance with 10 CFR 54.21(c). The applicant stated that the TLAA identified for the steam and power conversion systems is addressed separately in LRA Section 4.3.4. The staff's evaluation is documented in SER Section 4.3.4.2.

The staff reviewed LRA Section 3.4.2.2.1 against the criteria in SRP-LR Section 3.4.2.2.1, which states that fatigue of steam and power conversion system components is a TLAA as defined in 10 CFR 54.3, and that these TLAAs are to be evaluated in accordance with the TLAA acceptance criteria requirements in 10 CFR 54.21(c) and in accordance with the staff's recommended acceptance criteria and review procedures for reviewing these TLAAs in SRP-LR Section 4.3, "Metal Fatigue Analysis." The staff reviewed the applicant's AMR line items and finds that the AMR results are consistent with the recommendations of the GALL Report and SRP-LR for managing cumulative fatigue damage in steel piping, piping components, and piping elements exposed to steam or treated water.

With regard to the applicant's metal fatigue AMR assessment, LRA Table 3.4.1, Item 3.4.1-01, for its steam and power conversion systems, the staff found that the applicant's AMR assessment complied with the recommendations in SRP-LR Section 3.4.2.2.1. However, the staff also noted that AMR Item 3.4.1-01 is not included in the LRA Tables that list the AMR results for its steam and power conversion system components. Therefore, as part of the RAI, "Cumulative Fatigue Damage AMR," the staff asked the applicant to justify why LRA Tables 3.4.2-1 to 3.4.2-7 for the steam and power conversion subsystem components do not include any AMR items related to TLAA for managing cumulative fatigue damage in the steel piping, piping components, and piping elements exposed to steam or treated water. The applicant's response to the RAI and the staff's evaluation and acceptance of the RAI response is documented in SER Section 3.2.2.2.1.

Based on the staff's review, the staff concludes that the applicant met the SRP-LR Section 3.4.2.2.1 criteria. For those line items that apply to LRA Section 3.4.2.2.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3). SER Section 4.3 documents the staff's review of the applicant's evaluation of the TLAA for these components.

3.4.2.2.2 Loss of Material Due to General, Pitting, and Crevice Corrosion

(1) LRA Section 3.4.2.2.2 refers to LRA Table 3.4.1, Items 3.4.1-02 and 3.4.1-04, and addresses steel piping, piping components, and piping elements exposed to treated water or steam, which are being managed for loss of material due to general, pitting, and crevice corrosion by the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that its BWR Water Chemistry Program manages aging effects through periodic monitoring and control of contaminants. The applicant also stated that one-time inspections under its Chemistry Program Effectiveness Inspection will provide a verification of the effectiveness of the BWR Water Chemistry Program to manage loss

of material due to general, pitting, and crevice corrosion through examination of steel piping components and tanks exposed to treated water.

The staff reviewed LRA Section 3.4.2.2.2.1 against the criteria in SRP-LR Section 3.4.2.2.2, Item 1, which states that loss of material due to general, pitting, and crevice corrosion could occur for steel piping, piping components, and piping elements exposed to treated water or steam. The SRP-LR also states that the existing AMP relies on monitoring and control of water chemistry to manage the effects of loss of material due to general, pitting, and crevice corrosion but that control of water chemistry does not preclude loss of material due to general, pitting, and crevice corrosion at locations of stagnant-flow conditions. The SRP further states that the effectiveness of the Water Chemistry Control Program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to verify the effectiveness of the Water Chemistry Control Program. A one-time inspection of select components and susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

The staff's evaluations of the applicant's BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs are documented in SER Sections 3.0.3.1.7 and 3.0.3.1.8, respectively. In its review of components associated with line Items 3.4.1-02 and 3.4.1.04, the staff finds the applicant's proposal to manage aging using the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs acceptable because the BWR Water Chemistry Program provides for monitoring and control of water chemistry to adequately manage the effects of loss of material due to general, pitting, and crevice corrosion, and the Chemistry Program Effectiveness Inspection Program provides adequate verification of the effectiveness of the Water Chemistry Control Program. The combination of programs is consistent with the recommendation in the SRP-LR for these components.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.2, Item 1, criteria. For those line items that apply to LRA Section 3.4.2.2.2, Item 1, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

LRA Section 3.4.2.2.2 also refers to LRA Table 3.4.1 item 3.4.1-03 which addresses steel heat exchanger components exposed to treated water. The applicant stated that associated item is only applicable to PWRs. The staff reviewed the SRP-LR, confirmed this item only applies to PWRs, and finds this item is not applicable to Columbia.

(2) LRA Section 3.4.2.2.2.2, referenced by LRA Table 3.4.1, Item 3.4.1-07, addresses steel piping, piping components, and piping elements exposed to lubricating oil, which are being managed for loss of material due to general, pitting, and crevice corrosion by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that this item is not applicable because there is no steel piping, piping components, or piping elements in the steam and power conversion systems exposed to lubricating oil.

The staff reviewed the UFSAR and confirmed that there are no steel piping, piping components, or piping elements in the steam and power conversion systems exposed to lubricating oil.

Based on information in the UFSAR, the staff confirmed that the applicant's plant does not have steel piping, piping components, or piping elements in the steam and power conversion systems exposed to lubricating oil. Therefore, the staff finds that this item is not applicable.

3.4.2.2.3 Loss of Material Due to General, Pitting, Crevice, and MIC and Fouling

LRA Section 3.4.2.2.3, associated with LRA Table 3.4.1 Item 3.4.1-8, addresses loss of material due to general, pitting, crevice, and MIC and fouling in steel piping, piping components, and piping elements exposed to raw water. The applicant stated that this line item is not applicable because there are no steel components exposed to raw water in the steam and power conversion system. The staff reviewed LRA Sections 2.3.4 and 3.4 and the applicant's UFSAR and confirmed that no in-scope steel piping, piping components, and piping elements exposed to raw water are present in the steam and power conversion system; therefore, the staff finds the applicant's determination acceptable.

3.4.2.2.4 Reduction of Heat Transfer Due to Fouling

(1) LRA Section 3.4.2.2.4.1, associated with LRA Table 3.4.1, Item 3.4.1-9, addresses reduction of heat transfer due to fouling in stainless steel and copper alloy heat exchanger tubes exposed to treated water. The applicant stated that this item is not applicable to Columbia because there are no stainless steel or copper alloy heat exchanger tubes in the steam and power conversion systems exposed to treated water. The staff reviewed LRA Sections 2.3.4 and 3.4 and the UFSAR and confirmed that no in-scope stainless steel and copper alloy heat exchanger tubes exposed to treated water are present in the steam and power conversion systems; therefore, it finds the applicant's determination acceptable.

(2) LRA Section 3.4.2.2.4.2, referenced by LRA Table 3.4.1, Item 3.4.1-10, addresses steel, stainless steel, and copper alloy heat exchanger tubes exposed to lubricating oil, which are being managed for reduction in heat transfer due to fouling by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that this item is not applicable because there are no steel, stainless steel, and copper alloy heat exchanger tubes in the steam and power conversion systems exposed to lubricating oil.

The staff reviewed the UFSAR and confirmed that there are no steel, stainless steel, and copper alloy heat exchanger tubes in the steam and power conversion systems exposed to lubricating oil.

Based on information in the UFSAR, the staff confirmed that the applicant's plant does not have steel, stainless steel, and copper alloy heat exchanger tubes in the steam and power conversion systems exposed to lubricating oil. Therefore, the staff finds that this item is not applicable.

3.4.2.2.5 Loss of Material Due to General, Pitting, Crevice, and MIC

(1) LRA Section 3.4.2.2.5.1 is referenced by LRA Table 3.4.1, Item 3.4.1-11, and addresses steel piping, piping components, piping elements with coating or wrapping exposed to soil, which are being managed for loss of material due to general, pitting, crevice, and MIC by the Buried Piping and Tanks Inspection Program. The staff reviewed LRA Section 3.4.2.2.5.1 against the criteria in SRP-LR Section 3.4.2.2.5 Item 1, which states that loss of material due to general, pitting, crevice, and MIC could occur for steel piping, piping components, and piping elements, with or without coating or wrapping, exposed to soil. The SRP-LR also states that the effectiveness of the Buried Piping And Tanks Inspection Program should be verified to evaluate the applicant's inspection frequency and operating experience with buried components, ensuring that loss of material is not occurring. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the Buried Piping and Tanks Inspection Program is credited to manage loss of material of the steel piping components with coatings.

The staff's evaluation of the applicant's Buried Piping and Tanks Inspection Program is documented in SER Section 3.0.3.2.3. The staff notes that there is no plant-specific operating experience to indicate that the applicant's program would not be effective in managing aging effects during the period of extended operation. In its review of components associated with line item 3.4.1-11, the staff finds the applicant's proposal to manage aging using the Buried Piping and Tanks Inspection Program acceptable because the proposed program is a combination of a mitigation program consisting of protective coatings and a condition monitoring program consisting of visual inspections that will detect the loss of material aging effect, and as discussed in the response and staff evaluation of RAI B.2.5-1 in SER Section 3.0.3.2.3, the applicant has adjusted the frequency of its inspections based on plant-specific and industry operating experience.

Based on the program identified, the staff concludes that the applicant's program meets SRP-LR Section 3.3.2.2.8 criteria. For those line items that apply to LRA Section 3.4.2.2.5, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(2) LRA Section 3.4.2.2.5.2, referenced by LRA Table 3.4.1, Item 3.4.1-12, addresses steel heat exchanger components exposed to lubricating oil, which are being managed for loss of material due to general, pitting, crevice, and MIC by the Lubricating Oil Analysis and Lubricating Oil Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that this item is not applicable because there are no steel heat exchanger components in the steam and power conversion systems exposed to lubricating oil.

The staff reviewed the UFSAR and confirmed that there are no steel heat exchanger components in the steam and power conversion systems exposed to lubricating oil.

Based on information in the UFSAR, the staff confirmed that the applicant's plant does not have steel heat exchanger components in the steam and power conversion systems exposed to lubricating oil. Therefore, the staff finds that this item is not applicable.

3.4.2.2.6 Cracking Due to Stress-Corrosion Cracking

LRA Section 3.4.2.2.6 associated with LRA Table 3.4.1, Items 3.4.1-13 and 3.4.1-14, addresses stainless steel components exposed to either steam or treated water greater than 60 °C (140 °F), which are being managed for cracking due to SCC by the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection Program. The applicant also stated that for stainless steel bolting exposed to treated water, these components are managed by the Bolting Integrity Program. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the BWR Water Chemistry Program will manage aging effects through periodic monitoring and control of contaminants. The applicant also stated that it will use the Chemistry Program Effectiveness Inspection Program to provide a verification of the effectiveness of the BWR Water Chemistry Program. The applicant further stated that the Bolting Integrity Program will include periodic inspections of the bolting for indications of degradation.

The staff reviewed LRA Section 3.4.2.2.6 against the criteria in SRP-LR Section 3.4.2.2.6, which states that cracking due to SCC could occur for stainless steel piping, piping components, piping elements, tanks, and heat exchanger components exposed to treated water greater than 60 °C (140 °F) and for stainless steel piping, piping components, and piping elements exposed to steam. The SRP-LR also states that the existing AMP relies on monitoring and control of water chemistry to manage the effects of cracking due to SCC and that high concentration of impurities at crevices and locations of stagnant-flow conditions could cause SCC. The SRP-LR further stated that the GALL Report recommends that the effectiveness of the Water Chemistry Program should be verified to ensure that SCC is not occurring. In addition, the SRP-LR states that a one-time inspection of elected components at susceptible locations is an acceptable method to ensure that SCC is not occurring.

The staff's evaluations of the applicant's BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs are documented in SER Sections 3.0.3.1.7 and 3.0.3.1.8, respectively. The applicant stated that the BWR Water Chemistry Program is a mitigation program that manages loss of material, cracking, and reduction of heat transfer through proper monitoring and control consistent with the EPRI Water Chemistry guidelines. The applicant also indicated that the Chemistry Program Effectiveness Inspection Program will detect and characterize the material conditions in representative low-flow and stagnant areas of the plant systems influenced by the BWR Water Chemistry Program. In its review of components associated with line Items 3.4.1-13 and 3.4.1-14, the staff finds the applicant's proposal to manage aging using the BWR Water Chemistry Program and Chemistry Program Effectiveness Inspection Program acceptable for the following reasons:

- The BWR Water Chemistry Program establishes the plant water chemistry control parameters and identifies the actions required if the parameters exceed limits.
- The Chemistry Program Effectiveness Inspection Program includes a one-time inspection of select components to verify the effectiveness of the BWR Water Chemistry Program for managing the effects of aging due to SCC in a manner consistent with the GALL Report and SRP-LR.

The staff's evaluation of the applicant's Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The applicant stated that the Bolting Integrity Program relies on the manufacturer and vendor information and industry recommendations for proper selection, assembly, and maintenance of bolting. The applicant further stated that the Bolting Integrity Program consists of periodic inspection of bolting for indications of degradation, such as leakage, loss of material, loss of pre-load, and cracking. In its review, the staff finds the applicant's proposal to manage aging using the Bolting Integrity Program acceptable because the periodic inspections will detect the effect of aging in a timely manner, and the applicant's operating experience described in the LRA indicates that no instances of cracking have been identified for bolting or fasteners, which supports the effectiveness of the applicant's aging management.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.6 criteria. For those line items that apply to LRA Section 3.4.2.2.6, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.7 Loss of Material Due to Pitting and Crevice Corrosion

(1) LRA Section 3.4.2.2.7.1 is referenced by LRA Table 3.4.1, Items 3.4.1-6, 3.4.1-15, and 3.4.1-16, and addresses stainless steel piping components and tanks exposed to treated water, which are being managed for loss of material due to pitting and crevice corrosion by the BWR Water Chemistry Program and the Chemistry Program Effectiveness Inspection Program. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the BWR Water Chemistry Program manages aging effects through periodic monitoring and control of contaminants. The applicant also stated that the Chemistry Program Effectiveness Inspection Program will provide verification of the effectiveness of the BWR Water Chemistry Program through examination of stainless steel piping components. The applicant stated that there are no aluminum components, copper components, or stainless steel tanks or heat exchangers exposed to treated water in the steam and power conversion system. The applicant further stated that the stainless steel bolting exposed to treated water would be managed by the Bolting Integrity Program.

The staff reviewed LRA Section 3.4.2.2.7.1 against the criteria in SRP-LR Section 3.4.2.2.7, Item 1, which states that loss of material due to pitting and crevice corrosion could occur for stainless steel, aluminum, and copper alloy piping, piping components, and piping elements and stainless steel tanks and heat exchanger components exposed to treated water. The SRP-LR also states that the existing AMP relies on monitoring and control of water chemistry to mitigate degradation. The SRP-LR further states that the effectiveness of the chemistry control should be verified to ensure that corrosion is not occurring by using a one-time inspection of select components at susceptible locations.

The staff's evaluations of the applicant's BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs are documented in SER Sections 3.0.3.1.7 and 3.0.3.1.8, respectively. In its review of components associated with line Items 3.4.1-6 and 3.4.1-16, the staff finds the applicant's proposal to manage aging using the above specified programs acceptable because the BWR Water Chemistry Program will monitor and control plant water chemistry parameters consistent with the EPRI water chemistry guidelines, and the Chemistry Program Effectiveness Inspection Program will verify the effectiveness of the BWR Water Chemistry Program through a one-time inspection of select components in susceptible locations.

For line Item 3.4.1-6, the applicant stated that there are no in-scope stainless steel tanks in the steam and power conversion systems exposed to treated water. The staff reviewed LRA Section 2.3.4 and 3.4 and the UFSAR and confirmed that no in-scope stainless steel tanks exposed to treated water are present in the steam and power conversion systems.

For line Item 3.4.1-15, the applicant stated that there are no in-scope aluminum or copper alloy piping, piping components, or piping elements in the steam and power conversion systems exposed to treated water. The staff reviewed LRA Section 2.3.4 and 3.4 and the UFSAR and confirmed that no in-scope aluminum or copper alloy piping, piping components, or piping elements exposed to treated water are present in the steam and power conversion system.

For line Item 3.4.1-16, the applicant stated that there are no in-scope stainless steel tanks or heat exchanger components in the steam and power conversion systems exposed to treated water. The staff reviewed LRA Section 2.3.4 and 3.4 and the UFSAR and confirmed that no in-scope stainless steel tanks or heat exchanger components exposed to treated water are present in the steam and power conversion system.

The staff's evaluation of the applicant's Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The applicant stated that the Bolting Integrity Program is a Condition Monitoring Program that consists of the periodic inspection of bolting for indications of degradation including leakage, loss of material, and cracking. In its review of components associated with line Item 3.4.1-16, the staff finds the applicant's proposal to manage aging using the Bolting Integrity Program acceptable because the Bolting Integrity Program includes periodic inspections for aging bolting, consistent with the GALL Report guidance.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.7.1 criteria. For those line items that apply to LRA Section 3.4.2.2.7.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(2) LRA Section 3.4.2.2.7.2 associated with LRA Table 3.4.1, Item 3.4.1-17, addresses loss of material due to pitting and crevice corrosion in stainless steel piping, piping components, and piping elements exposed to soil. The applicant stated that this line item is not applicable because there are no stainless steel piping components in the steam and power conversion systems that are exposed to soil. The staff reviewed LRA Sections 2.3.4 and 3.4 and the UFSAR and confirmed that no in-scope stainless steel piping, piping components, and piping elements exposed to soil are present in the steam and power conversion systems; therefore, it finds the applicant's determination acceptable.

(3) LRA Section 3.4.2.2.7.3, referenced by LRA Table 3.4.1, Item 3.4.1-18, addresses copper alloy piping, piping components, and piping elements exposed to lubricating oil. The applicant addressed the further evaluation criteria of the SRP-LR by stating that this item is not applicable because there are no copper alloy piping, piping components, and piping elements in the steam and power conversion systems exposed to lubricating oil.

The staff reviewed the UFSAR and confirmed that there are no copper alloy piping, piping components, and piping elements in the steam and power conversion systems exposed to lubricating oil.

Based on information in the UFSAR, the staff confirmed that the applicant's plant does not have copper alloy piping, piping components, and piping elements in the steam and power conversion systems exposed to lubricating oil. Therefore, the staff finds that this item is not applicable.

3.4.2.2.8 Loss of Material Due to Pitting, Crevice, and MIC

LRA Section 3.4.2.2.8, referenced by LRA Table 3.4.1, Item 3.4.1-19, addresses stainless steel piping, piping components, piping elements, and heat exchanger components exposed to lubricating oil. The applicant addressed the further evaluation criteria of the SRP-LR by stating that this item is not applicable because there are no stainless steel piping, piping components, piping elements, and heat exchanger components in the steam and power conversion systems exposed to lubricating oil.

The staff reviewed the UFSAR and confirmed that there are no stainless steel piping, piping components, piping elements, and heat exchanger components in the steam and power conversion systems exposed to lubricating oil.

Based on information in the UFSAR, the staff confirmed that the applicant's plant does not have stainless steel piping, piping components, piping elements, and heat exchanger components in the steam and power conversion systems exposed to lubricating oil. Therefore, the staff finds that this item is not applicable.

3.4.2.2.9 Loss of Material Due to General, Pitting, Crevice, and Galvanic Corrosion

LRA Section 3.4.2.2.9 is referenced by LRA Table 3.4.1, Item 3.4.1-05, and addresses steel heat exchanger components exposed to treated water, which are being managed for loss of material due to general, pitting, crevice, and galvanic corrosion by the BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs. The applicant addressed the further evaluation criteria of the SRP-LR by stating that loss of material due to general, galvanic, pitting, and crevice corrosion for steel heat exchanger components (main condenser shell) exposed to treated water in the steam and power conversion systems is managed by the BWR Water Chemistry Program through periodic monitoring and control of contaminants. The applicant also stated that the Chemistry Program Effectiveness Inspection Program will provide a verification of the effectiveness of the BWR Water Chemistry Program to manage loss of material through examination of steel heat exchanger components exposed to treated water.

The staff reviewed LRA Section 3.4.2.2.9 against the criteria in SRP-LR Section 3.4.2.2.9, which states that loss of material due to general, pitting, crevice, and galvanic corrosion can occur for steel heat exchanger components exposed to treated water. The SRP-LR also states that the existing AMP relies on monitoring and control of water chemistry to manage the effects of loss of material, but control of water chemistry does not preclude loss of material at locations of stagnant-flow conditions. The SRP-LR further states that the effectiveness of the Water Chemistry Control Program should be verified, and a one-time inspection of select components in susceptible locations is an acceptable method to ensure that corrosion is not occurring.

The staff's evaluations of the applicant's BWR Water Chemistry and Chemistry Program Effectiveness Inspection Programs are documented in SER Sections 3.0.3.1.7 and 3.0.3.1.8, respectively. The staff notes that the BWR Water Chemistry Program controls of relevant water conditions to ensure the water chemistry is maintained to the required quality. The staff also notes that the Chemistry Program Effectiveness Inspection Program is a new One-Time Inspection Program, which will provide a one-time inspection of representative sample at low-flow and stagnant areas for evidence of loss of material. In its review of components associated with line Item 3.4.1-05, the staff finds the applicant's proposal to manage aging using the above programs acceptable because BWR Water Chemistry Program maintains water chemistry to minimize contaminants, which can lead to loss of material, and the Chemistry Program Effectiveness Inspection Program verifies the effectiveness of the BWR Water Chemistry Program to manage loss of material

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.4.2.2.9 criteria. For those line items that apply to LRA Section 3.4.2.2.9, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.2.10 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA Program.

3.4.2.3 AMR Results that are Not Consistent with or Not Addressed in the GALL Report

In LRA Tables 3.4.2-1 through 3.4.2-7, the staff reviewed additional details of AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

In LRA Tables 3.4.2-1 through 3.4.2-7, the applicant indicated, via notes F through J, that the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report. The applicant provided further information concerning how the aging effects will be managed. Specifically, Note F indicates that the material for the AMR line item component is not evaluated in the GALL Report. Note G indicates that the environment for the AMR line item component and material is not evaluated in the GALL Report. Note H indicates that the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report. Note I indicates that the aging effect identified in the GALL Report for the line item component, material, and environment combination is not applicable. Note J indicates that neither the component nor the material and environment combination for the line item is evaluated in the GALL Report.

For component type, material, and environment combinations not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine if the applicant demonstrated that the aging effects will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation. The staff's evaluation is discussed in the following sections.

3.4.2.3.1 Steam and Power Conversion System—Auxiliary Steam System—Summary of Aging Management Evaluation—LRA Table 3.4.2-1

In LRA Tables 3.4.2-1 and 3.4.2-4, the applicant stated that the gray cast iron trap bodies exposed to steam (internal) are being managed for loss of material by the Selective Leaching

Inspection Program. The AMR line items cite Generic Note G, indicating that, for the line items, the environment is not in the GALL Report for this component and material.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this components, material, and environmental combination because, even though the gray cast iron exposed to steam (internal) is not specifically addressed in the GALL Report, Section XI.M33 "Selective Leaching of Materials" AMP of the GALL Report states that gray cast iron may be susceptible to selective leaching, and loss of material is being managed for these components in other line items in the same tables.

The staff's evaluation of the applicant's Selective Leaching Inspection Program is documented in SER Section 3.0.3.1.26. The staff noted that the Selective Leaching Program is a new program that is designed to detect and characterize the conditions on internal and external surfaces of components that are exposed to raw water, treated water (including closed cycle cooling water and steam), fuel oil, soil (buried), and moist air (including condensation) environments. The staff also noted that this One-Time Inspection Program is a combination of visual examination and material hardness testing, or NRC-approved alternative, and it provides direct evidence of whether, and to what extent loss of material due to selective leaching has occurred or is likely to occur in a loss of intended function. The staff finds the applicant's proposal acceptable because the program includes visual examinations and hardness testing, which are appropriate methods for determining whether loss of material due to selective leaching is occurring.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.4.2-1 and 3.4.2-3 the applicant stated that the steel bolting exposed to condensation (external) or air-outdoor (external) is being managed for cracking and loss of pre-load, by the Bolting Integrity AMP. The related AMR line items cite Generic Note H, indicating that the aging effect is not in the GALL Report for this component, material, and environment combination. Line item associated with bolting in Table 3.4.2-3 cites plant-specific Note 0407 which states that the Bolting Integrity Program will also manage cracking for the carbon and low-alloy (steel) bolting at the base and foundation of the condensate storage tanks due to potential for ponding or pooling of water.

The staff reviewed all AMR result line items in the GALL Report where the component and material is steel bolting exposed to condensation (external) or air-outdoor (external), and confirmed that there are no aging effect entries (for cracking or loss of pre-load) in the GALL Report for this component, material, and environment combination.

The staff's evaluation of the applicant's Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The staff finds the applicant's proposal to manage aging using the Bolting Integrity Program acceptable because the staff confirmed that the aging effects identified are appropriate for these component, material, and environment combinations and that the proposed aging related inspections under the applicant's Bolting Integrity Program will be adequate to detect this aging.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM and AMP combinations not addressed in the GALL

Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.2 Steam and Power Conversion System—Condensate (Auxiliary) System—Summary of Aging Management Evaluation—LRA Table 3.4.2-2

In LRA Tables 3.3.2-43 and 3.4.2-2, the applicant stated that the steel bolting exposed to outdoor air (external) is being managed for loss of preload by the Bolting Integrity Program. The AMR line items cite Generic Note H, indicating that, for the line item(s), the aging effect is not in the GALL Report for this component, material, and environment combination.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this components, material, and environmental combination because, even though the steel bolting exposed to outdoor air (external) is not specifically addressed in the GALL Report AMP XI.M18 “Bolting Integrity,” which recommends following industry guidance and practice to prevent or mitigate degradation and failure of safety-related bolting.

The staff’s evaluation of the applicant’s Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The staff noted that the Bolting Integrity Program is an existing Condition Monitoring Program that addresses the management of aging for the bolting of mechanical components and structural connections within the scope of license renewal based on industry recommendations. The staff also noted that the Bolting Integrity Program consists of the periodic inspection of bolting for indications of degradation such as leakage, loss of material due to corrosion, loss of pre-load, and cracking due to SCC and fatigue. The staff finds the applicant’s proposal acceptable because the applicant’s Bolting Integrity Program periodically inspects bolting to manage the aging effect, loss of preload, which is consistent with the GALL Report recommendation.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.4.2-2, the applicant stated that, for steel bolting, piping, and valve bodies exposed to uncontrolled indoor-air (external), there is no aging effect, and no AMP is proposed. The AMR line items cite Generic Note I, indicating that the aging effect in the GALL Report for this line item’s component, material, and environment combination is not applicable. The line items associated with steel bolting in Table 3.4.2-2 cite plant-specific Note 0406, which states that this steel component has an external surface temperature greater than 212 °F. Therefore, the surface is dry, and general corrosion is not an AERM; there are also no other AERMs.

The staff reviewed the associated line items in the LRA and confirmed that no aging effect is applicable for this component, material, and environmental combination. The staff notes that the indicated operating temperature of greater than 212 °F precludes the condensation of moisture on the component external surfaces, and, in the absence of such condensation or other sources of moisture, the general corrosion rate for carbon steel in contact with indoor air is negligible at anticipated condensate system operating temperatures. The staff also notes that condensate system steel components would have the same aging effect and degradation rate as steel piping, piping components, and piping elements, given the same environment, as in Item SP-1 of the GALL Report, which is applicable to the steel piping, piping components, and piping elements in an external environment of indoor air and does not require an AERM or AMP. The staff finds the applicant's proposal acceptable because the LRA components are similar to other GALL Report items for the material and environment (e.g., GALL Report, Volume 2, Item V.F-16, whereby the AERM is listed as "none," the AMP is listed as "none," and no further evaluation is required). Therefore, the effect of plant indoor air on steel components at the indicated temperatures is not expected to result in aging that will be of concern during the period of extended operation.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.4.2.3.3 Steam and Power Conversion System—Condensate (Nuclear) System—Summary of Aging Management Evaluation—LRA Table 3.4.2-3

In LRA Tables 3.4.2-3, 3.4.2-4 and 3.4.2-6, the applicant stated that the steel main condenser heat exchanger (shell), tanks, piping, piping components, piping elements, strainers, traps, and valve bodies exposed to moist air (internal) are being managed for loss of material by the Supplemental Piping/Tank Inspection Program. The AMR line items cite Generic Note G, indicating that, for the line items, the environment is not in the GALL Report for these components and material.

The staff reviewed all AMR result line items in the GALL Report where the material is steel and the aging effect is loss of material and identified two entries (VII.G-23 and VII.H2-21) in the GALL Report for steel piping, piping components, and piping elements exposed to moist air or condensation (internal). Both entries recommend GALL Report AMP XI.XM38 "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," which recommends periodic inspections to ensure that these aging effects are adequately managed.

The staff's evaluation of the applicant's Supplemental Piping/Tank Inspection Program is documented in SER Section 3.0.3.1.29. The staff noted that the Supplemental Piping/Tank Inspection Program is a new program that proposes to manage the aging of steel, gray cast iron, and stainless steel components that are exposed to moist air environments, particularly the aggressive alternate wet and dry environment that exists at air water interfaces or air spaces of susceptible piping and tanks, using a combination of volumetric and visual one-time inspections of internal and external surfaces to identify evidence of a loss of material. It is unclear to the staff how the one-time inspections performed by the Supplemental Piping/Tank Inspection Program are adequate to manage aging for components exposed to moist air or condensation (internal), given that the GALL Report recommends periodic visual inspections. By letter dated October 20, 2010, the staff issued RAI 3.4.2.3.3-1 requesting that the applicant justify why a one-time inspection is adequate to manage aging for these components exposed to moist air or condensation (internal).

In its response dated January 27, 2011, the applicant stated that the upper portions of the main condenser heat exchanger and connected systems in LRA Tables 3.4.2-3, 3.4.2-4, and 3.4.2-6 were originally evaluated as exposed to moist air, but further review identified that the correct environment is steam. The applicant revised the LRA accordingly to manage aging for components exposed to steam consistent with the GALL Report recommendations. The applicant also stated that the moist air environment in LRA Table 3.4.2-3 is associated with the air-water interface for the condensate storage tanks. The upper portion of the piping is exposed to air-outdoor, which is being managed by the External Surfaces Monitoring Program, and the lower portion of the piping is exposed to treated water, which is being managed by the BWR Water Chemistry Program and Chemistry Program Effectiveness Inspection. The applicant further stated that the moist air environment in LRA Table 3.4.2-4 is associated with the air-water interface for the discharge line to the suppression pool and that the upper portion of the piping is exposed to air-indoor which is being managed by the External Surfaces Monitoring Program and the lower portion of the piping is exposed to treated water which is being managed by the BWR Water Chemistry Program and Chemistry Program Effectiveness Inspection. The applicant added that the Supplemental Piping/Tank Inspection is adequate to manage loss of material because the inspections provide additional verification for the effectiveness of existing programs credited with managing aging above and below the air-water interface and serve to verify the effectiveness of the External Surfaces Monitoring Program for material above the air-water interface.

The staff finds the applicant's response, and its proposal to manage aging using the Supplemental Piping/Tank Inspection Program, acceptable because the surfaces of the subject components are being managed for aging above and below the air-water interface consistent with the recommendations in the GALL Report and application of the Supplemental Piping/Tank Inspection Program provides additional assurance that aging is not occurring at the air-water interface. The staff's concern described in RAI 3.4.2.3.3-1 is resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for stainless steel nozzles, orifices, piping, tubing, and valve bodies exposed to air-outdoor (internal) citing Generic Note G for which no aging effect and no AMP are proposed is documented in 3.3.2.3.16.

In LRA Table 3.4.2-3, the applicant stated that stainless steel orifices, pump casings, tubing, and valve bodies exposed to condensation (external) are being managed for loss of material by the External Surfaces Monitoring Program. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because, even though stainless steel exposed to air-outdoor (external) is not specifically addressed in the GALL Report, Table IX.C of the GALL Report states that stainless steel material is susceptible to a variety of aging effects and mechanisms, including loss of material due to pitting and crevice corrosion, and cracking due to SCC. The environment, condensation (external), would not induce SCC in stainless steel material; therefore, the aging effect of concern is loss of material, which is addressed in the AMR.

The staff's evaluation of the applicant's External Surfaces Monitoring Program is documented in SER Section 3.0.3.2.6. The staff noted that the applicant's External Surfaces Monitoring Program is a Periodic Inspection Program that will manage loss of material for metals and alloys, including stainless steel, that are exposed to condensation, air-indoor uncontrolled, and air-outdoor environments and cracking of stainless steel exposed to condensation environments. The staff also noted that the External Surfaces Monitoring Program uses visual inspections that are consistent, with enhancements, with the recommendations in GALL Report AMP XI.M36, “External Surfaces Monitoring.” The staff finds the applicant’s proposal to manage aging using the External Surfaces Monitoring Program acceptable because this program inspects external surfaces of components using visual inspection methods that are capable of detecting loss of material.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff’s evaluation for steel bolting exposed to condensation (external) or air-outdoor (external) is being managed for cracking and loss of pre-load, by the Bolting Integrity Program with a Generic Note H is documented in SER Section 3.4.2.3.1.

3.4.2.3.4 Steam and Power Conversion System—Main Steam System—Summary of Aging Management Evaluation—LRA Table 3.4.2-4

In LRA Tables 3.3.2-12, 3.3.2-17, and 3.4.2-4, the applicant stated that, for aluminum alloy pump casing (chiller high speed and low speed lubricating oil pump), heat exchanger components, oil fog lubricators, manifold, and valve bodies exposed to internal air or external uncontrolled indoor air, there is no aging effect, and no AMP is proposed. The AMR line items cite Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because, based on the GALL Report where the material is aluminum and the aging effect/mechanism is loss of material, there are no entries for these components and materials exposed to internal air or external uncontrolled indoor air.

The staff noted that, even though the GALL Report recommends no AERMs for aluminum alloy pump casing (chiller high speed and low speed lubricating oil pump), heat exchanger components, oil fog lubricators, manifold, and valve bodies in an internal air or external uncontrolled indoor air environment, the GALL Report, under Item VII.J-2 (AP-37), indicates that aluminum piping exposed to gas does not list an AERM or AMP. The staff finds the applicant’s proposal acceptable because no aging effect is expected to occur for aluminum in gas.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.4.2-1 and 3.4.2-4, the applicant stated that the gray cast iron trap bodies exposed to steam (internal) are being managed for loss of material by the Selective Leaching Inspection Program. The AMR line items cite Generic Note G, indicating that for the line items the environment is not in the GALL Report for this component and material.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this components, material, and environmental combination because, even though the gray cast iron exposed to steam (internal) is not specifically addressed in the GALL Report AMP XI.M33 “Selective Leaching of Materials,” which states that gray cast iron may be susceptible to selective leaching, and loss of material is being managed for these components in other line items in the same tables.

The staff’s evaluation of the applicant’s Selective Leaching Inspection Program is documented in SER Section 3.0.3.1.26. The staff noted that the Selective Leaching Program is a new program that is designed to detect and characterize the conditions on internal and external surfaces of components that are exposed to raw water, treated water (including closed cycle cooling water and steam), fuel oil, soil (buried), and moist air (including condensation) environments. The staff also noted that this One-Time Inspection Program is a combination of visual examination and material hardness testing, or NRC-approved alternative, and it provides direct evidence of whether, and to what extent, loss of material due to selective leaching has occurred or is likely to occur in a loss of intended function. The staff finds the applicant’s proposal acceptable because the program includes visual examinations and hardness testing, which are appropriate methods for determining whether loss of material due to selective leaching is occurring.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff’s evaluation for steel piping, valve bodies, and strainer bodies exposed to moist air (internal) and being managed for loss of material by the Supplemental Piping/Tank Inspection Program with Generic Note G is documented in 3.4.2.3.3.

In LRA Table 3.4.2-4, the applicant stated that the gray cast iron trap bodies exposed to moist air (internal) are being managed for loss of material by the Selective Leaching Inspection and Supplemental Piping/Tank Inspection Programs. The AMR line items cite Generic Note G, indicating that, for the line items, the environment is not in the GALL Report for this component and material.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this components, material, and environmental combination because, even though the gray cast iron exposed to moist air (internal) is not specifically addressed in the GALL Report AMP XI.M33 “Selective Leaching of Materials,” which states that gray cast iron may be susceptible to selective leaching, and loss of material is being managed for these components in other line items in the same tables.

The staff’s evaluations of the applicant’s Selective Leaching Inspection and Supplemental Piping/Tank Inspection Programs are documented in SER Sections 3.0.3.1.26 and 3.0.3.1.29, respectively. The staff noted that the Selective Leaching Program is a new program that is designed to detect and characterize the conditions on internal and external surfaces of components that are exposed to raw water, treated water (including closed cycle cooling water and steam), fuel oil, soil (buried), and moist air (including condensation) environments. The staff also noted that the applicant’s Supplemental Piping/Tank Inspection Program provides for a one-time inspection of internal and external surfaces components exposed to the environment in question.

In its review of these AMR line items, the staff finds the applicant's proposal to manage aging for the internal surfaces of these components using the Selective Leaching Inspection and Supplemental Piping/Tank Inspection Programs acceptable because the Selective Leaching Inspection Program includes visual examinations and hardness testing, which are appropriate methods for determining whether loss of material due to selective leaching is occurring. In addition, the Supplemental Piping/Tank Inspection Program includes a combination of volumetric and visual one-time inspections, which are capable of identifying evidence of a loss of material,

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for stainless steel bolting exposed to air-indoor uncontrolled (external) being managed for loss of pre-load by the Bolting Integrity Program with Generic Note F is documented in SER Section 3.2.2.3.2.

In LRA Table 3.4.2-4, the applicant stated that the stainless steel bolting exposed to treated water (external) is being managed for loss of pre-load by the Bolting Integrity Program. The AMR line items cite Generic Note F.

The staff notes that the LRA Table 3.4.2-4 has other line items associated with stainless steel bolting exposed to treated water (external), which address cracking and loss of material. The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because Table VIII.H of the GALL Report states that loss of preload due to thermal effects, gasket creep, and self-loosing is an aging effect for steel bolting exposed to air-indoor uncontrolled (external), and the GALL Report recommends XI.M18, "Bolting Integrity" for managing the aging effect.

The staff's evaluation of the applicant's Bolting Integrity Program is documented in SER Section 3.0.3.2.2. The staff finds the applicant's proposal to manage aging using the Bolting Integrity Program acceptable because the Bolting Integrity Program consists of the periodic inspection of bolting for indications of loss of pre-load, and the preventive measures in the program will preclude or minimize loss of pre-load.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.4.2-4 and 3.4.2-6, the applicant stated that stainless steel piping and orifices exposed to moist air (internal) are being managed for loss of material by the Supplemental Piping/Tank Inspection Program. The AMR lines item cite Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because the GALL Report states that stainless steel components exposed to condensation are susceptible to loss of material due to pitting and crevice corrosion.

The staff's evaluation of the applicant's Supplemental Piping/Tank Inspection Program is documented in SER Section 3.0.3.1.29. The staff noted that the applicant's Supplemental Piping/Tank Inspection Program is a One-Time Inspection Program that will detect and characterize material conditions in components exposed to moist air environments. The staff also noted that the Supplemental Piping/Tank Inspection Program inspects for conditions at the internal and external surfaces as well as wall thickness using visual, enhanced visual, and volumetric techniques consistent with the recommendations in GALL Report AMP XI.M32, "One-Time Inspection." The staff finds the applicant's proposal to manage aging using the Supplemental Piping/Tank Inspection Program acceptable because this program inspects internal and external surfaces of the components using inspection techniques that are capable of detecting pitting and crevice corrosion, and the applicant's use of a One-Time Inspection Program is acceptable given that the components are used in the main steam system and the miscellaneous drain system, which accepts drains from the main steam system, such that the presence of compounds that could cause loss of material in stainless steel items (e.g., chlorides, halides, bromides) is not likely. Therefore the applicant's proposal meets the criteria of GALL Report AMP XI.M32.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for steel piping, valve bodies, and strainer bodies exposed to moist air (internal) and being managed for loss of material by the Supplemental Piping/Tank Inspection Program with Generic Note G is documented in 3.4.2.3.3.

3.4.2.3.5 Steam and Power Conversion System—Main Steam Leakage Control System—Summary of Aging Management Evaluation—LRA Table 3.4.2-5

The staff reviewed LRA Table 3.4.2-5, which summarizes the results of AMR evaluations for the main steam leakage control system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J, whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.4.2.1.

3.4.2.3.6 Steam and Power Conversion System—Miscellaneous Drain System—Summary of Aging Management Evaluation—LRA Table 3.4.2-6

The staff's evaluation for steel piping, valve bodies, and strainer bodies exposed to moist air (internal) and being managed for loss of material by the Supplemental Piping/Tank Inspection Program with Generic Note G is documented in 3.4.2.3.3.

The staff's evaluation for stainless steel orifices exposed to moist air (internal) and being managed for loss of material by the Supplemental Piping/Tank Inspection Program citing Generic Note G is documented in 3.4.2.3.4.

3.4.2.3.7 Steam and Power Conversion System—Reactor Feedwater System—Summary of Aging Management Evaluation—LRA Table 3.4.2-7

The staff reviewed LRA Table 3.4.2-7, which summarizes the results of AMRs for the RFW system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.4.2.1.

3.4.2.3.8 Steam and Power Conversion System—Sealing Steam System—Summary of Aging Management Evaluation—LRA Table 3.4.2-8

The staff reviewed LRA Table 3.4.2-8, which summarizes the results of AMRs for the sealing steam system component groups.

The staff's review did not find any line items indicating plant-specific Notes F through J whereby the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report.

The staff's evaluation of the line items with Notes A through E is documented in SER Section 3.4.2.1.

3.4.3 Conclusion

The staff concludes that the applicant provided sufficient information to demonstrate that the effects of aging for the steam and power conversion system components within the scope of license renewal and subject to an AMR will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5 Aging Management of Containments, Structures, and Component Supports

This section of the SER documents the staff's review of the applicant's AMR results for the following containments, structures, and component supports groups:

- Primary Containment (Includes Drywell, Suppression Chamber, and Internal Structural Components)
- Reactor Building (Includes Secondary Containment, Reactor Cavity, Refueling Area, New Fuel Storage Vault, and Release Stack)
- SSW Pump House 1A and 1B and Spray Pond 1A and 1B
- Circulating Water Pump House
- Diesel Generator Building
- Fresh Air Intake Structure No. 1 and 2
- Makeup Water Pump House

- Radwaste Control Building
- Service Building
- Turbine Generator Building
- Water Filtration Building
- Yard Structures
- Bulk Commodities

3.5.1 Summary of Technical Information in the Application

LRA Section 3.5 provides AMR results for the containment, structures, and component supports groups. LRA Table 3.5-1, “Summary of Aging Management Evaluations for Structures and Component Supports,” is a summary comparison of the applicant’s AMRs with those evaluated in the GALL Report for the SC supports groups.

The applicant’s AMRs evaluated and incorporated applicable plant-specific and industry operating experience in the determination of AERMs. The plant-specific evaluation included CRs and discussions with appropriate site personnel to identify AERMs. The applicant’s review of industry operating experience included a review of the GALL Report and operating experience issues identified since the issuance of the GALL Report.

3.5.2 Staff Evaluation

The staff reviewed LRA Section 3.5 to determine if the applicant provided sufficient information to demonstrate that the effects of aging for the containment, structures, and component supports within the scope of license renewal and subject to an AMR will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff reviewed the AMRs to confirm the applicant’s claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL Report AMRs. The staff’s evaluations of the AMPs are documented in SER Section 3.0.3. Details of the staff’s evaluation are discussed in SER Section 3.5.2.1.

The staff also reviewed AMRs consistent with the GALL Report and for which further evaluation is recommended. The staff confirmed that the applicant’s further evaluations were consistent with the SRP-LR Section 3.5.2.2 acceptance criteria. The staff’s evaluations are documented in SER Section 3.5.2.2.

The staff also reviewed the AMRs not consistent with or not addressed in the GALL Report. The review evaluated whether all plausible aging effects were identified and whether the aging effects listed were appropriate for the combination of materials and environments specified. Details of the staff’s evaluation are discussed in SER Section 3.5.2.3.

For SSCs that the applicant claimed were not applicable or required no aging management, the staff reviewed the AMR line items and the plant’s operating experience to verify the applicant’s claims.

Table 3.5-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.5 and addressed in the GALL Report.

Table 3.5-1 Staff evaluation for containments, structures, and component supports in the GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
PWR concrete (reinforced and prestressed) and steel containments **BWR concrete and steel (Mark I, II, and III) containments**					
Concrete elements—walls, dome, basemat, ring girder, buttresses, and containment (as applicable) (3.5.1-1)	Aging of accessible and inaccessible concrete areas due to aggressive chemical attack and corrosion of embedded steel	ISI (IWL) and, for inaccessible concrete, an examination of representative samples of below-grade concrete and periodic monitoring of groundwater if environment is non-aggressive. A plant-specific program is to be evaluated if environment is aggressive.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.2.1)
Concrete elements—All (3.5.1-2)	Cracks and distortion due to increased stress levels from settlement	Structures Monitoring Program. If a dewatering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the dewatering system through the period of extended operation.	Yes	Not applicable Structures Monitoring Program	Not applicable to Columbia (See SER Section 3.5.2.2.1) Consistent with GALL Report (See SER Section 3.5.2.2.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Concrete elements—foundation and subfoundation (3.5.1-3)	Reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation	Structures Monitoring Program. If a dewatering system is relied upon to control erosion of cement from porous concrete subfoundations, then the licensee is to ensure proper functioning of the dewatering system through the period of extended operation.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.1.1)
Concrete elements—dome, wall, basemat, ring girder, buttresses, containment, and concrete fill-in annulus (as applicable) (3.5.1-4)	Reduction of strength and modulus of concrete due to elevated temperature	A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.2.1)
Steel elements—drywell; torus; drywell head; embedded shell and sand pocket regions; drywell support skirt; torus ring girder; downcomers; and liner plate, ECCS suction header, support skirt, region shielded by diaphragm floor, and suppression chamber (as applicable) (3.5.1-5)	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	Yes	ISI- IWE and Appendix J BWR Water Chemisty	Consistent with GALL Report (See SER Sections 3.5.2.2.1)
Steel elements—steel liner, liner anchors, and integral attachments (3.5.1-6)	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.1.1)
Prestressed containment tendons (3.5.1-7)	Loss of prestress due to relaxation, shrinkage, creep, and elevated temperature	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.2.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel and stainless steel elements—vent line, vent header, vent line bellows, and downcomers (3.5.1-8)	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA	Fatigue is a TLAA (See SER Section 3.5.2.2.1)
Steel, stainless steel elements, dissimilar metal welds—penetration sleeves, penetration bellows, suppression pool shell, and unbraced downcomers (3.5.1-9)	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	TLAA	Fatigue is a TLAA (See SER Section 3.5.2.2.1)
Stainless steel penetration sleeves, penetration bellows, dissimilar metal welds (3.5.1-10)	Cracking due to SCC	ISI (IWE) and 10 CFR Part 50, Appendix J and additional appropriate examinations/ evaluations for bellows assemblies and dissimilar metal welds.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.2.1)
Stainless steel vent line bellows (3.5.1-11)	Cracking due to SCC	ISI (IWE) and 10 CFR Part 50, Appendix J and additional appropriate examination/ evaluation for bellows assemblies and dissimilar metal welds.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.2.1)
Steel, stainless steel elements, dissimilar metal welds—penetration sleeves, penetration bellows, suppression pool shell, and unbraced downcomers (3.5.1-12)	Cracking due to cyclic loading	ISI (IWE) and 10 CFR Part 50, Appendix J and supplemented to detect fine cracks	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.2.1)
Steel, stainless steel elements, dissimilar metal welds—torus, vent line, vent header, vent line bellows, and downcomers (3.5.1-13)	Cracking due to cyclic loading	ISI (IWE) and 10 CFR Part 50, Appendix J and supplemented to detect fine cracks	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.2.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Concrete elements—dome, wall, basemat ring girder, buttresses, containment (as applicable) (3.5.1-14)	Loss of material (scaling, cracking, and spalling) due to freeze-thaw	ISI (IWL). Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-in./yr) (NUREG-1557).	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.1.1)
Concrete elements—walls, dome, basemat, ring girder, buttresses, containment, and concrete fill-in annulus (as applicable) (3.5.1-15)	Cracking due to expansion and reaction with aggregate; increase in porosity, permeability due to leaching of calcium hydroxide	ISI (IWL) for accessible areas. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R.	Yes	None	Consistent with GALL Report (See SER Section 3.5.2.2.1)
Seals, gaskets, and moisture barriers (3.5.1-16)	Loss of sealing and leakage through containment due to deterioration of joint seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	ISI (IWE) and 10 CFR Part 50, Appendix J	No	ISI-IWE and Appendix J	Consistent with GALL Report
Personnel airlock, equipment hatch and CRD hatch locks, hinges, and closure mechanisms (3.5.1-17)	Loss of leak tightness in closed position due to mechanical wear of locks, hinges, and closure mechanisms	10 CFR Part 50, Appendix J and plant TSs	No	ISI-IWE, Appendix J, and TSs	Consistent with GALL Report
Steel penetration sleeves and dissimilar metal welds, personnel airlock, equipment hatch, and CRD hatch (3.5.1-18)	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	No	ISI-IWE and Appendix J	Consistent with GALL Report
Steel elements—stainless steel suppression chamber shell (inner surface) (3.5.1-19)	Cracking due to SCC	ISI (IWE) and 10 CFR Part 50, Appendix J	No	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Steel elements—suppression chamber liner (interior surface) (3.5.1-20)	Loss of material due to general, pitting, and crevice corrosion	ISI (IWE) and 10 CFR Part 50, Appendix J	No	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.1.1)
Steel elements—drywell head and downcomer pipes (3.5.1-21)	Fretting or lock-up due to mechanical wear	ISI (IWE)	No	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.1.1)
Prestressed containment—tendons and anchorage components (3.5.1-22)	Loss of material due to corrosion	ISI (IWL)	No	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.1.1)
All Groups except Group 6—interior and above-grade exterior concrete (3.5.1-23)	Cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel	Structures Monitoring Program	Yes	Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)
All Groups except Group 6—interior and above-grade exterior concrete (3.5.1-24)	Increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack	Structures Monitoring Program	Yes	Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)
All Groups except Group 6—steel components—all structural steel (3.5.1-25)	Loss of material due to corrosion	Structures Monitoring Program. If protective coatings are relied upon to manage the effects of aging, the Structures Monitoring Program is to include provisions to address protective coating monitoring and maintenance.	Yes	Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
All Groups except Group 6—accessible and inaccessible concrete—foundation (3.5.1-26)	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Structures Monitoring Program. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-in./yr) (NUREG-1557).	Yes	Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)
All Groups except Group 6—accessible and inaccessible interior/exterior concrete (3.5.1-27)	Cracking due to expansion due to reaction with aggregates	Structures Monitoring Program. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes	Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)
Groups 1–3, 5–9—All (3.5.1-28)	Cracks and distortion due to increased stress levels from settlement	Structures Monitoring Program. If a dewatering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the dewatering system through the period of extended operation.	Yes	Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)
Groups 1–3, 5–9—foundation (3.5.1-29)	Reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation	Structures Monitoring Program. If a dewatering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the dewatering system through the period of extended operation.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.2.2)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Group 4—radial beam seats in BWR drywell; RPV support shoes for PWR with nozzle supports; and steam generator supports (3.5.1-30)	Lock-up due to wear	ISI (IWF) or Structures Monitoring Program	Yes	ISI-IWF Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)
Groups 1–3, 5, 7–9—below-grade concrete components, such as exterior walls below grade and foundation (3.5.1-31)	Increase in porosity and permeability, cracking, loss of material (spalling, scaling), aggressive chemical attack; cracking, loss of bond, and loss of material (spalling, scaling), corrosion of embedded steel	Structures Monitoring Program; examination of representative samples of below-grade concrete, and periodic monitoring of groundwater, if the environment is non-aggressive. A plant-specific program is to be evaluated if environment is aggressive.	Yes	Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)
Groups 1–3, 5, 7–9—exterior above and below-grade reinforced concrete foundations (3.5.1-32)	Increase in porosity and permeability and loss of strength due to leaching of calcium hydroxide	Structures Monitoring Program for accessible areas. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes	None	Consistent with GALL Report (See SER Section 3.5.2.2.2)
Groups 1–5—concrete (3.5.1-33)	Reduction of strength and modulus due to elevated temperature	A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.2.2)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Group 6—Concrete—All (3.5.1-34)	Increase in porosity and permeability, cracking, loss of material due to aggressive chemical attack; cracking, loss of bond, loss of material due to corrosion of embedded steel	Inspection of Water-Control Structures or Federal Energy Regulatory Commission (FERC)/U.S. Army Corps of Engineers dam inspections and maintenance programs and for inaccessible concrete, an examination of representative samples of below-grade concrete, and periodic monitoring of groundwater, if the environment is non-aggressive. A plant-specific program is to be evaluated if environment is aggressive.	Yes	Structures Monitoring Program Water Control Structures Inspection	Consistent with GALL Report (See SER Section 3.5.2.2.2)
Group 6—Exterior above and below-grade concrete foundation (3.5.1-35)	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Inspection of Water-Control Structures or FERC/U.S. Army Corps of Engineers dam inspections and maintenance programs. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-in./yr) (NUREG-1557).	Yes	Structures Monitoring Program Water Control Structures Inspection	Consistent with GALL Report (See SER Sections 3.5.2.1.2 and 3.5.2.2.2)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Group 6—All accessible and inaccessible reinforced concrete (3.5.1-36)	Cracking due to expansion/ reaction with aggregates	Accessible areas: Inspection of Water-Control Structures or FERC/U.S. Army Corps of Engineers dam inspections and maintenance programs. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes	Structures Monitoring Program Water Control Structures Inspection	Consistent with GALL Report (See SER Section 3.5.2.2.2)
Group 6—Exterior above and below-grade reinforced concrete foundation interior slab (3.5.1-37)	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide	For accessible areas, Inspection of Water-Control Structures or FERC/U.S. Army Corps of Engineers dam inspections and maintenance programs. None for inaccessible areas if concrete was constructed in accordance with the recommendations in ACI 201.2R-77.	Yes	Structures Monitoring Program Water Control Structures Inspection	Consistent with GALL Report (See SER Section 3.5.2.2.2)
Groups 7 and 8—Tank liners (3.5.1-38)	Cracking due to SCC and loss of material due to pitting and crevice corrosion	A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.2.2)
Support members; welds; bolted connections; and support anchorage to building structure (3.5.1-39)	Loss of material due to general and pitting corrosion	Structures Monitoring Program	Yes	Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)
Building concrete at locations of expansion and grouted anchors and grout pads for support base plates (3.5.1-40)	Reduction in concrete anchor capacity due to local concrete degradation, service-induced cracking, or other concrete aging mechanisms	Structures Monitoring Program	Yes	Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Vibration isolation elements (3.5.1-41)	Reduction or loss of isolation function, radiation hardening, temperature, humidity, sustained vibratory loading	Structures Monitoring Program	Yes	Structures Monitoring Program	Consistent with GALL Report (See SER Section 3.5.2.2.2)
Groups B1.1, B1.2, and B1.3—support members—anchor bolts and welds (3.5.1-42)	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.2.2)
Groups 1–3, 5, 6—All masonry block walls (3.5.1-43)	Cracking due to restraint shrinkage, creep, and aggressive environment	Masonry Wall Program	No	Structures Monitoring Program Masonry Wall Program Fire Protection Program	Consistent with GALL Report (See SER Section 3.5.2.1.4)
Group 6—Elastomer seals, gaskets, and moisture barriers (3.5.1-44)	Loss of sealing due to deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	Structures Monitoring Program	No	Structures Monitoring Program	Consistent with GALL Report
Group 6—Exterior above- and below-grade concrete foundation and interior slab (3.5.1-45)	Loss of material due to abrasion and cavitation	Inspection of Water-Control Structures or FERC/U.S. Army Corps of Engineers dam inspections and maintenance	No	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.1.1)
Group 5—Fuel pool liners (3.5.1-46)	Cracking due to SCC and loss of material due to pitting and crevice corrosion	Water Chemistry and monitoring of SFP water level in accordance with TSs and leakage from the leak chase channels	No	BWR Water Chemistry and monitoring of spent fuel pool water level in accordance with TSs and leakage from the leak chase channels	Consistent with GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Group 6—All metal structural members (3.5.1-47)	Loss of material due to general (steel only), pitting, and crevice corrosion	Inspection of Water-Control Structures or FERC/U.S. Army Corps of Engineers dam inspections and maintenance. If protective coatings are relied upon to manage aging, protective coating monitoring and maintenance provisions should be included.	No	Structures Monitoring Program Water Control Structures Inspection	Consistent with GALL Report (See SER Section 3.5.2.1.3)
Group 6—Earthen water control structures/dams, embankments, reservoirs, channels, canals, and ponds (3.5.1-48)	Loss of material; loss of form due to erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, and seepage	Inspection of Water-Control Structures or FERC/U.S. Army Corps of Engineers dam inspections and maintenance programs	No	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.1.1)
Support members; welds; bolted connections; and support anchorage to building structure (3.5.1-49)	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and ISI (IWF)	No	BWR Water Chemistry and ISI-IWF	Consistent with GALL Report (See SER Section 3.5.2.1.3)
Groups B2 and B4—galvanized steel, aluminum, stainless steel support members; welds; bolted connections; and support anchorage to building structure (3.5.1-50)	Loss of material due to pitting and crevice corrosion	Structures Monitoring Program	No	Structures Monitoring Program	Consistent with GALL Report
Group B1.1—high-strength low-alloy bolts (3.5.1-51)	Cracking due to SCC and loss of material due to general corrosion	Bolting Integrity	No	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.1.1)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Groups B2 and B4—sliding support bearings and sliding support surfaces (3.5.1-52)	Loss of mechanical function due to corrosion, distortion, dirt, overload, and fatigue due to vibratory and cyclic thermal loads	Structures Monitoring Program	No	Structures Monitoring Program	Consistent with GALL Report
Groups B1.1, B1.2, and B1.3—support members: welds; bolted connections; support anchorage to building structure (3.5.1-53)	Loss of material due to general and pitting corrosion	ISI (IWF)	No	ISI-IWF	Consistent with GALL Report
Groups B1.1, B1.2, and B1.3—constant and variable load spring hangers, guides, and stops (3.5.1-54)	Loss of mechanical function due to corrosion, distortion, dirt, overload, and fatigue due to vibratory and cyclic thermal loads	ISI (IWF)	No	ISI-IWF	Consistent with GALL Report
Steel, galvanized steel, and aluminum support members; welds; bolted connections; support anchorage to building structure (3.5.1-55)	Loss of material due to boric acid corrosion	Boric Acid Corrosion	No	Not applicable	Not applicable to BWRs (See SER Section 3.5.2.1.1)
Groups B1.1, B1.2, and B1.3—sliding surfaces (3.5.1-56)	Loss of mechanical function due to corrosion, distortion, dirt, overload, and fatigue due to vibratory and cyclic thermal loads	ISI (IWF)	No	ISI-IWF	Consistent with GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Groups B1.1, B1.2, and B1.3—vibration isolation elements (3.5.1-57)	Reduction or loss of isolation function, radiation hardening, temperature, humidity, and sustained vibratory loading	ISI (IWF)	No	Not applicable	Not applicable to Columbia (See SER Section 3.5.2.1.1)
Galvanized steel and aluminum support members; welds; bolted connections; support anchorage to building structure exposed to air-indoor uncontrolled (3.5.1-58)	None	None	No	None	Consistent with GALL Report
Stainless steel support members; welds; bolted connections; support anchorage to building structure (3.5.1-59)	None	None	No	None	Consistent with GALL Report

The staff's review of the containments, structures, and component supports groups followed several approaches. One approach, documented in SER Section 3.5.2.1, discusses the staff's review of AMR results for components that the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.5.2.2, discusses the staff's review of AMR results for components that the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.5.2.3, discusses the staff's review of AMR results for components that the applicant indicated are not consistent with, or not addressed in, the GALL Report. The staff's review of AMPs credited to manage or monitor aging effects of the containments, structures, and component supports is documented in SER Section 3.0.3.

3.5.2.1 AMR Results that are Consistent with the GALL Report

LRA Section 3.5.2.1 identifies the materials, environments, AERMs, and the following programs that manage aging effects for the structures and structural components and its commodity groups:

- Appendix J Program
- B_4C Monitoring Program
- BWR Water Chemistry Program
- Fire Protection Program
- ISI Program—IWE
- ISI Program—IWF
- Material Handling System Inspection Program

- Service Level 1 Protective Coating Program
- Structures Monitoring Program
- Structures Monitoring Program—Masonry Wall Inspection
- Structures Monitoring Program—Water Control Structures Inspection

Although not identified directly in LRA Section 3.5.2.1, LRA Table 3.5.1 identifies the following additional program under the discussion column that manages aging effects for the structures and structural components and its commodity groups for specified conditions:

- TLAA

In LRA Tables 3.5.2-1 through 3.5.2-13, the applicant summarized AMRs for SC supports and indicated AMRs claimed to be consistent with the GALL Report.

For component groups evaluated in the LRA for which the applicant claimed consistency with the GALL Report and for which the GALL Report does not recommend further evaluation, the staff's audit and review determined whether the plant-specific components groups were bounded by the GALL Report evaluation.

For each AMR line item, the applicant noted how the information in the tables aligns with the information in the GALL Report. The staff reviewed those AMRs with notes A through E, indicating how the AMR is consistent with the GALL Report.

Note A indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP is consistent with the GALL Report AMP. The staff reviewed these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the GALL Report AMP. The staff reviewed these line items to verify consistency with the GALL Report and verified that the identified exceptions to the GALL Report AMPs have been reviewed and accepted. The staff also determined whether the applicant's AMP was consistent with the GALL Report AMP and whether the AMR was valid for the site-specific conditions.

Note C indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the staff verified that the AMP is consistent with the GALL Report AMP. This note indicates that the applicant was unable to find a listing of some system components in the GALL Report; however, the applicant identified a different component with the same material, environment, aging effect, and AMP as the component under review. The staff reviewed these line items to verify consistency with the GALL Report. The staff also determined whether the AMR line item of the different component was applicable to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item, although different from, is consistent with the GALL Report for material, environment, and aging effect. In addition, the AMP takes some exceptions to the GALL Report AMP. The staff reviewed these line items to verify consistency with the GALL Report. The staff verified whether the AMR line item of the different component was applicable to the component under review and verified whether the identified exceptions to the GALL Report AMPs have been reviewed and accepted. The staff also determined whether the applicant's AMP was consistent with the GALL Report AMP and whether the AMR was valid for the site-specific conditions.

Note E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but credits a different AMP. The staff audited these line items to verify consistency with the GALL Report. The staff also determined whether the credited AMP would manage the aging effect consistently with the GALL Report AMP and whether the AMR was valid for the site-specific conditions.

The staff reviewed the information in the LRA. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMRs.

The staff reviewed the LRA to confirm that the applicant did the following:

- provided a brief description of the system, components, materials, and environments
- stated that the applicable aging effects were reviewed and evaluated in the GALL Report
- identified those aging effects for the structures and structural components and its commodity groups that are subject to an AMR

On the basis of its audit and review, the staff determines that, for AMRs not requiring further evaluation, as identified in LRA Table 3.5.1, the applicant's references to the GALL Report are acceptable, and no further staff review is required, with the exception of the following AMRs that the applicant identified were consistent with the AMRs of the GALL Report and for which the staff determined were in need of additional clarification and assessment. The staff's evaluations of these AMRs are provided in the subsections that follow.

3.5.2.1.1 AMR Results Identified as Not Applicable

For line Items 3.5.1-6, 3.5.1-19, 3.5.1-20, 3.5.1-22, and 3.5.1-55 in LRA Table 3.5.1, the applicant claimed that the corresponding AMR items in the GALL Report are not applicable based on the containment and reactor design. The staff confirmed Columbia is a BWR reactor with a Mark II stand-alone steel containment, and the listed items are only applicable to PWR designs or to concrete containments.

For line Items 3.5.1-21, 3.5.1-45, 3.5.1-48, and 3.5.1-57 in LRA Table 3.5.1, the applicant claimed that it was not applicable. The staff reviewed the LRA and UFSAR and confirmed that the applicant's LRA does not have any AMR results that are applicable to these line items.

Line Item 3.5.1-51 in LRA Table 3.5.1 addresses Group B1.1 high-strength low-alloy bolts in an indoor air environment. The GALL Report recommends the Bolting Integrity Program to manage aging due to SCC. The applicant stated that this item is not applicable because the necessary corrosive environments for SSC do not exist. The staff finds the applicant's claim acceptable because it explains that one of the three necessary conditions for SCC to occur is not present at the plant. A more detailed discussion of the staff's review can be found in SER Section 3.0.3.2.2.

The remaining items identified as not applicable in LRA Table 3.5.1 require further evaluation and are discussed in the corresponding subsections of SER Section 3.5.2.2.

3.5.2.1.2 Loss of Material and Cracking due to Freeze-Thaw

LRA Table 3.5.1, Item 3.5.1-35, addresses concrete exposed to water flowing or raw water that is being managed for loss of material and cracking. The LRA credits the applicant's Structures Monitoring Program that implements the Water Control Structures Inspection Program to manage the aging effects. The GALL report recommends GALL Report AMP XI.S7, "RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.S7 recommends monitoring and visual inspection at intervals not to exceed 5 years for indications of cracking, movements (e.g., settlement, heaving, deflection), conditions at junctions with abutments and embankments, erosion, cavitation, seepage, and leakage to manage the aging of these line items. In its review of components associated with item Number 3.5.1-35 for which the applicant cited Generic Note E, the staff noted that the Structures Monitoring Program has been proposed to manage aging of the concrete barrier skimmer wall, pump intake chambers, spray pond walls, foundation, circulating water basin, cooling tower basin, and support pedestal through use of monitoring and visual inspection at intervals not to exceed 5 years for loss of material and cracking aging effects.

The staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18. In its review of components associated with line Item 3.5.1-35, the staff finds the applicant's proposal to manage aging using the Structures Monitoring Program, which incorporates the Water Control Structures Inspection Program, acceptable because the related structural components are managed for loss of material and cracking by the appropriate AMP, which, with enhancements related to scope and parameters monitored or inspected, is consistent with guidance provided in GALL Report AMP XI.S7.

3.5.2.1.3 Loss of Material due to General, Pitting, and Crevice Corrosion

LRA Table 3.5.1, Item 3.5.1-47, addresses stainless steel, galvanized steel, and carbon steel exposed to water flowing, raw water, air-indoor, or air-outdoor that is being managed for loss of material. The LRA credits the applicant's Structures Monitoring Program that implements the Water Control Structures Inspection Program to manage the aging effect. The GALL report recommends GALL Report AMP XI.S7, "RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.S7 recommends monitoring and visual inspection at intervals not to exceed 5 years following guidelines for water-control structures as specified in Section C.2 of RG 1.127 (i.e., the adequacy of structures or equipment should be examined and tested to determine the structural integrity and verify operational adequacy). In its review of components associated with item Number 3.5.1-47, for which the applicant cited Generic Note E, the staff noted that the Structures Monitoring Program has been proposed to manage aging of bulkhead fixed screens, bulkhead screen frames, bulkhead screen guides, structural steel (columns, beams, plates, and trusses), battery racks, metal siding, and weir box through use of monitoring and visual inspections at intervals not to exceed 5 years for loss of material aging effects.

The staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18. In its review of components associated with line Item 3.5.1-47, the staff finds the applicant's proposal to manage aging using the Structures Monitoring Program, which incorporates the Water Control Structures Inspection Program, acceptable because the related structural components are managed for loss of material by the appropriate AMP, which, with enhancements related to scope and parameters monitored or inspected, is consistent with guidance provided in GALL Report AMP XI.S7.

LRA Table 3.5.1, Item 3.5.1-47, also addresses carbon and galvanized steel ASME Class 1, 2, 3, and MC supports exposed to raw water that are being managed for loss of material. The LRA credits the ISI Program—IWF to manage the aging effect. The GALL report recommends GALL Report AMP XI.S7, "RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants," to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.S7 recommends monitoring and visual inspection at intervals not to exceed 5 years following guidelines for water-control structures as specified in Section C.2 of RG 1.127 (i.e., the adequacy of structures or equipment should be examined and tested to determine the structural integrity and verify operational adequacy). In its review of components associated with item number 3.5.1-47 for which the applicant cited Generic Note E, the staff noted that the ISI Program—IWF proposes to manage aging of the component and piping supports (ASME Classes 1, 2, 3, and MC) and anchor bolts (ASME Class 1, 2, 3, and MC supports bolting) through visual inspections for loss of material aging effect.

The staff's evaluation of the applicant's ISI Program—IWF is documented in SER Section 3.0.3.1.21. In its review of components associated with line Item 3.5.1-47, the staff finds the applicant's proposal to manage aging using the ISI Program—IWF acceptable because the applicant's AMP credits visual inspections and is consistent with guidance provided in GALL Report AMP XI.S3, "ASME Section XI, Subsection IWF," which addresses ASME Section XI Class 1, 2, 3, and MC component supports for degradation that could potentially compromise the support function or load capacity.

LRA Table 3.5.1, Item 3.5.1-49, addresses carbon steel and stainless steel pipe supports and HELB barriers exposed to treated water that are being managed for loss of material. The LRA credits the applicant's BWR Water Chemistry and Structures Monitoring Programs to manage the aging effect. The GALL report recommends GALL Report AMP XI.M2, "Water Chemistry" and GALL Report AMP XI.S3, "ASME Section XI, Subsection IWF," to ensure that these aging effects are adequately managed. The associated AMR line items related to HELB barriers (including pipe restraints) and pipe supports cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.M2 is a mitigation program and relies on periodic monitoring and control of known contaminants such as chlorides, dissolved oxygen, and sulfate concentrations to ensure that it is below the known levels to result in loss of material or cracking. The AMP also uses inspection methods or sampling to monitor water quality (pH and conductivity). GALL Report AMP XI.S3 includes the performance of visual inspections of ASME Section XI Class 1, 2, 3, and MC piping and components and its associated supports to detect degradation that could potentially compromise its intended function. In its review of components associated with item Number 3.5.1-49, for which the applicant cited Generic Note E, the staff noted that the BWR Water Chemistry Program and Structures Monitoring Program are used to manage aging of the HELB barriers (including pipe restraints) and pipe supports through control of the relevant conditions (e.g., concentrations of chlorides, oxygen, and sulfates) that could lead to the onset and propagation of a loss of material, cracking, or a reduction of heat transfer, and visual examinations of external surfaces for loss of material or cracking aging effect. In addition, the staff noted that these components are non-ASME supports, which are not within the recommended scope of the IWF Program. Per the GALL Report, visual inspections of these components should be conducted under the Structures Monitoring Program.

The staff's evaluations of the applicant's BWR Water Chemistry Program and the Structures Monitoring Program are documented in SER Sections 3.0.3.1.7 and 3.0.3.2.18, respectively. In its review of components associated with line Item 3.5.1-49, the staff finds the applicant's proposal to manage aging using the BWR Water Chemistry Program and the Structures Monitoring Program acceptable because the applicant's BWR Water Chemistry Program is consistent with guidance provided in GALL Report AMP XI.S3, and the Structures Monitoring Program performs visual examinations of the external surfaces for loss or material or cracking that is the same inspection method employed by GALL Report AMP XI.S3.

3.5.2.1.4 Cracking due to Restraint Shrinkage, Creep and Aggressive Environment

LRA Table 3.5.1, Item 3.5.1-43, addresses concrete blocks exposed to air-indoor being managed for cracking degradation. The LRA credits the applicant's Structures Monitoring Program that implements the Masonry Wall Inspection Program and the Fire Protection Program to manage the aging effects. The GALL report recommends GALL Report AMP XI.S5, "Masonry Wall Program," to ensure that these aging effects are adequately managed. The associated AMR line items cite Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.S5 recommends visual examination of the masonry walls by qualified inspection personnel for cracking of the masonry and degradation of steel edge supports and bracing at a frequency to ensure that there is no loss of intended function between inspections. In its review of components associated with item Number 3.5.1-43, for which the applicant cited Generic Note E, the staff noted that the Fire Protection Program is used to manage aging of the concrete blocks through periodic visual examinations for signs of cracking of the masonry and degradation of steel edge supports and bracing aging effects for the walls serving as fire barriers.

The staff's evaluations of the applicant's Structures Monitoring Program and Fire Protection Program are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.8, respectively. In its review of components associated with line Item 3.5.1-43, the staff finds the applicant's proposal to manage aging using the Fire Protection Program acceptable because the related structural components are managed for cracking of the masonry and degradation of the steel edge supports and bracing through visual inspections. In addition, the components are managed by the applicant's Structures Monitoring Program, which incorporates the recommendations of the Masonry Wall Inspection Program and is the GALL Report-recommended AMP for these components.

3.5.2.2 AMR Results that are Consistent with the GALL Report, for which Further Evaluation is Recommended

In LRA Section 3.5.2, the applicant further evaluated aging management, as recommended by the GALL Report, for the containments, structures, and component supports components and provides information concerning how it will manage aging effects in the following areas:

- PWR and BWR containments:
  - aging of inaccessible concrete areas
  - cracks and distortion due to increased stress levels from settlement and reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations if not covered by the Structures Monitoring Program
  - reduction of strength and modulus of concrete structures due to elevated temperature
  - loss of material due to general, pitting, and crevice corrosion
  - loss of prestress due to relaxation, shrinkage, creep, and elevated temperature
  - cumulative fatigue damage
  - cracking due to SCC
  - cracking due to cyclic loading
  - loss of material (scaling, cracking, and spalling) due to freeze-thaw
  - cracking due to expansion and reaction with aggregate and increase in porosity and permeability due to leaching of calcium hydroxide
- safety-related and other SC supports:
  - aging of structures not covered by the Structures Monitoring Program
  - aging management of inaccessible areas (below-grade inaccessible concrete areas of Groups 1–5 and 7–9 structures)
  - reduction of strength and modulus of concrete structures due to elevated temperature for Group 1–5 structures
  - aging management of inaccessible areas for Group 6 structures (below-grade inaccessible concrete areas)
  - cracking due to SCC and loss of material due to pitting and crevice corrosion for Groups 7 and 8 stainless steel tank liners
  - aging of supports not covered by the Structures Monitoring Program
  - cumulative fatigue damage due to cyclic loading
- QA for aging management of nonsafety-related components

For component groups evaluated in the GALL Report, for which the applicant claimed consistency with the report and for which the report recommends further evaluation, the staff reviewed the applicant's evaluation to determine whether it adequately addressed the issues further evaluated. In addition, the staff reviewed the applicant's further evaluations against the criteria contained in SRP-LR Section 3.5.2.2. The staff's review of the applicant's further evaluation follows.

3.5.2.2.1 Pressurized-Water Reactor and Boiling-Water Reactor Containments

The staff reviewed LRA Section 3.5.2.2.1 against the criteria in SRP-LR Section 3.5.2.2.1, which addresses several areas.

Aging of Inaccessible Concrete Areas. LRA Section 3.5.2.2.1.1, associated with LRA Table 3.5.1, Item 3.5.1-1, addresses aging of inaccessible concrete areas that are being managed for aggressive chemical attack and corrosion of embedded steel by the ASME Section XI, Subsection IWL Program. The applicant stated that the ISI Program—IWL is not applicable since the primary containment is a BWR Mark II free-standing steel containment with no pressure retaining concrete. The staff reviewed LRA Sections 2.4.1 and 3.5 and confirmed that no containment concrete serves a pressure retaining function. Therefore, the concrete is not subject to IWL inspections or further evaluation in this section. Aging of the accessible reinforced concrete associated with the containment is managed by the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.18. SER Section 3.5.2.2.2, "Aging Management of Inaccessible Areas," documents the staff's review of the applicant's evaluation of aging management of inaccessible concrete areas.

Cracks and Distortion Due to Increased Stress Levels from Settlement and Reduction of Foundation Strength, Cracking, and Differential Settlement Due to Erosion of Porous Concrete Subfoundations, if Not Covered by the Structures Monitoring Program. LRA Section 3.5.2.2.1.2, associated with LRA Table 3.5.1, Items 3.5.1-2 and 3.5.1-3, addresses concrete components being managed for cracks and distortion due to increased stress levels from settlement; and reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations, by the Structures Monitoring Program. The applicant stated that these line items are not applicable because the primary containment is a free-standing steel pressure vessel enclosed in a reactor building that is supported on a reinforced concrete mat foundation that is not subjected to flowing water, and neither a porous concrete foundation nor dewatering system are employed. The LRA also states that Columbia plant structures are supported on structural backfill, and measurement points established on the corners of several buildings, including the reactor building, have indicated that the settlement experienced in the past 20 years is within permissible limits. Additionally, there is no evidence in the form of cracked walls or foundations resulting from differential settlement.

The staff evaluated the applicant's not applicable claim and found it acceptable because the foundations are not constructed of porous concrete exposed to flowing water, and no dewatering system is used onsite. In addition, the applicant will continue to monitor accessible structures for cracks and distortion due to settlement under the Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.18. SER Section 3.5.2.2.2, "Aging Management of Inaccessible Areas," further documents the staff's review of the applicant's evaluation of aging management of inaccessible concrete areas, including aging effects due to settlement and erosion.

Reduction of Strength and Modulus of Concrete Structures Due to Elevated Temperature. LRA Section 3.5.2.2.1.3, associated with LRA Table 3.5.1, Item 3.5.1-4, addresses reduction of strength and modulus of concrete structures due to elevated temperature. The applicant stated that this line item is not applicable because during normal plant operation areas within the primary containment are maintained below 150˚F during normal operation, with 135˚F bulk average maximum, and the area beneath the RPV is a localized area having a maximum temperature of 165˚F. These temperatures are below limits provided in ASME Section III, Division 2, Subsection CC. The LRA also states that piping in the Primary Containment is not in direct contact with concrete, and the concrete temperature surrounding hot penetrations are maintained less than or equal to 200˚F. The staff reviewed the UFSAR and confirmed that no in-scope containment concrete is exposed to temperatures exceeding the GALL Report limits

(150˚F general, 200˚F local) and, therefore, finds the applicant's not applicable determination acceptable.

Loss of Material Due to General, Pitting, and Crevice Corrosion. LRA Section 3.5.2.2.1.4, associated with LRA Table 3.5.1, Item 3.5.1-5, addresses loss of material due to general, pitting and crevice corrosion for steel elements of accessible and inaccessible areas of containments being managed by the ASME Section XI, Subsection IWE and 10 CFR Part 50, Appendix J Programs. The LRA states that loss of material due to corrosion of steel elements of accessible areas is managed by the ISI Program—IWE and the Appendix J Program, and loss of material due to pitting and crevice corrosion for steel elements exposed to treated water (i.e., suppression chamber) is managed by the BWR Water Chemistry Program. The LRA also states that the primary containment is protected from the weather by being housed in the reactor building, the drywell and suppression pool atmosphere is inerted by nitrogen during normal operation, the drywell peripheral seal is fabricated of stainless steel and welded to the primary containment vessel and to the underside of the circular closure girder embedded in the drywell floor, and there are no concrete to metal moisture barriers at the drywell floor. The LRA further states that Columbia committed to monitor the humidity levels in the sand pocket region where drainage between the primary containment vessel exterior and the biological shield wall would accumulate. The applicant stated in the LRA that, as a result of design features and surveillance activities significant corrosion of inaccessible areas of the primary containment is not expected.,

The staff reviewed LRA Section 3.5.2.2.1.4 against the criteria in SRP-LR Section 3.5.2.2.1.4, which states that loss of material due to general, pitting, and crevice corrosion could occur in steel elements of accessible and inaccessible areas for all types of PWR and BWR containments. The existing program relies on ASME Section XI Subsection IWE, and 10 CFR Part 50, Appendix J to manage this aging effect. The GALL Report recommends further evaluation of plant-specific programs to manage this aging effect for inaccessible areas if corrosion is significant. GALL Report Item II.B2.1-1 states that, for inaccessible areas (embedded steel shell or liner), loss of material due to corrosion is not significant if the following conditions are satisfied:

- Concrete meeting the specifications of ACI 318 or 349 and the guidance of ACI 201.2R was used for the containment concrete in contact with the embedded containment shell or liner.
- The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner.
- The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements.
- Water ponding on the containment concrete floor is not common and, when detected, is cleaned up in a timely manner

The staff's review of the applicant's ISI Program—IWE, Appendix J Program, and BWR Water Chemistry Program is documented in SER Sections 3.0.3.1.20, 3.0.3.1.1, and 3.0.3.1.7, respectively. The staff found that although the above conditions were adequately addressed, during the onsite audit, and the staff reviewed documentation stating that "[a]ll coated surfaces exhibited a light dusting on all surfaces, which was removed prior to the VT-3 examination. It is recommended that a complete Wet Well desludge be performed prior to the next VT-3 examination on the bottom head moisture barrier." As a result, the staff issued RAI B.2.34-3 requesting that the applicant provide the inspection frequency for the accessible coated wetwell metal shell surface and the moisture barrier inside the wetwell at the concrete-to-metal interface. In addition, the staff requested that the applicant provide the details and number of all coating degradations in the drywell and wetwell and degradation of the wetwell moisture barrier observed during the previous IWE inspections. The staff also requested that the applicant describe how VT-3 examination of the moisture barrier and steel containment is performed without removing the sludge from the inspected surfaces. A detailed discussion of the applicant's response, as well as the successful resolution of this issue, is included in SER Section 3.0.3.1.20, which documents the staff's review of the ISI—IWE Program.

Industry operating experience has identified water leakage from refueling cavity liners and bellows, which may contact and degrade the primary containment vessel. During review of the LRA, the staff noted that the applicant has no leakage detection system or alarm that could identify this possible leakage into the annular space between the steel containment and the shield wall, other than the sand pocket drains. Without a clear drainage path and leakage detection system, additional inspections should be conducted to verify leakage is not entering the annular space. Therefore, by letter dated October 14, 2010, the staff issued RAI 3.5.2.2.1.4-1 requesting the applicant discuss any additional examinations being conducted on the refueling cavity liner and bellows to verify no leakage path exists.

By letter dated January 18, 2011, the applicant explained that the configuration of the refueling bellows does not lend itself to visual or NDE inspection that would be able to detect potential leakage points. However, the applicant stated that the containment vessel has eight inspection ports equally spaced around the containment below the bellows. To verify leakage is not entering the annular space below the bellows, the applicant will open the inspection ports and inspect the vessel during an RFO while the reactor cavity is flooded. The applicant committed to conducting this inspection twice—once prior to the period of extended operation and once during the period of extended operation (Commitment No. 64).

Subsequent to the applicant's RAI response, by letter dated November 16, 2011, the applicant submitted a supplement to the LRA that states that the plant does have a leak detection system with alarm capability for the annular space. The leak dection capability is provided by drain lines from the region of primary containment at the top of the annular space and below the refuel bellows seal which would be the most likely source of any leakage into the annular space. All drain lines in the region, funnel into a common drain line header, which has a flow indicating switch installed in the piping. The flow indicating switch, alarms to the main control room if flow, detected at the drain piping, is greater than 1.0 gpm. The flow indicating switch is calibrated every six years and based on a search of the control room logs and the corrective action database, the alarm has not been received to date. However, based on this additional source of leak detection, the applicant states it will continue with all commitments currently stated in the LRA related to monitoring of potential leakage and loss of material in the annular space, and the leak detection system will be used as an additional resource to detect leakage in the annular space.

The staff reviewed the applicant's response and found it acceptable because the additional inspections will likely detect leakage into the annular space through the refueling bellows. These additional inspections, as well as plant-specific operating experience and commitments to monitor and maintain the sand cushion drain lines free of obstructions (as discussed in SER Section 3.0.3.1.20), provide assurance that the applicant will identify leakage, if any, into the annular space. Since the annular space is being properly monitored for leakage that may cause corrosion and a leak detection with alarm capability is available for the annular space, the staff finds the applicant's aging management approach acceptable, and the staff's concern in RAI 3.5.2.2.1.4-1 is resolved.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.5.2.2.1.4 criteria. For those line items that apply to LRA Section 3.5.2.2.1.4, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Loss of Prestress Due to Relaxation, Shrinkage, Creep, and Elevated Temperature. LRA Section 3.5.2.2.1.5, associated with LRA Table 3.5.1, Item 3.5.1-7, addresses loss of prestress due to relaxation, shrinkage, creep, and elevated temperature in prestressed containment tendons. The applicant stated that this line item is not applicable since the containment structure is a BWR Mark II steel containment that does not use prestressed tendons. The staff confirmed that the containment employs a Mark II steel primary containment with no prestressed tendons; therefore, it finds the applicant's determination acceptable.

Cumulative Fatigue Damage. LRA Section 3.5.2.2.1.6 states that TLAAs are evaluated in accordance with 10 CFR54.21(c) and that the evaluation of this TLAA is addressed in Section 4.6. This is consistent with SRP-LR Section 3.5.2.2.1.6 and is, therefore, acceptable.

Cracking Due to SCC. LRA Section 3.5.2.2.1.7, associated with LRA Table 3.5.1, Items 3.5.1-10 and 3.5.1-11, addresses cracking due to SCC in stainless steel penetration sleeves, penetration bellows, and dissimilar metal welds exposed to an air environment. The GALL Report recommends ASME Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J Programs, as well as additional examinations as appropriate to mange SCC for this component group. The LRA states that these line items are not applicable because the primary containment penetrations are of welded steel construction without expansion bellows, gaskets, or sealing compounds and are an integral part of construction. The LRA also states that SCC is not applicable for primary containment penetration sleeves, vent line headers, or downcomers because it is carbon steel components and that SCC is not an applicable aging effect for dissimilar metal welds in the primary containment penetration sleeves since the welds are located inside the primary containment drywell or within reactor building and not subject to an aggressive chemical environment. The LRA further states that, for the steel elements of the containment that are part of the IWE pressure boundary, both the ISI Program—IWE and the Appendix J Program are used to monitor degradation. The staff's review of the Columbia ISI Program—IWE and the Appendix J Program is documented in SER Sections 3.0.3.1.20 and 3.0.3.1.1, respectively. The staff reviewed LRA Sections 2.4 and 3.5 and confirmed that no in-scope stainless steel penetration sleeves, penetration bellows, or dissimilar metal welds experience both high temperatures (greater than 140˚F) and an aggressive chemical environment. Therefore, the staff finds that none of the components are susceptible to SCC, and the applicant's not applicable determination is acceptable.

Cracking Due to Cyclic Loading. LRA Section 3.5.2.2.1.8, associated with LRA Table 3.5.1, Items 3.5.1-12 and 3.5.1-13, addresses cracking due to cyclic loading in penetration sleeves and bellows exposed to an air environment. The LRA states that these line items are not applicable because a review of the containment and associated operating experience concluded that cyclic loading from plant heatups and cooldowns, containment testing, and system vibration was very low or limited in number of cycles. The LRA further states that cyclic loading of steel containment elements has been analyzed as a TLAA in LRA Section 4.6. The staff reviewed

LRA Sections 3.5 and 4.6 and the UFSAR and confirmed that the cycles experienced by the in-scope components is low; therefore, it finds the applicant's determination acceptable. A further discussion of cyclic loading can be found in SER Section 4.6 "Containment and Penetration Fatigue Analysis."

Loss of Material (Scaling, Cracking, and Spalling) Due to Freeze-Thaw. LRA Section 3.5.2.2.1.9, associated with LRA Table 3.5.1, Item 3.5.1-14, addresses loss of material (scaling, cracking, and spalling) of concrete elements due to freeze–thaw. The LRA states that this line item is not applicable because the primary containment is a BWR Mark II steel design that is housed in a reactor building and no pressure-retaining concrete is used; therefore, loss of material (scaling, cracking, and spalling) due to freeze-thaw is not applicable. The staff confirmed that the containment employs a Mark II steel containment with no pressure-retaining concrete; therefore, it finds the applicant's determination acceptable.

Cracking Due to Expansion and Reaction with Aggregate and Increase in Porosity and Permeability Due to Leaching of Calcium Hydroxide. LRA Section 3.5.2.2.1.10, associated with LRA Table 3.5.1, Item 3.5.1-15, addresses cracking due to expansion and reaction with aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide of concrete elements exposed to any environment. The LRA states that concrete was designed in accordance with ACI 318 and constructed in accordance with ACI 301 using materials conforming to ASTM and ACI standards. The LRA also states that the concrete had a water-to-cement ratio below 0.5, air entrainment between 3–6 percent, and meets the intent of ACI 201.2R-77. The LRA further states that the aggregate materials conformed to ASTM C33, potential reactivity of the aggregates was based on acceptable results from ASTM C227 or ASTM C289, and concrete is not subjected to flowing water. The applicant stated in the LRA that cracking due to expansion and reaction of aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide, are not AERMs for the primary containment related concrete.

The staff reviewed LRA Section 3.5.2.2.1.10 against the criteria in SRP-LR Section 3.5.2.2.1.10, which states that cracking due to expansion and reaction with aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide, could occur in concrete elements of concrete and steel containments. The GALL Report recommends further evaluation if the aggregate was not evaluated for potential expansion and reaction due to reactivity with the cementitious materials and suggests ASME Section XI, Subsection IWL as the AMP. GALL Report Items II.B2.2-4 and II.B2.2-6 note that an AMP for inaccessible concrete is not required if the concrete was constructed in accordance with the recommendations of ACI 201.2R-77.

In its review of components associated with Item 3.5.1-15, the staff noted that the applicant does not have an ASME Section XI, Subsection IWL Program because the containment does not use pressure-retaining concrete; however, containment related concrete is monitored under the applicant's Structures Monitoring Program. The staff's review of the Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff finds the applicant's evaluation of the AERM acceptable because containment-related concrete meets the intent of ACI 201.2R-77 by being designed in accordance with ACI 318, constructed in accordance with ACI 301, and using materials conforming to ASTM and ACI standards. The aggregate materials were found to be nonreactive based on criteria in ASTM C227 or ASTM C289, and the concrete is not subjected to flowing water. In addition, the applicant will continue to use the Structures Monitoring Program to monitor accessible structures for aging effects due to reaction with aggregates and leaching of calcium hydroxide.

Based on the programs identified, the staff concludes that the applicant's programs meet SRP-LR Section 3.5.2.2.1.10 criteria. For those line items that apply to LRA Section 3.5.2.2.1.10, the staff determines that the LRA is consistent with the GALL Report, and the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.2.2 Safety-Related and Other SC Supports

The staff reviewed LRA Section 3.5.2.2.2 against the criteria in SRP-LR Section 3.5.2.2.2, which addresses several areas, as discussed below.

Aging of Structures Not Covered by the Structures Monitoring Program. LRA Section 3.5.2.2.2.1 addresses aging of structures not covered by the Structures Monitoring Program. In the LRA, the applicant stated that the Structures Monitoring Program is credited for aging management of the following effects and mechanisms for the affected concrete structures and components, even if the AMR did not identify AERMs.

The staff reviewed LRA Section 3.5.2.2.2.1 against the criteria in SRP-LR Section 3.5.2.2.2.1, which states that the GALL Report recommends further evaluation of certain structure and aging effect combinations if it is not covered by the Structures Monitoring Program, including those listed below:

- cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for Groups 1–5, 7, and 9 structures
- increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack for Groups 1–5, 7, and 9 structures
- loss of material due to corrosion for Groups 1–5, 7, and 8 structures
- loss of material (spalling, scaling) and cracking due to freeze-thaw for Groups 1–3, 5, and 7–9 structures
- cracking due to expansion and reaction with aggregates for Groups 1–5 and 7–9 structures
- cracks and distortion due to increased stress levels from settlement for Groups 1–3 and 5–9 structures
- reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation for Groups 1–3 and 5–9 structures.

In addition, lock-up due to wear may occur for Lubrite® radial beam seats in BWR drywells, RPV support shoes for PWRs with nozzle supports, steam generator supports, and other sliding support bearings and sliding support surfaces. The existing program relies on the Structures Monitoring Program or ASME Section XI, Subsection IWF to manage this aging effect. The GALL Report recommends further evaluation only for structure-aging effect combinations not within the ASME Section XI, Subsection IWF or Structures Monitoring Programs.

During its review of LRA Section 3.5.2.2.2.1, the staff noted that the applicant credited the Structures Monitoring Program for managing the concrete aging effects, even if an AMR did not identify the aging effects. However, the LRA does not discuss an inspection interval associated with these components or the Structures Monitoring Program. Therefore, by letter dated

August 26, 2010, the staff issued RAI 3.5.2.2.2-01 requesting that the applicant explain the inspection interval for structures within the scope of license renewal.

By letter dated November 11, 2010, the applicant responded and explained that the inspection frequency is performed on a 4-year cycle for all structures within the scope of the Structures Monitoring Program. The applicant further explained that the 4-year cycle is an administrative frequency, and the committed inspection frequency is 5 years, as suggested in Chapter 6 of ACI 349.3R. The response further stated that opportunistic inspections will be employed for inaccessible below-grade concrete, and groundwater will be monitored to validate that the below-grade environment remains non-aggressive.

The staff reviewed the applicant's response and found it acceptable because it aligns the inspection interval of the Structures Monitoring Program with guidance in industry standards, which suggest a 5-year interval. The inspection interval also meets all the recommendations in the GALL Report. Therefore, the staff finds the inspection interval for the Structures Monitoring Program appropriate, and the staff's concern in RAI 3.5.2.2.2-01 is resolved.

In addition, the staff further evaluated the specific aging effects and mechanisms presented in LRA 3.5.2.2.2.1, and made the following determinations:

(1) Cracking, Loss of Bond, and Loss of Material (Spalling, Scaling) due to Corrosion of Embedded Steel for Groups 1–5, 7, and 9 Structures

LRA Section 3.5.2.2.2.1, associated with LRA Table 3.5.1, Item 3.5.1-23, addresses cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel for concrete elements of groups 1–5, 7, and 9 structures. The GALL Report recommends further evaluation of this structure and aging effect combination only if it is not covered by the Structures Monitoring Program. In the LRA, the applicant stated that this aging effect does not require management; however, the applicant's Structures Monitoring Program is credited for aging management, even if the AMR did not identify aging effects. The staff reviewed LRA Sections 2.4 and 3.5 and confirmed that the structure and aging effect combination is covered by the applicant's Structures Monitoring Program; therefore, it finds the applicant's evaluation acceptable. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

(2) Increase in Porosity and Permeability, Cracking, Loss of Material (Spalling, Scaling) due to Aggressive Chemical Attack for Groups 1–5, 7, and 9 Structures

LRA Section 3.5.2.2.2.1, associated with LRA Table 3.5.1, Item 3.5.1-24, addresses increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack for concrete elements of groups 1–5, 7, and 9 structures. The GALL Report recommends further evaluation of this structure and aging effect combination only if it is not covered by the Structures Monitoring Program. In the LRA, the applicant stated that this aging effect does not require management; however, the applicant's Structures Monitoring Program is credited for aging management, even if the AMR did not identify aging effects. The staff reviewed LRA Sections 2.4 and 3.5 and confirmed that the structure and aging effect combination is covered by the applicant's Structures Monitoring Program; therefore, it finds the applicant's evaluation acceptable. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

(3) Loss of Material due to Corrosion for Groups 1–5, 7, and 8 Structures

LRA Section 3.5.2.2.2.1, associated with LRA Table 3.5.1, Item 3.5.1-25, addresses loss of material due to corrosion for groups 1–5, 7, and 8 structures. The GALL Report recommends further evaluation of this structure and aging effect combination only if it is not covered by the Structures Monitoring Program. In the LRA, the applicant stated that this line item does not require further evaluation because it is covered by the Structures Monitoring Program. The staff confirmed that the structure and aging effect combination is covered by the Structures Monitoring Program; therefore, it finds the applicant's determination acceptable. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

(4) Loss of Material (Spalling, Scaling) and Cracking due to Freeze-Thaw for Groups 1–5 and 7–9 Structures

LRA Section 3.5.2.2.2.1, associated with LRA Table 3.5.1, Item 3.5.1-26, addresses loss of material (scaling, cracking, and spalling) due to freeze-thaw in concrete elements of groups 1–3, 5, and 7–9 structures. The GALL Report recommends further evaluation of this structure and aging effect combination only if it is not covered by the Structures Monitoring Program. In the LRA, the applicant stated that this aging effect does not require management; however, the applicant's Structures Monitoring Program is credited for aging management, even if the AMR did not identify aging effects. The staff reviewed LRA Sections 2.4 and 3.5 and confirmed that the structure and aging effect combination is covered by the applicant's Structures Monitoring Program; therefore, it finds the applicant's evaluation acceptable. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

(5) Cracking due to Expansion and Reaction with Aggregates for Groups 1–5 and 7–9 Structures

LRA Section 3.5.2.2.2.1, associated with LRA Table 3.5.1, Item 3.5.1-27, addresses cracking due to expansion and reaction with aggregates for concrete elements of groups 1–5 and 7–9 structures. The GALL Report recommends further evaluation of this structure and aging effect combination only if it is not covered by the Structures Monitoring Program. In the LRA, the applicant stated that this aging effect does not require management; however, the applicant's Structures Monitoring Program is credited for aging management, even if the AMR did not identify aging effects. The staff reviewed LRA Sections 2.4 and 3.5 and confirmed that the structure and aging effect combination is covered by the applicant's Structures Monitoring Program; therefore, it finds the applicant's evaluation acceptable. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

(6) Cracks and Distortion due to Increased Stress Levels from Settlement for Groups 1–3 and 5–9 Structures

LRA Section 3.5.2.2.2.1, associated with LRA Table 3.5.1, Item 3.5.1-28, addresses cracks and distortion due to increased stress levels from settlement for concrete elements of groups 1–3 and 5–9 structures. The GALL Report recommends further evaluation of this structure and aging effect combination only if it is not covered by the Structures Monitoring Program. In the LRA, the applicant stated that this aging effect does not require management; however, the applicant's Structures Monitoring Program is credited for aging management, even if the AMR did not identify aging effects. The staff reviewed LRA Sections 2.4 and 3.5 and confirmed that the structure and aging effect combination is covered by the applicant's Structures Monitoring Program; therefore, it finds the applicant's evaluation acceptable. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

(7) Reduction in Foundation Strength, Cracking, and Differential Settlement due to Erosion of Porous Concrete Subfoundation for Groups 1–3 and 5–9 Structures

LRA Section 3.5.2.2.2.1, associated with LRA Table 3.5.1, Item 3.5.1-29, addresses reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations for groups 1–3 and 5–9 structures. The applicant stated that this line item is not applicable because porous concrete subfoundations were not used at Columbia. The staff reviewed LRA Sections 2.4 and 3.5 and confirmed that no porous concrete subfoundations are present or exposed to flowing water; therefore, the staff finds that applicant's determination acceptable.

(8) Lock-Up due to Wear for Lubrite® Radial Beam Seats in BWR Drywell and Other Sliding Support Surfaces

LRA Section 3.5.2.2.2.1, associated with LRA Table 3.5.1, Item 3.5.1-30, addresses lockup due to wear for Lubrite radial beam seats in BWR drywell and other sliding support surfaces. The GALL Report recommends further evaluation of this structure and aging effect combination only if it is not covered by the Structures Monitoring Program. In the LRA, the applicant stated that this aging effect does not require management; however, the applicant's ISI Program—IWF and Structures Monitoring Program are credited for managing these aging effects and mechanisms for supports designed with or without sliding connections. The staff reviewed LRA Sections 2.4 and 3.5 and confirmed that the structure and aging effect combination is covered by the applicant's ISI—IWF or Structures Monitoring Program; therefore, it finds the applicant's evaluation acceptable. The staff's reviews of the applicant's ISI Program—IWF and Structures Monitoring Programs are documented in SER Sections 3.0.3.1.21 and 3.0.3.2.18, respectively.

<u>Aging Management of Inaccessible Areas</u>. LRA Section 3.5.2.2.2.2 addresses aging management of inaccessible areas (below-grade inaccessible concrete areas of Groups 1–3, 5, and 7–9 Structures).

The staff reviewed LRA Section 3.5.2.2.2.2 against the criteria in SRP-LR Section 3.5.2.2.2.2, which states that the GALL Report recommends further evaluation of the following structure and aging effect combinations:

- 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 for plants located in moderate to severe weathering conditions
- cracking due to expansion and reaction with aggregates in below-grade inaccessible concrete areas of Groups 1–5 and 7–9 structures if concrete was not constructed in accordance with recommendations in ACI 201.2R-77
- cracks and distortion due to increased stress levels from settlement and reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations in below-grade inaccessible concrete areas of Groups 1–3, 5,

and 7–9 structures for plants whose structures are not included within the scope of the applicant's Structures Monitoring Program

- increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack, and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel in below-grade inaccessible concrete areas of Groups 1–3, 5, and 7–9 structures if the environment is aggressive
- increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide in below-grade inaccessible concrete areas of Groups 1–3, 5, and 7–9 structures if the concrete was not constructed in accordance with the recommendations in ACI 201.2R-77

(1) 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

LRA Section 3.5.2.2.2.2.1, associated with LRA Table 3.5.1, Item 3.5.1-26, addresses loss of material (scaling, cracking, and spalling) of inaccessible concrete elements due to freeze-thaw. The applicant addressed the further evaluation criteria of the SRP-LR by stating that concrete was designed in accordance with ACI 318 and constructed in accordance with ACI 301 using materials conforming to ASTM and ACI standards. The LRA also states that the concrete has a water-to-cement ratio below 0.5, air entrainment between 3–6 percent, and meets the intent of ACI 201.2R-77. The LRA further states that the plant is located in an area where weathering conditions are moderate (weathering index 100–500 day-in. per year), and the concrete structures are designed with proper drainage and slope such that ponding or prolonged exposure to standing water is not significant. The applicant stated in the LRA that, although loss of material (spalling, scaling) and cracking due to freeze-thaw are not AERMs for the below-grade inaccessible concrete structural components, the Structures Monitoring Program is credited for managing these aging effects and mechanisms and will be enhanced to include examination of exposed concrete for age-related degradation when a below-grade concrete structure becomes accessible through excavation.

The staff reviewed LRA Section 3.5.2.2.2.2.1 against the criteria in SRP-LR Section 3.5.2.2.2.2.1, which states that further evaluation is required for loss of material (spalling, scaling) and cracking due to freeze-thaw in below-grade inaccessible areas of reinforced concrete structures for plants subjected to moderate to severe weathering conditions. The GALL Report suggests that for moderate to severe weathering conditions the concrete water-to-cement ratio should be between 0.35–0.45, the concrete air content between 3–6 percent, and inspections should not identify degradation related to freeze-thaw.

The staff notes that the applicant stated that the concrete water-to-cement ratio was below 0.5, the concrete air content was between 3–6 percent, the concrete met the intent of ACI 201.2R-77, and the Structures Monitoring Program will be enhanced to include examination of exposed concrete for age-related degradation when a below-grade concrete structure becomes accessible through excavation. The staff also notes that accessible portions of structures will continue to be inspected under the applicant's Structures Monitoring Program. In its review of components associated with line Item 3.5.1-26, the staff finds the applicant's further evaluation of freeze-thaw degradation of inaccessible concrete elements acceptable because the concrete meets the intent of ACI 2-1.2R, the Structures Monitoring Program has been enhanced to examine exposed portions of below-grade concrete when it is accessible due to excavation, and the Structures Monitoring Program is credited for managing this aging effect in accessible areas. Even though the water-to-cement ratio may be slightly above the GALL recommended limit of 0.45, considering the points discussed above, the staff finds the water-to-cement ratio acceptable. The staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

Based on the evaluation provided, the staff concludes that the applicant met SRP-LR Section 3.5.2.2.2.2.1 criteria. For those line items that apply to LRA Section 3.5.2.2.2.2.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(2) Cracking due to expansion and reaction with aggregates in below-grade inaccessible concrete areas for Groups 1–5 and 7–9 structures

LRA Section 3.5.2.2.2.2.2, associated with LRA Table 3.5.1, Item 3.5.1-27, addresses cracking due to reaction with aggregates for groups 1–5, and 7–9 structures. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the concrete was designed in accordance with ACI 318, constructed in accordance with ACI 301 and used materials conforming to ASTM and ACI standards; therefore, it met the intent of ACI 201.2R-77. The LRA also states that the aggregate materials conformed to ASTM C33, and potential reactivity of the aggregates was based on acceptable results from ASTM C227 or ASTM C289. The LRA further states that the Structures Monitoring Program is credited for managing these aging effects and mechanisms in accessible concrete.

The staff reviewed LRA Section 3.5.2.2.2.2.2 against the criteria in SRP-LR Section 3.5.2.2.2.2.2, which states that the GALL Report recommends further evaluation of inaccessible areas of these groups of structures if the concrete was not constructed in accordance with the recommendations in ACI 201.2R-77. GALL Report Item III.A3-2 states that investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that the aggregate is not reactive within the reinforced concrete. If either of these conditions is met, the GALL Report notes that aging management is not necessary.

In its review of components associated with line Item 3.5.1-27, the staff finds the applicant's further evaluation acceptable because the concrete meets the intent of ACI 201.2R-77, and the aggregate materials were evaluated in accordance with ASTM 227 or 289 and found to be nonreactive. In addition, the applicant will continue to monitor accessible concrete areas for cracking due to reaction with aggregates through Structures Monitoring Program inspections. The staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

Based on the evaluation provided, the staff concludes that the applicant met SRP-LR Section 3.5.2.2.2.2.2 criteria. For those line items that apply to LRA Section 3.5.2.2.2.2.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(3) Cracks and distortion due to increased stress levels from settlement and reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations in below-grade inaccessible concrete areas of Groups 1–3, 5, and 7–9 structures

LRA Section 3.5.2.2.2.2.3, associated with LRA Table 3.5.1, Items 3.5.1-28 and 3.5.1-29, addresses cracks and distortion due to increased stress levels from settlement, and reduction of foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundations for Groups 1–3 and 5–9 structures. The LRA states that plant structures are supported on structural backfill that provides safe bearing for the structural foundations, measurement points established on the corners of several buildings (reactor building, radwaste control building, spray ponds, and substructure of the turbine generator building) have indicated that the settlement experienced in the past 20 years is within permissible limits, and there is no evidence in the form cracked walls or foundations resulting from differential settlement. The LRA also states that a dewatering system is not employed in any site structure for control of settlement since the groundwater level is sufficiently lower than the deepest foundation, and porous concrete subfoundations are not employed. The LRA further states that the Structures Monitoring Program is credited for aging management of these effects.

The staff reviewed LRA Section 3.5.2.2.2.2.3 against the criteria in SRP-LR Section 3.5.2.2.2.2.3, which states that the GALL Report recommends verification of the continued functionality of the dewatering system during the period of extended operation if the plant's CLB credits a dewatering system. The GALL Report recommends no further evaluation if this activity and these aging effects are included in the scope of the applicant's Structures Monitoring Program.

In its review of components associated with line Items 3.5.1-28 and 3.5.1-29, the staff finds the applicant's further evaluation acceptable because the applicant does not use a dewatering system, and there are no porous subfoundations on the site. In addition, the applicant monitors the above-grade exposed concrete for the aging effects under the Structures Monitoring Program. The staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

Based on the evaluation provided, the staff concludes that the applicant met SRP-LR Section 3.5.2.2.2.2.3 criteria. For those line items that apply to LRA Section 3.5.2.2.2.2.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(4) Increase in porosity and permeability, cracking and loss of material (spalling, scaling) due to aggressive chemical attack, and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel in below-grade inaccessible concrete areas of Groups 1–3, 5, and 7–9 structures

LRA Section 3.5.2.2.2.2.4, associated with LRA Table 3.5.1, Item 3.5.1-31, addresses below-grade concrete components exposed to a groundwater and soil environment that are being managed for cracking, loss of material, and loss of bond due to aggressive chemical attack and corrosion of embedded steel. The applicant addressed the further evaluation criteria of the SRP-LR by stating that concrete was designed in accordance with ACI 318 and constructed in accordance with ACI 301 using materials conforming to

ASTM and ACI standards. The LRA also states that the concrete had a water-to-cement ratio below 0.5, air entrainment between 3–6 percent, meets the intent of ACI 201.2R-77, and is not subjected to flowing water. The LRA further states that the below-grade environment is non-aggressive (i.e., groundwater: chlorides 36 ppm, sulfates 323 ppm, and pH 6.9) and will be monitored periodically during the period of extended operation, and the Structures Monitoring Program will be enhanced to include examination of exposed concrete for age-related degradation when a below-grade concrete structure becomes accessible through excavation.

The staff reviewed LRA Section 3.5.2.2.2.2.4 against the criteria in SRP-LR Section 3.5.2.2.2.4, which states that the GALL Report recommends further evaluation of plant-specific programs to manage these aging effects and mechanisms in inaccessible areas of these groups of structures if the environment is aggressive. In the GALL Report it is noted that for inaccessible areas of plants with non-aggressive groundwater and soil (i.e., pH > 5.5, chlorides < 500 ppm, or sulfates < 1,500 ppm), as a minimum the following should be considered:

- examinations of the exposed portions of the below-grade concrete, when excavated for any reason
- periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations

In its review of components associated with line Item 3.5.1-31, the staff finds the applicant's further evaluation acceptable because the site groundwater and soil is non-aggressive and will be monitored periodically during the period of extended operation, and the applicant's Structures Monitoring Program will examine exposed concrete for age-related degradation when a below-grade concrete structure becomes accessible through excavation. The staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

Based on the evaluation provided, the staff concludes that the applicant met SRP-LR Section 3.5.2.2.2.2.4 criteria. For those line items that apply to LRA Section 3.5.2.2.2.2.4, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(5) Increase in porosity and permeability and loss of strength due to leaching of calcium hydroxide in below-grade inaccessible concrete areas of Groups 1–3, 5, and 7–9 structures

LRA Section 3.5.2.2.2.2.5, associated with LRA Table 3.5.1, Item 3.5.1-32, addresses below-grade concrete components exposed to a flowing water or soil environment that are being managed for increase in porosity and permeability and loss of strength due to leaching of calcium hydroxide. The applicant addressed the further evaluation criteria of the SRP-LR by stating that concrete was designed in accordance with ACI 318 and constructed in accordance with ACI 301 using materials conforming to ASTM and ACI standards that meet the intent of ACI 201.2R-77. The LRA also states that the concrete had a water-to-cement ratio below 0.5, air entrainment between 3–6 percent, and meets the intent of ACI 201.2R-77. The LRA further states that concrete components below-grade are not exposed to flowing water as the Seismic Category I structures and safety-related systems and components are located above the present groundwater elevation (approximately 20 ft above).

The staff reviewed LRA Section 3.5.2.2.2.2.5 against the criteria in SRP-LR Section 3.5.2.2.2.2.5 which states that the GALL Report recommends further evaluation of this aging effect for inaccessible areas of Groups 1–3, 5 and 7–9 structures if concrete was not constructed in accordance with the recommendations in ACI 201.2R-77.

In its review of components associated with line Items 3.5.1-32, the staff finds the applicant's further evaluation acceptable because the concrete mix designs were developed in compliance with guidance provided in ACI 301, which contains specifications for structural concrete that address durability requirements identified in ACI 201.2R-77. Therefore, the GALL Report recommendations have been met.

Based on the evaluation provided, the staff concludes that the applicant met SRP-LR Section 3.5.2.2.2.2.5 criteria. For those line items that apply to LRA Section 3.5.2.2.2.2.5, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

<u>Reduction of Strength and Modulus of Concrete Structures Due to Elevated Temperature</u>. LRA Section 3.5.2.2.2.3, associated with LRA Table 3.5.1, Item 3.5.1-33, addresses reduction of strength and modulus of concrete structures due to elevated temperature. The applicant stated that this aging effect does not require management because in-scope concrete elements are maintained below 150˚F during normal operation. The LRA also states that piping in the primary containment is not in direct contact with concrete, and the concrete temperature surrounding hot penetrations are maintained less than or equal to 200˚F. The GALL Report recommends further evaluation if in-scope concrete structures exceed 150˚F for general areas or 200˚F for localized areas. The staff reviewed the UFSAR and noted that several areas listed in Table 3.11-1 had operating condition temperature limits above 150˚F. Therefore, by letter dated October 14, 2010, the staff issued RAI 3.5.2.2.2.3-1 requesting that the applicant explain how concrete in areas with elevated temperatures will be managed for possible aging effects due to elevated temperatures.

By letter dated January 18, 2011, the applicant responded and explained that the temperatures above 150˚F in UFSAR Table 3.11-1 were accompanied by a note stating, "During design basis events this temperature may be exceeded for a short period of time (less than 30 days). These room temperatures are used to support the evaluated design capability of equipment during design basis events. Analysis has confirmed that these rooms will not exceed the temperatures listed." The applicant further explained that the associated temperatures are not normal operating temperatures but operability temperatures after design basis events. The normal operating temperatures can be found in a different portion of UFSAR Table 3.11-1, and, for the areas of concern (i.e., the emergency diesel generator engine room), the maximum normal operating temperature is 120˚F.

The staff reviewed the applicant's response, and the UFSAR, and noted that the temperatures listed in Table 3.11-1 which exceed 150˚F are only experienced after design basis events. The staff also noted that the normal operating temperature is below the GALL Report limit of 150˚F for general areas. The staff further noted that the GALL Report recommended limit is intended for concrete which is exposed to high temperatures for normal operation or any other long-term period (greater than 30 days). Therefore, the staff finds the applicant's response acceptable because the concrete has not experienced temperatures above the GALL Report limit, and it would only experience temperatures above the limit for a short period of time on an event-driven basis. The staff also finds acceptable the applicant's determination that this aging effect does not require further evaluation because the concrete does not exceed the GALL Report limit.

Based on the evaluation provided, the staff concludes that the applicant met SRP-LR Section 3.5.2.2.2.3 criteria. For those line items that apply to LRA Section 3.5.2.2.2.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Aging Management of Inaccessible Areas for Group 6 Structures. LRA Section 3.5.2.2.2.4 addresses aging management of inaccessible areas for Group 6 structures (below-grade inaccessible concrete areas).

(1) Increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack and cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel in below-grade inaccessible concrete areas of Group 6 structures

LRA Section 3.5.2.2.2.4.1, associated with LRA Table 3.5.1, Item 3.5.1-34, addresses below-grade concrete components exposed to a groundwater and soil environment that are being managed for increase in porosity and permeability, cracking, loss of material, and loss of bond due to aggressive chemical attack and corrosion of embedded steel. The applicant addressed the further evaluation criteria of the SRP-LR by stating that concrete was designed in accordance with ACI 318 and constructed in accordance with ACI 301 using materials conforming to ASTM and ACI standards. The LRA also states that the concrete had a water-to-cement ratio below 0.5, air entrainment between 3–6 percent, meets the intent of ACI 201.2R-77, and is not subjected to flowing water. The LRA further states that the below-grade environment is non-aggressive (i.e., groundwater: chlorides 36 ppm, sulfates 323 ppm, and pH 6.9) and will be monitored periodically during the period of extended operation. The applicant stated in the LRA that the Structures Monitoring Program that implements the Water Control Structures Inspection Program will be used for aging management of these effects and mechanisms, and the water control structure's concrete is not exposed to an aggressive environment.

The staff reviewed LRA Section 3.5.2.2.2.4.1 against the criteria in SRP-LR Section 3.5.2.2.2.4.1, which states that the GALL Report recommends further evaluation of plant-specific programs to manage these aging effects in inaccessible areas if the environment is aggressive. In the GALL Report it is noted that for inaccessible areas of plants with non-aggressive groundwater and soil (i.e., pH > 5.5, chlorides < 500 ppm, or sulfates < 1,500 ppm), as a minimum the following should be considered:

- examinations of the exposed portions of the below-grade concrete, when excavated for any reason
- periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations

The staff notes that inspections of accessible portions of Group 6 structures are performed under the Structures Monitoring Program that implements the Water Control Structures Inspection Program which, with enhancements related to scope and parameters monitored or measured, is consistent with the 10 elements of GALL Report AMP XI.S7, RG 1.127, "Inspection of Water-Control Structures Associated with Nuclear Power Plants Program." In its review of components associated with line Items 3.5.1-34, the staff finds the applicant's further evaluation acceptable because the site groundwater and soil is non-aggressive and will be monitored periodically during the period of extended operation, and the applicant's Structures Monitoring Program will examine exposed concrete for age-related degradation when a below-grade concrete structure becomes accessible through excavation. The staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff's review of these aging effects for inaccessible elements of Groups 1–3, 5, and 7–9 concrete structures is documented in SER Section 3.5.2.2.2, "Aging Management of Inaccessible Areas," Item 4.

Based on the evaluation provided, the staff concludes that the applicant met SRP-LR Section 3.5.2.2.2.4.1 criteria. For those line items that apply to LRA Section 3.5.2.2.2.4.1, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(2) Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Group 6 structures

LRA Section 3.5.2.2.2.4.2, associated with LRA Table 3.5.1, Item 3.5.1-35, addresses loss of material (scaling, cracking, and spalling) of inaccessible concrete elements due to freeze–thaw in Group 6 structures. The applicant addressed the further evaluation criteria of the SRP-LR by stating that concrete was designed in accordance with ACI 318 and constructed in accordance with ACI 301 using materials conforming to ASTM and ACI standards. The LRA also states that the concrete had a water-to-cement ratio below 0.5, air entrainment between 3–6 percent, and meets the intent of ACI 201.2R-77. The LRA further states that loss of material (spalling, scaling) and cracking due to freeze-thaw are AERMs for concrete located in water control structures that become saturated, but concrete components submerged in raw water (e.g., spray pond foundation) are not susceptible to freeze-thaw. The applicant stated in the LRA that inspections of the Group 6 structures are performed under the Structures Monitoring Program that implements the Water Control Structures Inspection Program which, with enhancements related to scope and parameters monitored or measured, is consistent with the 10 elements of RG 1.127, "Inspection of Water-Control Structures Associated with Nuclear Power Plants Program." The applicant also stated in the LRA that the Structures Monitoring Program will be enhanced to include examination of exposed concrete for age-related degradation when a below-grade concrete component becomes accessible through excavation.

The staff reviewed LRA Section 3.5.2.2.2.4.2 against the criteria in SRP-LR Section 3.5.2.2.2.4.2, which states that further evaluation is required for loss of material (spalling, scaling) and cracking due to freeze-thaw in below-grade inaccessible areas of reinforced concrete structures for plants subjected to moderate to severe weathering conditions. The GALL Report notes, that for moderate to severe weathering conditions, inspections of concrete with water-to-cement ratio between 0.35–0.45 and air content between 3–6 percent did not reveal degradation related to freeze-thaw.

In its review of components associated with line Items 3.5.1-35, the staff finds the applicant's further evaluation acceptable because the applicant's concrete contains the appropriate air content and water-to-cement ratio, and the Structures Monitoring Program (which implements the Water Control Structures Inspection Program) will be used for management of this aging effect in accessible concrete. The staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff's review of this aging effect for inaccessible concrete elements of Groups 1–3, 5, and 7–9 structures is documented in SER Section 3.5.2.2.2, "Aging Management of Inaccessible Concrete," Item 1.

Based on the evaluation provided, the staff concludes that the applicant has met SRP-LR Section 3.5.2.2.2.4.2 criteria. For those line items that apply to LRA Section 3.5.2.2.2.4.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

(3) Cracking due to expansion and reaction with aggregates and increase in porosity and permeability and loss of strength due to leaching of calcium hydroxide in below-grade inaccessible reinforced concrete areas of Group 6 structures

LRA Section 3.5.2.2.2.4.3, associated with LRA Table 3.5.1, Items 3.5.1-36 and 3.5.1-37, addresses cracking due to reaction with aggregates and increase in porosity and permeability due to leaching of calcium hydroxide for below-grade concrete areas of Group 6 structures. The applicant addressed the further evaluation criteria of the SRP-LR by stating that the concrete was designed in accordance with ACI 318 and constructed in accordance with ACI 301 using materials conforming to ASTM and ACI standards, the aggregate materials conformed to ASTM C33, and potential reactivity of the aggregates was based on acceptable results from ASTM C227 or ASTM C289. The LRA also states that, although the water control structures are exposed to flowing water, the below-grade portion of the structures is above the groundwater elevation. The LRA further states that the Structures Monitoring Program that implements the Water Control Structures Inspection Program will be used for aging management of these effects and mechanisms, and the Structures Monitoring Program will be enhanced to include examination of exposed concrete for age-related degradation when a below-grade concrete component becomes accessible through excavation.

The staff reviewed LRA Section 3.5.2.2.2.4.3 against the criteria in SRP-LR Section 3.5.2.2.2.4.3, which states that cracking due to expansion and reaction with aggregate, and increase in porosity and permeability due to leaching of calcium hydroxide, could occur in concrete elements of Group 6 structures. The GALL Report notes that investigations, tests, and petrographic examinations performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that the aggregate does not react within the reinforced concrete. The GALL Report also notes that leaching of calcium hydroxide from reinforced concrete becomes significant only if the concrete is exposed to flowing water. Additionally, even if the reinforced concrete is exposed to flowing water, such leaching is not significant if the concrete was constructed to ensure that it is dense, well-cured, has low permeability, and that cracking is well controlled through proper arrangement and distribution of reinforcing bars. All the above characteristics are assured if the concrete was constructed in accordance with ACI 201.2R-77.

In its review of components associated with line Items 3.5.1-36 and 3.5.1-37, the staff finds the applicant's further evaluation acceptable because potential reactivity of the aggregates was based on acceptable results from ASTM C227 or ASTM C289, and the concrete mix designs were developed in compliance with guidance provided in ACI 301 which provides specifications for structural concrete that address durability requirements such as identified in ACI 201.2R-77. Therefore, the GALL Report recommendations have been met.

Based on the evaluation provided, the staff concludes that the applicant met SRP-LR Section 3.5.2.2.2.4.3 criteria. For those line items that apply to LRA Section 3.5.2.2.2.4.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

<u>Cracking Due to SCC and Loss of Material Due to Pitting and Crevice Corrosion</u>. LRA Section 3.5.2.2.2.5, associated with LRA Table 3.5.1, Item 3.5.1-38, addresses cracking due to SCC and loss of material due to pitting and crevice corrosion for Group 7 and 8 stainless steel tank liners exposed to standing water. The applicant stated that no tanks with stainless steel liners are included in the structural reviews for aging management, and tanks subject to this AMR are evaluated with the respective mechanical systems. The staff verified that the in-scope tank liners were evaluated as tanks with its mechanical systems and assigned lines from NUREG-1801 Chapters VII and VIII.

<u>Aging of Supports not Covered by the Structures Monitoring Program</u>. LRA Section 3.5.2.2.2.6 addresses aging of supports not covered by structures monitoring program.

(1) Loss of material due to general and pitting corrosion, for Groups B2–B5 supports

LRA Section 3.5.2.2.2.6, associated with LRA Table 3.5.1, Item 3.5.1-39, addresses loss of material due to general and pitting corrosion of Groups B2–B5 steel supports exposed to an air environment. The GALL Report recommends further evaluation of this structure and aging effect combination only if it is not covered by the Structures Monitoring Program. In the LRA, the applicant stated that this line item does not require further evaluation because it is covered by the Structures Monitoring Program. The staff confirmed that the structure and aging effect combination is covered by the Structures Monitoring Program; therefore, it finds the applicant's determination acceptable. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

(2) Reduction in concrete anchor capacity due to degradation of the surrounding concrete for Groups B1–B5 supports

LRA Section 3.5.2.2.2.6, associated with LRA Table 3.5.1, Item 3.5.1-40, addresses reduction in anchor capacity due to degradation of surrounding concrete for Groups B1–B5 supports exposed to an air environment. The GALL Report recommends further evaluation of this structure and aging effect combination only if it is not covered by the Structures Monitoring Program. In the LRA, the applicant stated that this line item does not require further evaluation because it is covered by the Structures Monitoring Program. The staff confirmed that the structure and aging effect combination is covered by the Structures Monitoring Program; therefore, it finds the applicant's determination acceptable. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

(3) Reduction due to loss of isolation function due to degradation of vibration isolation elements for Group B4 supports

LRA Section 3.5.2.2.2.6, associated with LRA Table 3.5.1, Item 3.5.1-41, addresses reduction of isolation function of non-metallic vibration isolation elements in an air environment. The GALL Report recommends further evaluation of this structure and aging effect combination only if it is not covered by the Structures Monitoring Program. In the LRA, the applicant stated that this line item does not require further evaluation because it is covered by the Structures Monitoring Program. The staff confirmed that the structure and aging effect combination is covered by the Structures Monitoring Program; therefore, it finds the applicant's determination acceptable. The staff's review of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

Cumulative Fatigue Damage Due to Cyclic Loading. LRA Section 3.5.2.2.2.7 states that TLAAs are evaluated in accordance with 10 CFR 54.21(c), as documented in Section 4. The LRA also states that no fatigue analyses were identified for component support members, anchor bolts, or welds for Groups B1.1, B1.2, and B1.3. This is consistent with SRP-LR Section 3.5.2.2.2.7 and is, therefore, acceptable.

3.5.2.2.3 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA Program.

3.5.2.3 AMR Results that are Not Consistent with or Not Addressed in the GALL Report

In LRA Tables 3.5.2-1 through 3.5.2-13, the staff reviewed additional details of the AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

In LRA Tables 3.5.2-1 through 3.5.2-13, the applicant indicated, via notes F through J, that the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report. The applicant provided further information about how it will manage the aging effects. Specifically, Note F indicates that the material for the AMR line item component is not evaluated in the GALL Report. Note G indicates that the environment for the AMR line item component and material is not evaluated in the GALL Report. Note H indicates that the aging effect for the AMR line item component, material, and environment combination is not evaluated in the GALL Report. Note I indicates that the aging effect identified in the GALL Report for the line item component, material, and environment combination is not applicable. Note J indicates that neither the component nor the material and environment combination for the line item is evaluated in the GALL Report.

For component type, material, and environment combinations not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine if the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation. The staff's evaluation is documented in the following sections.

3.5.2.3.1 Containment, Structures, and Component Supports—Primary Containment—Summary of Aging Management Evaluation—LRA Table 3.5.2-1

In LRA Table 3.5.2-1, the applicant stated that for the stainless steel drywell floor peripheral seal assembly exposed to indoor air there is no AERM but credits the ISI Program—IWE and Appendix J Program to manage aging for the component. The AMR line item cites Generic Note I. The line item associated with the stainless steel drywell floor peripheral seal assembly (LRA Table 3.5.2-1, row 5) cites plant-specific Note 0501, which states that no applicable aging effects have been identified for the component type, but that the ISI Program—IWE and Appendix J Program will be used to confirm the absence of significant aging effects for the period of extended operation. This line item also cites plant-specific Note 0502, which states that the GALL Report item II.B2.1-1 indicates the moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements, but that the applicant's drywell floor peripheral seal is made of stainless steel which is welded to the primary containment vessel and to the underside of the circular closure girder embedded in the drywell floor; therefore there are no concrete-to-metal moisture barriers and the GALL Report regarding the moisture barrier is not applicable.

The staff reviewed LRA Table 3.5.2-1, "Aging Management Review Results—Primary Containment," that states that the seal has no aging effects and verification is credited by the ISI Program—IWE and the Appendix J Program and Section 3.5.2.2.1.4 that discusses "Loss of Material due to General, Pitting, and Crevice Corrosion" and states that the drywell floor peripheral seal is made of stainless steel, welded to the primary containment vessel and to the underside of the circular closure girder, both of which are made of carbon structural steel.

The staff's evaluations of the applicant's ISI Program—IWE and Appendix J Programs are documented in SER Sections 3.0.3.1.20, and 3.0.3.1.1, respectively. The staff noted that the GALL Report Item II.B2.1-1 deals with steel drywell components in contact with uncontrolled indoor air or treated water and identifies loss of material due to general, pitting, and crevice corrosion as the applicable aging effect and recommends GALL Report AMP XI.S1, "ASME Section XI, Subsection IWE," and GALL Report AMP XI.S4, "Appendix J," to manage these aging effects. The staff also noted that the drywell floor peripheral seal assembly is made of stainless steel. Upon review of the UFSAR, the staff further noted that the drywell floor peripheral seal assembly is made from a portion of an open pipe and plates capable of carrying loads and that the purpose of the seal is to contain drywell area leaks and to seal the over-under portions of the primary containment vessel. The staff then noted that the drywell floor peripheral seal is welded to dissimilar metals (stainless to carbon steel) and can be exposed to moisture and possible loss of material and that fabrication residual stresses combined with the prevalent thermal environment, imposed loads, and possible aggressive environment may exacerbate the potential for SCC. The staff revisited the GALL Report and noted that line Item II.B4-2 more appropriately discusses the susceptibility of stainless steel components and dissimilar metal welds to SCC.

Following these reviews, it was not clear to the staff how the stainless steel drywell floor seal subjected to multiple loads and a potential aggressive environment will be managed for SCC during the period of extended operation. Because of the difficulty of inspecting the drywell floor peripheral seal, the staff had concerns of the adequacy of the selected GALL Report ISI-IWE and Appendix J Programs recommended frequency of inspections.

By letter dated March 18, 2011, the staff issued RAI 3.5.2.2.1.4-02 asking the applicant to describe the environment and applied loads (e.g., thermal, seismic, etc.) to which the drywell floor peripheral seal is exposed to and to justify the component's capacity to perform its intended function(s) for the period of extended operation. The staff also requested that the applicant explain how the drywell floor peripheral seal will be managed for SCC during the period of extended operation, specifically the visual examination methodology the applicant will use and how it will inspect the interior of the seal. Finally the staff requested the applicant to report when the last inspection took place, its outcome, its frequency, and its justification.

In letter dated April 13, 2011, the applicant responded and stated that the drywell floor peripheral seal is designed to accommodate all applicable loads and deflections (i.e., differential thermal movements, effects of LOCA—temperature and pressure changes, and seismic loads) within the elastic range. Any additional loads on the seal (i.e., fluid jet forces due to pipe breaks) are deflected through specialized hardware. Shear lugs also eliminate potential lateral and torsional movements between the seal, the vessel, and the floor during seismic events.

As to the environment that exists during normal operations, the applicant stated that the seal is exposed to an air-indoor (nitrogen inerted) environment. The interior of the seal faces the drywell, while the exterior faces the wetwell of the primary containment. The applicant further stated that the seal is exposed to a non-aggressive air and water environment without high temperatures and hence SCC, which requires the combination of stress (applied and residual), a corrosive environment at high temperature, and a susceptible material does not exist and therefore SCC is not an AERM. Consequently, the seal is expected to maintain its structural integrity for pressure suppression during the period of extended operation. The applicant also stated that the internal part of the seal due to its configuration cannot be visually inspected as initially was proposed via the ISI—IWE general inspection. The visual inspection, therefore, is limited to the exterior of the seal and is performed from a platform below. Since the pressure suppression function of the primary containment is to limit leakage from the drywell to the wetwell, the bypass leak rate testing (BLRT) performed per TSs will replace the visual inspection of the seal ensuring potential leaks that could bypass the suppression pool remain within allowable limits. Because BLRT is not part of the Appendix J Program, the applicant amended LRA Table 3.5.2-1, line Item 5, crediting the TSs instead of the Appendix J Program for confirming the absence of significant aging effects for the drywell floor peripheral seal.

The applicant finally stated that the drywell floor peripheral seal was last inspected under the ISI—IWE Program during Columbia's R-18 RFO in 2007, and no unacceptable indications were found. The visual inspection frequency (based on ASME Section XI, IWE, 2001 Code Edition through 2003 Addenda) is once per every ISI—IWE inspection period which is three times every 10-year inspection interval. The last BLRT was performed in 2005, and the bypass leakage between the drywell and wetwell was approximately 17 percent of the limit and, therefore, was acceptable. The frequency for BLRT is at least once every 10 years and is based on TS requirements.

The staff finds the applicant’s response acceptable because it eliminates the likelihood of SCC, verifies that the applicant will periodically visually inspect the external part of the seal, revises LRA Table 3.5.2-1, and assures that the seal’s intended function will remain during the period of extended operation through the BLRT test procedure. The staff’s concern described in RAI 3.5.2.2.1.4-02 is resolved

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.5.2-1, the applicant stated that the stainless steel drywell sump liners exposed to raw water are being managed for loss of material by the Structures Monitoring Program and the BWR Water Chemistry Program. The AMR line item cites Generic Note J. The line item associated with the stainless steel drywell sump liners also cites plant-specific Note 0508, which states that, in addition to Structures Monitoring Program as the applicable AMP, the BWR Water Chemistry Program is also credited with the elimination of excessive chlorides and sulfates from the water.

The staff reviewed the associated AMR results in the LRA and confirmed that the applicant has identified the correct aging effects for this component, material, and environment combination because the GALL Report states that stainless steel exposed to raw water is susceptible to loss of material, which is being managed in this AMR item.

The staff’s evaluation of the applicant’s Structures Monitoring and BWR Water Chemistry Programs are documented in SER Sections 3.0.3.2.18 and 3.0.3.1.7, respectively. The staff noted that the GALL Report recommends GALL Report AMP XI.M20, “Open-Cycle Cooling Water System,” to manage loss of material for stainless steel components exposed to raw water, but that in this case, the water collected is mostly reactor water and closed cooling water system leakage, and is not part of an open-cycle cooling water system. However, the staff also noted that the configuration of the floor drain and drywell equipment drain sumps do not prevent the intrusion of water that was part of the primary water system but has been exposed to contaminants or water from the closed cooling water system that is not monitored by the BWR Water Chemistry Program. It is unclear to the staff how the BWR Water Chemistry Program is being used to reduce chlorides and sulfates in the water being collected by the drywell sumps in order to manage loss of material for the drywell sump liners. By letter dated September 16, 2010, the staff issued RAI 3.5.2.1-1 requesting that the applicant explain how the BWR Water Chemistry Program is being used to manage loss of material for the drywell sump liners.

In its response dated December 21, 2010, the applicant stated the BWR Water Chemistry Program was credited since it reduces excessive chlorides and sulfates in the primary water, but that it was not intended to be used to manage loss of material for the drywell sump liners. The applicant also stated that the Structures Monitoring Program is the program credited to manage loss of material for the drywell sump liners. The applicant revised the LRA to delete the AMR result crediting the BWR Water Chemistry Program for managing loss of material and to delete plant-specific Note 0508. The staff’s evaluation of the applicant’s Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff finds the applicant’s proposal to manage aging using the Structures Monitoring Program acceptable because the program includes periodic visual inspections, which are capable of detecting loss of material due to general, pitting, and crevice corrosion. The staff’s concern described in RAI 3.5.2.1-1 is resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these

components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.5.2-1, 3.5.2-2, 3.5.2-5, 3.5.2-6, 3.5.2-8, 3.5.2-9, 3.5.2-10, 3.5.2-11, 3.5.2-12, and 3.5.2-13, the applicant stated that, for the concrete components exposed to either an air-indoor, air-outdoor, soil, or treated water environment, there is no aging effect. However, the Structures Monitoring Program that implements the Water Control Structures Inspection Program is credited for aging management of the concrete components. The AMR line items cite Generic Note I and plant-specific Note 501, which states that no applicable aging effects have been identified for the component type. However, the identified AMP will be used to confirm the absence of significant aging effects for the period of extended operation.

The staff reviewed the associated line items in the LRA and does not agree that no aging effect is applicable for these component, material, and environment combinations. However, the staff notes that the concrete was designed in accordance with ACI 318 and constructed in accordance with ACI 301 using materials conforming to ASTM and ACI standards, the aggregate materials are not reactive, and the groundwater is non-aggressive. All of these attributes increase the durability of concrete and reduce the likelihood of significant degradation. The staff also notes that the applicant will monitor the concrete components for aging effects during the period of extended operation using the Structures Monitoring Program. The staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff finds the applicant's proposal to manage aging using the Structures Monitoring Program acceptable because the AMP employs appropriate visual inspections capable of detecting concrete degradation, such as scaling, spalling or cracking, and the GALL Report recommends the Structures Monitoring Program to manage concrete for similar aging effects in similar environments.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.5.2-1 the applicant stated that, for concrete with sand in the sand-filled pocket area subjected to an air-indoor environment there is no aging effect; however, the Structures Monitoring Program is credited for aging management of the concrete components. The AMR line items cite Generic Note I and plant-specific Note 501, which states that "no applicable aging effects have been identified for the component type. However, the identified AMP will be used to confirm the absence of significant aging effects for the period of extended operation." This line item also cites plant-specific Note 504, which states that "due to possibility of containment shell degradation from corrosion induced by a moist environment in sand pocket region, Columbia has committed to monitor humidity levels in this region. Columbia has implemented a procedure to survey the relative humidity of air drawn from within containment annulus sand pocket region."

The staff reviewed the associated line items in the LRA and does not agree that no aging effect is applicable for this component, material, and environment combination. However, the staff notes that the concrete was designed in accordance with ACI 318 and constructed in accordance with ACI 301 using materials conforming to ASTM and ACI standards, and the aggregate materials are not reactive. All of these attributes increase the durability of concrete and reduce the likelihood of significant degradation. The staff also notes that this area is inaccessible for routine inspections; however, the applicant's Structures Monitoring Program will be used to confirm the absence of significant aging effects in similar regions of accessible concrete. The staff's evaluation of the applicant's approach to aging management of inaccessible concrete areas is discussed in SER Section 3.5.2.2.2, "Aging Management of Inaccessible Areas," and the staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff finds the applicant's proposal to manage aging using the Structures Monitoring Program acceptable because the GALL Report recommends the Structures Monitoring Program to manage concrete for similar aging effects in similar environments, and the applicant appropriately evaluated the aging effects of inaccessible concrete (see SER Section 3.5.2.2.2). A more detailed review of the applicant's management of the sand pocket region can be found in SER Section 3.0.3.1.20, which documents the staff's review of the ISI—IWE Program.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.2 Containment, Structures, and Component Supports—Reactor Building—Summary of Aging Management Evaluation—LRA Table 3.5.2-2

The staff's evaluation for concrete components exposed to either an air-indoor, air-outdoor, or soil environment, which are being managed for aging by the Structures Monitoring Program, citing Generic Note I and plant-specific Note 501, is documented in SER Section 3.5.2.3.1.

In LRA Tables 3.5.2-2 and 3.5.2-10, the applicant stated that, for concrete (solid blocks or bricks) shield walls exposed to an air-indoor environment, there is no aging effect; however, the Structures Monitoring Program is credited for aging management of the concrete components. The AMR line items cite Generic Note I, and plant-specific Note 501, which states that "no applicable aging effects have been identified for the component type. However, the identified AMP will be used to confirm the absence of significant aging effects for the period of extended operation." This line item also cites plant-specific Note 517 which states the following:

> The shield walls at Columbia are made up of free-standing or stacked solid bricks (blocks) sandwiched between metal (siding) panels. The panel sections (and blocks) are held in place under all load conditions by angle sections anchored to the concrete wing walls at the pipe chases. Concrete block shield walls do not function like a typical block wall within a structure and are not subjected to degradations found from industry experience (i.e., aging effects cited in IEB 80-11).-

The staff reviewed the associated line items in the LRA and confirmed that no aging effect is applicable for this component, material, and environment combination. The staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff finds the applicant's proposal to manage aging using the Structures Monitoring Program acceptable because the concrete shield walls by being in an air-indoor environment are not subjected to AERMs, and the applicant will use the Structures Monitoring Program to confirm the absence of significant aging effects.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.3 Containment, Structures, and Component Supports—Standby Service Water Pump House 1A and 1B and Spray Pond 1A and 1B—Summary of Aging Management Evaluation—LRA Table 3.5.2-3

In LRA Tables 3.5.2-3, 3.5.2-4, and 3.5.2-7, the applicant stated that, for concrete components exposed to soil, air-indoor, air-outdoor, or raw water environment, there is no aging effect. However, the Structures Monitoring Program that implements the Water Control Structures Inspection Program is credited for aging management of the concrete components. The AMR line items cite Generic Note I and plant-specific Note 501, which states that "no applicable aging effects have been identified for the component type. However, the identified AMP will be used to confirm the absence of significant aging effects for the period of extended operation." These line items also cite plant-specific Note 518, which states that "Columbia is not committed to RG 1.127 Inspection of Water Control Structures Associated with Nuclear Power Plants, Revision 1. However, the Structures Monitoring Program will be enhanced to include the inspection elements delineated in RG 1.127, Revision 1 per NUREG-1801 Chapter XI.S7." These line items also cite plant-specific Note 520, which states that "concrete component submerged in raw water is not susceptible to freeze-thaw. No applicable aging effects have been identified for the component type. However, the identified AMP will be used to confirm the absence of significant aging effects for the period of extended operation."

The staff reviewed the associated line items in the LRA and does not agree that no aging effect is applicable for these component, material, and environment combinations. However, the staff notes that the concrete was designed in accordance with ACI 318 and constructed in accordance with ACI 301 using materials conforming to ASTM and ACI standards, the aggregate materials are not reactive, and the groundwater and raw water is non-aggressive. All of these attributes increase the durability of concrete and reduce the likelihood of significant degradation. The staff also notes that the applicant will confirm the absence of significant aging effects during the period of extended operation using the augmented Structures Monitoring Program, which incorporates the recommendations of the Water-Control Structures Inspection Program. The staff's evaluations of the applicant's Structures Monitoring Program and Water-Control Structures Inspection Program are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.19, respectively. The staff finds the applicant's proposal to manage aging using the Structures Monitoring Program acceptable because the Structures Monitoring Program employs appropriate visual inspections capable of detecting concrete degradation, such as scaling, spalling or cracking, and the GALL Report recommends the Structures Monitoring Program to manage concrete for similar aging effects in similar environments.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Tables 3.5.2-3 the applicant stated that Teflon (Fluorogold) spray pond circular header supports exposed to air-outdoor environment are being managed for cracking by the ISI

Program—IWF and the Structures Monitoring Program, which implements the Water Control Structures Program. The AMR line item cites Generic Note J, and plant-specific Note 518, which states that "Columbia is not committed to RG 1.127 Inspection of Water Control Structures Associated with Nuclear Power Plants, Revision 1. However, the Structures Monitoring Program will be enhanced to include the inspection elements delineated in RG 1.127, Revision 1 per NUREG-1801 Chapter XI.S7."

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environment combination. The staff's evaluations of the applicant's ISI—IWF and Structures Monitoring Programs are documented in SER Sections 3.0.3.1.21 and 3.0.3.2.18, respectively. The staff finds the applicant's proposal to manage aging using the ISI Program—IWF and the Structures Monitoring Program acceptable because fluoropolymer (Teflon) does not display susceptibility to corrosion in normal environments. Rather than depend on an oxide layer for protection, Teflon depends on chemical resistance to the environment to which it is exposed. Teflon is highly resistant to normal environments and, in a treated air internal environment, is resistant to aging effects. The LRA states that the air-outdoor environment is non-aggressive; however, the ISI—IWF and Structures Monitoring Programs will be used to confirm the absence of aging effects such as cracking.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.4 Containments, Structures, and Component Supports—Circulating Water Pump House—Summary of Aging Management Evaluation—LRA Table 3.5.2-4

The staff's evaluation for concrete components exposed to either an air-indoor, or soil environment, which are being managed for aging by the Structures Monitoring Program—Water Control Structures, citing Generic Note I and plant-specific Notes 501 and 518, is documented in SER Section 3.5.2.3.3.

3.5.2.3.5 Containment, Structures, and Component Supports—Diesel Generator Building—Summary of Aging Management Evaluation—LRA Table 3.5.2-5

The staff's evaluation for concrete components exposed to either an air-indoor, air-outdoor, or soil environment that are being managed for aging by the Structures Monitoring Program and cite Generic Note I and plant-specific Note 501 is documented in SER Section 3.5.2.3.1.

In LRA Table 3.5.2-5, the applicant stated that for the concrete roof exposed to an air-indoor environment there is no aging effect; however, the Structures Monitoring Program is credited for aging management of the concrete roof. The AMR line item cites Generic Note I, and plant-specific Note 501, which states that "no applicable aging effects have been identified for the component type. However, the identified AMP will be used to confirm the absence of significant aging effects for the period of extended operation." The line item also cites plant-specific Note 526, which states that "the roof is insulated or has built-up roofing. Therefore, environment for this concrete roof slab is 'air-indoor' for underside of slab. Roof membrane is evaluated and addressed in bulk commodities."

The staff reviewed the associated line items in the LRA and confirmed that no aging effect is applicable for this component, material, and environment combination. The staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff finds the applicant's proposal to manage aging using the Structures Monitoring Program acceptable because the concrete roof, by being in an air-indoor environment, is not subjected to AERMs. Additionally, the LRA states that the concrete was designed in accordance with ACI 318 and constructed in accordance with ACI 301 using materials conforming to ASTM and ACI standards, the aggregate materials are not reactive, and the applicant will use the Structures Monitoring Program to confirm the absence of significant aging effects.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.6 Containment, Structures, and Component Supports—Fresh Air Intake Structure No. 1 and 2—Summary of Aging Management Evaluation—LRA Table 3.5.2-6

The staff's evaluation for concrete components exposed to either an air-outdoor, or soil environment that are being managed for aging by the Structures Monitoring Program and cite Generic Note I and plant-specific Note 501 is documented in SER Section 3.5.2.3.1.

3.5.2.3.7 Containment, Structures, and Component Supports—Makeup Water Pump House—Summary of Aging Management Evaluation—LRA Table 3.5.2-7

The staff's evaluation for concrete components exposed to either an air-indoor, air-outdoor, or soil environment, which are being managed for aging by the Structures Monitoring Program—Water Control Structures, citing Generic Note I and plant-specific Notes 501 and 518, is documented in SER Section 3.5.2.3.3.

3.5.2.3.8 Containment, Structures, and Component Supports—Radwaste Control Building—Summary of Aging Management Evaluation—LRA Table 3.5.2-8

In LRA Tables 3.5.2-8 and 3.5.2-13, the applicant stated that the reinforced concrete walls, floors, ceilings, and equipment pads exposed to air-indoor environment are being managed for cracking and change in material properties due to irradiation by the Structures Monitoring Program and Fire Protection Program. The AMR line items cite Generic Note H and plant-specific Note 521, which states the following:

> The indicated aging effects (cracking and change in material properties due to irradiation) requiring management are only applicable to component types within the Radwaste Control Building charcoal absorber zones (i.e., Zone E at el. 437'-0" and Zone K at elevation 467'-0"). Radiation values are the worst case surface (contact) doses for the indicated zones. The identified AMP will be used to confirm the absence of significant aging effects for the period of extended operation.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environment combination. The staff's evaluations of the applicant's Structures Monitoring and Fire Protection Programs are documented in SER Sections 3.0.3.2.18 and 3.0.3.2.8, respectively. The staff finds the applicant's proposal to manage aging using the Structures Monitoring and Fire Protection Programs acceptable because degradation of concrete due to radiation effects will manifest itself in the form of cracking or loss of material properties, and the applicant will use the Structures Monitoring and Fire Protection Programs to visually examine the reinforced concrete components for evidence of cracking or degradation of material properties.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.9 Containment, Structures, and Component Supports—Service Building—Summary of Aging Management Evaluation—LRA Table 3.5.2-9

The staff's evaluation for concrete components exposed to either an air-indoor, air-outdoor, or soil environment that are being managed for aging by the Structures Monitoring Program and cite Generic Note I and plant-specific Note 501 is documented in SER Section 3.5.2.3.1.

3.5.2.3.10 Containment, Structures, and Component Supports—Turbine Generator Building—Summary of Aging Management Evaluation—LRA Table 3.5.2-10

The staff's evaluation for concrete components exposed to either an air-indoor, air-outdoor, or soil environment that are being managed for aging by the Structures Monitoring Program and cite Generic Note I and plant-specific Note 501 is documented in SER Section 3.5.2.3.1.

The staff's evaluation for concrete (solid blocks or bricks) shield walls exposed to an air-indoor environment, which are being managed for aging by the Structures Monitoring Program, citing Generic Note I and plant-specific Notes 501 and 517, is documented in SER Section 3.5.2.3.2.

3.5.2.3.11 Containment, Structures, and Component Supports—Water Filtration Building—Summary of Aging Management Evaluation—LRA Table 3.5.2-11

The staff's evaluation for concrete components exposed to either an air-indoor, or soil environment, which are being managed for aging by the Structures Monitoring Program, citing Generic Note I and plant-specific Note 501, is documented in SER Section 3.5.2.3.1.

3.5.2.3.12 Containment, Structures, and Component Supports—Yard Structures—Summary of Aging Management Evaluation—LRA Table 3.5.2-12

The staff's evaluation for concrete components exposed to either an air-outdoor, or soil environment that are being managed for aging by the Structures Monitoring Program, citing Generic Note I and plant-specific Note 501, is documented in SER Section 3.5.2.3.1.

In LRA Table 3.5.2-12 the applicant stated that, for the aluminum fire water bladder tank (FP-TK-110) vent line enclosure exposed to an air-outdoor environment. there is no aging effect; however, the Structures Monitoring Program is credited for aging management of the tank. The AMR line items cite Generic Note I and plant-specific Note 522, which states the following:

> Loss of material due to crevice corrosion and pitting corrosion is not an aging effect requiring management for aluminum exposed to air-outdoor since Columbia is located in an in-land rural environment and not exposed to aggressive environmental conditions. However, the identified AMP will be used to confirm the absence of significant aging effects for the period of extended operation.

The staff reviewed the associated line items in the LRA and confirmed that no aging effect is applicable for this component, material, and environment combination. The staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff finds the applicant's proposal to manage aging using the Structures Monitoring Program acceptable because Columbia is located in a rural environment that is not subjected to aggressive environmental conditions (i.e., the LRA further states that annual precipitation is less than 7 in.), and the applicant will use the Structures Monitoring Program to confirm the absence of significant aging effects as recommended in GALL Report Item III.B4-7 for aluminum structures and component supports exposed to an air-outdoor environment.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.5.2-12 the applicant stated that the earthen fire water bladder tank (FP-TK-110) embankment exposed to an air-outdoor environment is being managed for loss of form by the Structures Monitoring Program. The AMR line item cites Generic Note G.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environmental combination because this is an aging effect discussed in the GALL Report for earthen structures. The staff's evaluation of the Structures Monitoring Program is documented in SER Section 3.0.3.2.18. The staff finds that the applicant's proposal to manage aging using the Structures Monitoring Program acceptable because the Structures Monitoring Program includes appropriate visual inspections to detect loss of form of earthen embankments, as recommended by the GALL Report.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.2.3.13 Containment, Structures, and Component Supports—Bulk Commodities—Summary of Aging Management Evaluation—LRA Table 3.5.2-13

The staff reviewed LRA Table 3.5.2-13, which summarizes the results of AMR evaluations for the bulk commodities component groups.

In LRA Table 3.5.2-13, the applicant stated that for elastomer waterstops exposed to air-indoor (within walls, floors, or foundation) there is no aging effect and no AMP is proposed. The AMR line item cites Generic Note J.

The staff reviewed the associated line item in the LRA and was not able to confirm that no aging effect is applicable for this component, material and environmental combination. The staff noted that based on review of technical literature (e.g., Roff, W.J., *Fibres, Plastics, and Rubbers: A Handbook of Common Polymers*, Academic Press Inc., New York, 1956), and current industry research and operating experience related to elastomers, in the absence of specific environmental stressors such as ultraviolet light, high radiation, or ozone concentrations, components made of these materials do not exhibit aging effects of concern during the period of extended operation. The staff also noted that given the location of the components within walls, floors or foundations, that ultraviolet light and ozone exposure is not a concern. By letter dated July 15, 2010, the staff issued RAI 3.5.2.3-1 requesting that the applicant justify why the these elastomeric components are not exposed to high temperature or radiation specific to its locations that would lead to hardening and loss of strength and thus require an AMP.

In its response dated September 13, 2010, the applicant stated that (a) given the location of the waterstops, it is not exposed to ozone or ultraviolet radiation, (b) based on plant-specific radiation levels and the minimum shielding provided by the concrete, the waterstops are imbedded in, the dose exposure is less than 10^6 rads, and (c) local room temperatures are 70 °F—90 °F.

The staff noted that the applicant referenced EPRI 1015078, "Aging Effects for Structures and Structural Components (Structural Tools)" as a reference to justify the 10^6 rads threshold. The staff independently checked this threshold in the *Chemical Resistance of Plastics and Elastomers* (3rd Electronic Edition), Plastics Design Library Staff. The staff finds the applicant's response and proposal acceptable because the components are not exposed to ultraviolet light or ozone, radiation exposure is below the 10^6 rads threshold, and room temperatures are below the temperature threshold of 95 °F as stated in GALL Report Chapter IX.D. The staff's concern described in RAI 3.5.2.3-1 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM and AMP combinations not addressed in the GALL Report. The staff determines the applicant has demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.5.2-13, the applicant stated that for elastomeric expansion boots, water proof membrane, and waterstops exposed to soil (external) there is no aging effect and no AMP is proposed. For this component, the LRA cites Generic Note J.

The staff reviewed the associated line items in the LRA and could not confirm that no aging effect is applicable for this component, material and environmental combination. The staff noted that the applicant stated that the below-ground water environment is non-aggressive (i.e., pH >6.9, chlorides < 36 ppm, and sulfate < 323 ppm) and its Structuring Monitoring Program will continue to review the site groundwater chemistry to validate that the below-ground environment remaining non-aggressive during the period of extended operation. However, the staff noted that elastomeric components exposed to soil can be damaged if the backfill contains large or sharp rocks due to migration of the objects to the outside wall of the component caused by normal ground movement, resulting in wear of the external surface of the component. By letter dated October 20, 2010, the staff issued RAI 3.3.2-2 requesting that the applicant provide data on the quality of the backfill in the vicinity of buried elastomeric components that would support that aging will not occur due to large or sharp material contained in the backfill.

In its response dated January 20, 2011, the applicant stated that backfill specifications require that the bedding around structures or components be free of trash, roots, organic, frozen, or other unsuitable materials, and the maximum sized material is 3/8 in. The applicant also stated in its January 28, 2011, response to RAI B.2.5-2 that it will conduct four inspections of buried piping not containing hazardous material, including polymeric buried pipe, and two percent of buried piping containing hazardous materials every ten years, starting ten years prior to the period of extended operation. The applicant further stated that the elastomeric expansion boots, water proof membrane, and waterstops components are located such that movement of heavy loads above the components are minimal.

The staff finds the applicant's response acceptable because it has specifications that restrict the type and size of material that can be used in buried structures bedding material such that damage would not be expected, and confirmatory excavated buried piping inspections will be conducted as part of the Buried Piping and Tanks Inspection Program to verify the quality of backfill. The staff's concern described in RAI 3.3.2-2 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not evaluated in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.5.2-13, the applicant stated that for fluoropolymer cable tie wraps, nylon cable tie wraps, and fiberglass piping and mechanical insulation exposed to indoor air there is no aging effect and no AMP is proposed. The AMR line items cite Generic Note J, indicating that for these line items, neither the components nor the materials and environment combination are evaluated in the GALL Report. Line items associated with cable tie wraps cite plant-specific Note 0531 and 0532 which states Tefzel (fluoropolymer) and nylon tie wraps exceed the temperature, tensile strength, and radiation requirements set forth by an indoor air environment.

The staff reviewed the associated line items in the LRA and confirmed that the applicant has identified the correct aging effects for this component, material and environmental combination because based on industry operating experience for fluoropolymer cable tie wraps, nylon cable tie wraps, and fiberglass piping and mechanical insulation, there are no AERMs.

The staff finds the applicant's proposal acceptable because industrial experience and engineering knowledge of fluoropolymer cable tie wraps, nylon cable tie wraps, and fiberglass piping and mechanical insulation materials suggests that deterioration of those material types in an indoor air environment is not expected.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM and AMP combinations not addressed in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.5.2-13, the applicant stated that for fire wraps (ceramic fiber, Dramatt, Thermolag, and 3M Interam) and fireproofing (Thermolag), exposed to air-indoor there is no AERM. The AMR line items cite Generic Note J. The LRA states that no applicable aging effects have been identified for these component types, but that the Fire Protection Program will be used to confirm the absence of significant aging effects for the period of extended operation.

During the audit, the staff noted that the applicant's inspection of fire wraps includes splits, tears, holes, gaps or missing pieces, and the inspection of Thermo-lag fireproofing includes holes, cracks, splits, voids, gouges, or broken pieces. The staff also noted that the applicant's procedure for inspection of Thermo-lag states that the inspection verifies that the Thermo-lag is free of obvious holes, cracks, splits, voids, gouges, or broken pieces. It is not clear to the staff why the applicant does not consider splits, tears, cracks, holes, gaps or missing pieces as applicable aging effects for wire wraps and fire proofing. By letter dated June 24, 2010, the staff issued RAI B.2.25-2 requesting that the applicant provide justification for why the aging effects mentioned above for fire wraps and fire proofing do not require aging management during the period of extended operation.

In its response to RAI B.2.25-2, dated Aug, 19, 2010, the applicant stated:

> Fire wraps and fireproofing at Columbia are located inside plant buildings and are exposed to the ambient (Air-indoor) environment within the buildings. Loss of material due to flaking is not an aging effect requiring management for fire wraps or fireproofing.
>
> Based on industry and Columbia experiences, rigid fire wrap materials (trowelable grades with smooth, hard finishes) have not been observed to readily release fibers from the surfaces and are not susceptible to flaking. Fireproofing material at Columbia is applied by trowel technique built up to desired thickness. The texture of the finished application is trowelled smooth. Fireproofing and fireproofed members at Columbia are not exposed to strong airflow or induced vibrations. Loss of material due to abrasion is not an aging effect requiring management for fire wraps and fireproofing. Fire wraps and fireproofed members at Columbia are not in contact with vibrating items or exposed to continuous movement or vibration (self excited or imposed vibration from adjacent components) that can cause abrasion. Cracking and delamination due to vibration is not an aging effect requiring management for fire wraps and fireproofing. Fire wraps and fireproofed members at Columbia are not in contact or exposed to continuous movement or vibration (self excited or imposed vibration from adjacent components). Cracking and delamination and change in material properties due to gamma irradiation exposure is not an aging effect requiring management for fire wraps and fireproofing since this aging mechanism applies to elastomeric material. Therefore, these components are not prone to irradiation damage. The corresponding line items for fire wraps and fireproofing are in the LRA Table 3.5.2-13, lines 164-168, with plant-specific Note 0501. plant-specific Note 0501 committed the identified aging management program (Fire Protection Program) to confirm the absence of significant aging effects for fire wraps and fireproofing the period of extended operation.

Based on its review, the staff finds the applicant's response to RAI B.2.25-2 and its proposal to manage aging using the Fire Protection Program acceptable because industry and plant operating experience show that loss of material, cracking and delamination are not expected aging effects for fire wraps and fire proofings at the station and the visual inspections performed by the Fire Protection Program are capable of detecting if these aging effects occur. The staff's concern described in RAI 2.25-2 is resolved.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM and AMP combinations not addressed in the GALL

Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.5.2-13, the applicant stated that for galvanized steel fire doors exposed to indoor air there is no aging effect and no AMP is proposed. The AMR line items cite Generic Note I, indicating that the aging effect in the GALL Report for this line item's component, material and environment combination is not applicable. The line item cites a plant-specific Note 0501, which states that no applicable aging effects have been identified for the component type. However, the applicant stated that the Fire Protection Program and Structures Monitoring Program will be used to confirm the absence of significant aging effects for the period of extended operation.

The staff reviewed the associated line items in the LRA and confirmed that no aging effect is applicable for this component, material and environmental combination. The staff notes that fire barrier system galvanized steel components would have the same aging effect and degradation rate as galvanized steel piping, piping components, and piping elements, given the same environment, as in item AP-13 in the GALL Report, which is applicable to the galvanized steel piping, piping components, and piping elements in an external environment of indoor air and does not require an AERM or AMP. The staff finds the applicant's proposal acceptable because the LRA components are similar to other GALL Report items for the material and environment (e.g., GALL Report, Volume 2, Item VII.J-6, whereby the AERM is listed as "none," the AMP is listed as "none," and no further evaluation is required), and therefore the effect of plant indoor air on galvanized steel components is not expected to result in aging that will be of concern during the period of extended operation. In addition, the staff notes that both the Fire Protection and Structures Monitoring Programs proposed by the applicant include periodic inspection of the fire barriers, which is consistent of the GALL Report recommendation.

On the basis of its review, the staff finds that the applicant has appropriately evaluated the AMR results of material, environment, AERM and AMP combinations not addressed in the GALL Report. The staff finds that the applicant has demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will be maintained consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff's evaluation for concrete components that exposed to either an air-outdoor or air-indoor environment, which are being managed for aging by the Structures Monitoring Program and citing Generic Note I and plant-specific Note 501, is documented in SER Section 3.5.2.3.1.

The staff's evaluation for concrete equipment pads that are exposed to an air-indoor environment and are being managed for aging by the Structures Monitoring Program and citing Generic Note H and plant-specific Note 521 is documented in SER Section 3.5.2.3.8.

In LRA Table 3.5.2-13 the applicant stated that, for the stainless steel and aluminum components exposed to an air-outdoor environment, there is no aging effect; however, the Structures Monitoring Program is credited for aging management of the components. The AMR line items cite Generic Note I and plant-specific Note 525, which states the following:

> The NUREG-1801 item lists loss of material as an aging effect. This aging effect was determined not applicable since Columbia is located in an in-land rural environment and is not exposed to aggressive environmental conditions.

> Component external surfaces are not continuously wetted or exposed to an aggressive ambient environment (such as a saltwater atmosphere, sulfur dioxide, etc.) or industrial locations. However, the identified AMP will be used to confirm the absence of significant aging effects for the period of extended operation.

The staff finds the applicant's proposal to manage aging using the Structures Monitoring Program acceptable because Columbia is located in a rural environment that is not subjected to aggressive environmental conditions (i.e., the LRA further states that annual precipitation is less than 7 in.), and the applicant will use the Structures Monitoring Program to confirm the absence of significant aging effects as recommended in GALL Report Items III.B2-7 and III.B4-7 for aluminum and stainless steel structures and component supports exposed to an air-outdoor environment. The staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.5.2-13, the applicant stated that for Lubrite sliding supports exposed to an air-indoor environment there is no aging effect; however, the Structures Monitoring Program and the ISI Program—IWF is credited for aging management of the components. The AMR line items cite Generic Note I and plant-specific Note 523, which states the following:

> Lubrite material resists deformation, has a low coefficient of friction, resists softening at elevated temperatures, absorbs grit and abrasive particles, is not susceptible to corrosion, withstands high intensities of radiation, and will not score or mar. The Lubrite lubricants used in nuclear applications are designed for the environments to which it is exposed. There are no known aging effects that would lead to a loss of intended function. However, the identified AMP will be used to confirm the absence of significant aging effects for the period of extended operation.

The staff finds the applicant's proposal to manage aging using the Structures Monitoring Program and the ISI Program—IWF acceptable because the applicant will use the Structures Monitoring and the ISI—IWF Programs to confirm the absence of significant aging effects, as recommended in GALL Report Items III.B1.1-5, III.B1.2-3, III.B1.3-3, and III.B2-2 for Lubrite sliding supports exposed to an air-indoor environment. The staff's evaluations of the applicant's ISI—IWF and Structures Monitoring Programs are documented in SER Sections 3.0.3.1.21 and 3.0.3.2.18, respectively.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.5.2-13 the applicant stated that, for insulation materials (i.e., fiberglass, aluminum jacketing, calcium silicate, and stainless steel mirror) for containment penetrations and piping and mechanical equipment exposed to air-indoor environment, there are no AERMs. The AMR line item cites Generic Note J.

The staff reviewed the associated line items in the LRA and confirmed that the applicant identified the correct aging effects for this component, material, and environment combination. The in-scope insulation is located in areas with non-aggressive environments (i.e., insulation is not exposed to contaminants). The staff finds the applicant's assessment that there are no AERMs acceptable because the in-scope insulation is located in an air-indoor environment that is non-aggressive.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.5.2-13, the applicant stated that for insulating materials (i.e., aluminum jacketing and stainless steel mirror) for piping and mechanical equipment exposed to an air-outdoor environment there is no aging effect; however, the Structures Monitoring Program is credited for aging management of the components. The AMR line item cites Generic Note J and plant-specific Note 525, which states the following:

> The NUREG-1801 item lists loss of material as an aging effect. This aging effect was determined not applicable since Columbia is located in an in-land rural environment and is not exposed to aggressive environmental conditions. Component external surfaces are not continuously wetted or exposed to an aggressive ambient environment (such as a saltwater atmosphere, sulfur dioxide, etc.) or industrial locations. However, the identified AMP will be used to confirm the absence of significant aging effects for the period of extended operation.

The staff finds the applicant's proposal to manage aging using the Structures Monitoring Program acceptable for the following reasons:

- Columbia is located in a rural environment that is not subjected to aggressive environmental conditions (i.e., the LRA further states that annual precipitation is less than 7 in.).
- The applicant will use the Structures Monitoring Program to confirm the absence of significant aging effects.

The staff's evaluation of the applicant's Structures Monitoring Program is documented in SER Section 3.0.3.2.18.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging for these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In LRA Table 3.5.2-13, the applicant stated that, for calcium silicate and fiberglass materials for piping and mechanical equipment insulation exposed to an air-outdoor environment, there is no aging effect, and no AMP is proposed. The AMR line item cites Generic Note J.

The staff reviewed the associated line items in the LRA and noted that the component has an intended function of providing structural or functional support to nonsafety-related equipment whose failure could prevent satisfactory accomplishment of required safety functions (includes Seismic II over I considerations). The staff is unclear why an AMP is not credited with aging management of components associated with this line item since it provides a support function and are subjected to an air-outdoor environment. By letter dated August 26, 2010, the staff issued RAI 3.5.2.3.13-1 requesting that the applicant justify why it did not reference an AMP for the calcium silicate and fiberglass insulation for piping and mechanical support.

In it response dated November 11, 2010, the applicant stated that all insulated piping is covered with an aluminum jacketing material with a vapor proof barrier either bonded to the inside of the aluminum or over the outside of the insulation. When insulation is necessary for outdoor piping, the aluminum jacketing is applied with all joints lapped and positioned to properly shed water. The response further stated that the outdoor insulation was not exposed to aggressive environmental conditions.

The staff reviewed the applicant's response and noted that the insulation on outdoor piping is protected by aluminum jacketing. In addition, the staff noted that the outdoor environment is not considered aggressive. The staff also noted that the Structures Monitoring Program will be used to manage aging of the aluminum insulation jacketing. Based on review of current industry research and operating experience, the staff has found that fiberglass and calcium silicate protected from weather will not experience aging that will be of concern during the period of extended operation. Therefore, the staff finds the applicant's response, and the AMR line items, acceptable because the outdoor fiberglass insulation will be protected from the weather by aluminum jacketing, which will be managed for aging by the Structures Monitoring Program. The staff's concern in RAI 3.5.2.3.13-1 is resolved.

On the basis of its review, the staff finds that the applicant appropriately evaluated the AMR results of material, environment, AERM, and AMP combinations not addressed in the GALL Report. The staff finds that the applicant demonstrated that the effects of aging of these components will be adequately managed so that its intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.5.3 Conclusion

The staff concludes that the applicant provided sufficient information to demonstrate that, the effects of aging for the SC supports within the scope of license renewal and subject to an AMR will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6 Aging Management of Electrical and Instrumentation and Control

The following information documents the staff's review of the applicant's AMR results for the following electrical and instrumentation and control (I&C) components and component groups:

- Non-Environmentally Qualified Insulated Cables and Connections
- MEB
- Swithyard Bus and Connections
- Transmission Conductors and Connections
- Uninsulated Ground Conductors and Connections
- High-Voltage Insulators

3.6.1 Summary of Technical Information in the Application

LRA Section 3.6 provides AMR results for the electrical and I&C components and component groups. LRA Table 3.6.1, "Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of NUREG-1801," is a summary comparison of the applicant's AMRs with those evaluated in the GALL Report for the electrical components, I&C components, and component groups.

3.6.2 Staff Evaluation

The staff reviewed LRA Section 3.6 to determine if the applicant provided sufficient information to demonstrate that the effects of aging for the electrical and I&C components within the scope of license renewal and subject to an AMR will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff reviewed AMRs to ensure the applicant's claim that certain AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMPs. The staff's evaluations of the AMPs are documented in SER Section 3.0.3. Details of the staff's AMR evaluation are documented in SER Section 3.6.2.1.

The staff also reviewed AMRs consistent with the GALL Report and for which further evaluation is recommended. The staff confirmed that the applicant's further evaluations were consistent with the SRP-LR Section 3.6.2.2 acceptance criteria. The staff's evaluations are documented in SER Section 3.6.2.2.

Table 3.6-1 summarizes the staff's evaluation of components, aging effects or mechanisms, and AMPs listed in LRA Section 3.6 and addressed in the GALL Report.

Table 3.6-1 Staff evaluation for electrical and I&Cs in the GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Electrical equipment subject to 10 CFR 50.49 EQ requirements (3.6.1-1)	Degradation due to various aging mechanisms	EQ of Electric Components	Yes	TLAA	Environmental Qualification is a TLAA (See SER Section 3.6.2.2.1)
Electrical cables, connections and fuse holders (insulation) not subject to 10 CFR 50.49 EQ requirements (3.6.1-2)	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements	No	Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements	Consistent with GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Conductor insulation for electrical cables and connections used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements that are sensitive to reduction in conductor insulation resistance (3.6.1-3)	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	Electrical Cables and Connections used In Instrumentation Circuits Not Subject to 10 CFR 50.49 EQ Requirements	No	Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Used In Instrumentation Circuits	Consistent with GALL Report
Conductor insulation for inaccessible medium voltage (2 kV to 35 kV) cables (e.g., installed in conduit or direct buried) not subject to 10 CFR 50.49 EQ requirements (3.6.1-4)	Localized damage and breakdown of insulation leading to electrical failure due to moisture intrusion and water trees	Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements	No	Inaccessible Power Cables Not Subject to 10 CFR 50.49 EQ Requirements	Consistent with GALL Report
Connector contacts for electrical connectors exposed to borated water leakage (3.6.1-5)	Corrosion of connector contact surfaces due to intrusion of borated water	Boric Acid Corrosion	No	Not applicable	Not applicable to BWRs (See SER Section 3.6.2.1.1)
Fuse Holders (Not Part of a Larger Assembly): Fuse holders—metallic clamp (3.6.1-6)	Fatigue due to ohmic heating, thermal cycling, electrical transients, frequent manipulation, vibration, chemical contamination, corrosion, and oxidation	Fuse Holders	No	Not applicable	Not applicable to Columbia (See SER Section 3.6.2.1.1)
MEB—bus, connections (3.6.1-7)	Loosening of bolted connections due to thermal cycling and ohmic heating	MEB	No	Metal-Enclosed Bus	Consistent with GALL Report

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
MEB—insulation, insulators (3.6.1-8)	Reduced insulation resistance and electrical failure due to various physical, thermal, radiolytic, photolytic, and chemical mechanisms	MEB	No	Metal-Enclosed Bus	Consistent with GALL Report
MEB—enclosure assemblies (3.6.1-9)	Loss of material/ general corrosion	Structures Monitoring Program	No	Structures Monitoring Program	Consistent with GALL Report
MEB—enclosure assemblies (3.6.1-10)	Hardening and loss of strength due to elastomers degradation	Structures Monitoring Program	No	Structures Monitoring Program	Consistent with GALL Report
High-voltage insulators (3.6.1-11)	Degradation of insulation quality due to presence of any salt deposits and surface contamination; loss of material caused by mechanical wear due to wind blowing on transmission conductors	A plant-specific AMP is to be evaluated.	Yes	High Voltage Porcelain Insulators	Consistent with GALL Report
Transmission conductors and connections; switchyard bus and connections (3.6.1-12)	Loss of material due to wind-induced abrasion and fatigue; loss of conductor strength due to corrosion; increased resistance of connection due to oxidation or loss of preload	A plant-specific AMP is to be evaluated.	Yes	Not applicable	Not applicable to Columbia (See SER Section 3.6.2.2.3)

Component group (GALL Report Item No.)	Aging effect/ mechanism	AMP in GALL Report	Further evaluation in GALL Report	AMP in LRA, supplements, or amendments	Staff evaluation
Cable Connections—metallic parts (3.6.1-13)	Loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	Electrical Cable Connections Not Subject to 10 CFR 50.49 EQ Requirements	No	Electrical Cable Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements	Consistent with GALL Report
Fuse Holders (not part of a larger assembly)—insulation material (3.6.1-14)	None	None	No	None	Consistent with GALL Report

The staff's review of the electrical and I&C component groups followed any one of several approaches. One approach, documented in SER Section 3.6.2.1, reviewed AMR results for components that the applicant indicated are consistent with the GALL Report and require no further evaluation. Another approach, documented in SER Section 3.6.2.2, reviewed AMR results for components that the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended. A third approach, documented in SER Section 3.6.2.3, reviewed AMR results for components that the applicant indicated are not consistent with or not addressed in the GALL Report. The staff's review of AMPs credited to manage or monitor aging effects of the electrical and I&C components is documented in SER Section 3.0.3.

3.6.2.1 AMR Results that are Consistent with the GALL Report

LRA Section 3.6.2.1 identifies the materials, environments, and AERMs, and the following programs that manage aging effects for the electrical and I&C components:

- Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Program
- Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements Used in Instrumentation Circuits Program
- Electrical Cable Connections Not Subject to 10 CFR 50.49 EQ Requirements Inspection
- High-Voltage Porcelain Insulators AMP
- Inaccessible Power Cables Not Subject to 10 CFR 50.49 EQ Requirements Program
- MEB Program
- Structures Monitoring Program

In LRA Table 3.6.1, the applicant summarizes AMRs for the electrical and I&Cs components and claimed that these AMRs are consistent with the GALL Report.

For component groups evaluated in the GALL Report for which the applicant claimed consistency with the report and for which the GALL Report does not recommend further evaluation, the staff's review determined whether the plant-specific components of these GALL Report component groups were bounded by the GALL Report evaluation.

The applicant noted, for each AMR line item, how the information in the tables aligns with the information in the GALL Report. The staff reviewed those AMRs with notes A through E, indicating how the AMR is consistent with the GALL Report.

The staff reviewed the information in the LRA. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant identified the appropriate GALL Report AMRs.

The staff reviewed the LRA to confirm that the applicant did the following:

- provided a brief description of the system, components, materials, and environments
- stated that the applicable aging effects were reviewed and evaluated in the GALL Report
- identified those aging effects for the electrical and I&C components that are subject to an AMR

On the basis of its review, the staff determines that, for AMRs not requiring further evaluation, as identified in LRA Table 3.6.1, the applicant's references to the GALL Report are acceptable, and no further staff review is required.

The staff evaluated the applicant's claim of consistency with the GALL Report. The staff also reviewed information pertaining to the applicant proposals for managing aging effects. On the basis of its review, the staff concludes that the AMR results, which the applicant claimed to be consistent with the GALL Report, are indeed consistent with its AMRs. Therefore, the staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.1.1 AMR Results Identified as Not Applicable

For line item 3.6.1-5 in LRA Table 3.6.1 the applicant claimed that the corresponding AMR items in the GALL Report are not applicable because the associated line item is only applicable to PWRs. The staff reviewed the SRP-LR, confirmed this line item only applies to PWRs, and finds this line item is not applicable to Columbia.

For line item 3.6.1-6 in LRA Table 3.6.1, the applicant claimed that this was not applicable. The staff reviewed the LRA and UFSAR and confirmed that the applicant's LRA does not have any AMR results that are applicable to this line item.

LRA Table 3.6-1, Item 3.6.1-9, addresses aging effect of loss of material caused by the mechanisms of pitting and crevice corrosion for aluminum MEB enclosure assemblies exposed to indoor air and stated that there is no AERM, and no AMP is recommended. In LRA Table 3.5-1, Item 3.5.1-58, the applicant stated that the galvanized steel and aluminum support members, welds, bolted connections, and support anchorages to building structure exposed to indoor air for the material and environment combination do not have AERMs. The applicant also stated that no AMPs are applicable to the aluminum items exposed to indoor air for the electrical commodities system associated with this item number. The GALL Report, Item III.B5-2, which corresponding to Table 3.5.1, Item 3.5.1-58, recommends no AMP for this component group; therefore, the staff finds the applicant's determination acceptable.

3.6.2.1.2 Loss of Material Due to General Corrosion

LRA Table 3.6.1, Item Number 3.6.1-09, credits the GALL Report AMP XI.S6, Structures Monitoring Program, to manage the aging effect/mechanism loss of material due to general corrosion for MEB enclosure assemblies. In LRA Table 3.6.2-1, the applicant references Item 3.6.1-09 and Generic Note A and credits the Structures Monitoring Program to manage aging for MEB enclosure assemblies. However, the discussion of the Structures Monitoring Program (B.2.50) in Appendix B of the LRA does not indicate that the MEB enclosure assemblies are within the scope of the Structures Monitoring Program. In a letter dated August 16, 2010 (RAI 3.6-1), the staffs requested the applicant to confirm that the scope of Structures Monitoring Program includes the MEB enclosure assemblies. The staff also asked the applicant to revise the scope of the Structure Monitoring Program, as appropriate. In response to the staff request, in a letter dated September 21, 2010, the applicant stated the MEBes were termed electrical bus ducts in the civil/structural review and are covered in LRA Table 3.5.2-13, Lines 37–42. The electrical bus duct enclosure assemblies are in-scope and subject to aging management. As stated in LRA Table 3.6.2-1, Note 0605:

> The inspection of the metal-enclosed bus enclosure assembly elastomers (joints, seals, gaskets) will be performed as part of the Metal-Enclosed Bus Program. The elastomers will be inspected when the covers of the various bus enclosure sections are removed. The Structures Monitoring Program will address the metallic portion of the enclosure assembly and the external structural supports for the various bus assemblies (along with the building penetrations and seals where the bus ducts enter the Reactor Building).

The applicant also stated that LRA B.2.50, "Structure Monitoring Program," does not specifically list "Electrical Bus Duct." However, as stated in LRA B.2.50 under Required Enhancements—Parameters Monitored or Inspected, "Identify that the term 'structural component' for inspection includes component types that credit the Structures Monitoring Program for aging management."

The identification of electrical bus duct as a component type is an action that is required to comply with the commitment to complete this enhancement. The staff finds the applicant response acceptable because the applicant's commitment to include the MEB assemblies in the scope of Structure Monitoring Program is an action that is required to comply with an enhancement in the Structure Monitoring Program. The staff's concern in RAI 3.6-1 is resolved.

3.6.2.1.3 Hardening and Loss of Strength Due to Elastomer Degradation of MEB

In the discussion column in LRA Table 3.6.1, the applicant indicated that the inspection of the MEB enclosure assembly elastomers (joints, seals, gaskets) will be performed as part of the MEB Program. The applicant also stated that the elastomers will be inspected when the covers of various bus enclosure sections are removed. The staff noted that in the AMR results line that points to LRA Table 3.6.2-1, Item 3.6.1-10, the applicant included a reference to LRA Note E.

The staff reviewed the AMR results line referenced to LRA Note E and determined that the component type, material, environment, and aging effect are consistent with the corresponding line of the GALL Report; however, where the GALL Report recommends the AMP XI.S6, "Structures Monitoring Program," the applicant has proposed the MEB Program. As discussed in SER Section 3.0.3, the staff found visual inspection, as described in the MEB Program, acceptable to inspect the MEB elastomer degradation because the inspection method is the same as that in Structures Monitoring Program.

The staff evaluated the applicant's claim of consistency with the GALL Report. The staff also reviewed information pertaining to the applicant's proposal for managing aging effects. On the basis of its review, the staff concludes that the AMR results, which the applicant claimed to be consistent with the GALL Report, are indeed consistent with the GALL Report. Therefore, the staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

LRA Table 3.6.1, Item 3.6.1-10, addresses elastomers exposed to air-indoor uncontrolled and air-outdoor that is being managed for hardening and loss of strength due to elastomer degradation. The LRA credits the MEB Program to manage the aging effect. The GALL report recommends GALL Report AMP XI.S6, "Structures Monitoring Program" to ensure that these aging effects are adequately managed. The associated AMR line item cites Generic Note E.

For those line items associated with Generic Note E, GALL Report AMP XI.S6 selects parameters to be monitored or inspected for each structure and aging effect combination to ensure that aging degradation leading to loss of intended functions will be detected and the extent of degradation detected. Inspection methods, inspection schedule, and inspector qualifications are to be commensurated with industry codes, standards, and guidelines. In its review of components associated with item Number 3.6.1-10, for which the applicant cited Generic Note E, the staff noted that the MEB Program proposes to manage aging of the MEB enclosure assembly elastomers (joints, seals, and gaskets) through periodic visual examinations at intervals not to exceed 10 years for hardening and loss of strength due to elastomer aging effect. The staff also noted that the Structures Monitoring Program addresses the metallic portion of the enclosure assembly and the external structural supports for the various bus assemblies.

The staff's evaluation of the applicant's Metal-Enclosed Bus Program is documented in SER Section 3.0.3.2.16. In its review of components associated with line Item 3.6.1-10, the staff finds the applicant's proposal to manage aging using the MEB Program acceptable because the Metal-Enclosed Bus Program performs periodic visual inspections of the various bus elastomers (joints, seals, and gaskets) for embrittlement, cracking, loosening, flaking, peeling, or other indications of aging degradation at an inspection frequency commensurate with industry codes, standards, and guidelines.

The staff concludes that the applicant demonstrated that the effects of aging for these components will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.2 AMR Results that are Consistent with the GALL Report, for which Further Evaluation is Recommended

In LRA Section 3.6.2.2, the applicant further evaluates aging management, as recommended by the GALL Report, for the electrical and I&C components and provides information concerning how it will manage the following aging effects:

- electrical equipment subject to environmental qualification

- degradation of insulator quality due to salt deposits or surface contamination and loss of material due to mechanical wear
- loss of material due to wind-induced abrasion and fatigue, loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of preload

For component groups evaluated in the GALL Report, for which the applicant claimed consistency with the report and for which the GALL Report recommends further evaluation, the staff reviewed the corresponding AMR Items 3.6.1-11 and 3.6.1-12 in LRA Table 3.6.1. The staff also reviewed applicant's evaluation to determine if it adequately addressed the issues further evaluated. In addition, the staff reviewed the applicant's further evaluations against the criteria contained in SRP-LR Section 3.6.2.2. The staff's review of the applicant's further evaluation follows.

3.6.2.2.1 Electrical Equipment Subject to EQ

In LRA Section 3.6.2.2.1, the applicant referred to LRA Section 4.4 for an evaluation of EQ of electrical equipment TLAAs. SER Section 4.4 documents the staff's review of the applicant's evaluation of this TLAA.

3.6.2.2.2 Degradation of Insulator Quality Due to Presence of any Salt Deposits and Surface Contamination, and Loss of Material Due to Mechanical Wear

In LRA Section 3.6.2.2.2, the applicant addresses degradation of insulator quality due to salt deposits or surface contamination and loss of material due to mechanical wear. The applicant stated that contamination of high-voltage insulators (in the 500-kV system) in the plant transformer yard has caused plant trips in the past. The root cause evaluations concluded that the specific meteorological conditions (i.e., the wind and temperature) at the time, along with the associated plume from the cooling towers (which slumped over the power block into the transformer yard), allowed a coating of ice to form, which also trapped liquid water containing minerals on the surface of the insulators, thereby allowing electrical tracking to occur. The applicant also stated that corrective action was to implement a program to clean the insulators every 2 years. The applicant further stated that a similar event reoccurred on the 500-kV system. Additional testing was performed, which resulted in developing a coating system that has proven effective in mitigating the flashover when reapplied at least every 10 years.

The applicant stated that, due to the operating experience with the 500-kV system, Columbia instituted a program to clean the high-voltage insulators on the 115-kV system, identified for license renewal as the plant-specific High-Voltage Porcelain Insulators AMP, to manage the build-up of hard water residue from the cooling tower plume, and thereby mitigate potential degradation of the insulation function. This program allows for the option to either hand clean the in-scope high-voltage insulators every 2 years or to coat the insulators every 10 years and inspect the coating for damage every 2 years between coatings. The applicant also stated that operating experience indicates that this is only an issue with station post insulators. The applicant further stated that there are no station post insulators associated with the 230-kV system in the Columbia transformer yard; therefore, the 230-kV system is excluded.

The applicant stated that loss of material due to mechanical wear is an aging effect for certain strain insulators if it is subject to significant movement. Such movement of the insulators can be caused by wind blowing the supported transmission conductor, causing it to sway from side to side. If this swinging motion occurs frequently enough, it could cause wear on the metallic contact points of the insulator string and between an insulator and the supporting hardware.

Although this aging mechanism is possible, the applicant stated that industry experience has shown that transmission conductors do not normally swing unless subjected to a substantial wind, and it stops swinging shortly after the wind subsides. The applicant further stated that wind loading that can result in conductor sway is considered in the transmission system design. For insulators that are associated with switchyard bus, the applicant stated that movement is precluded by the rigid design of the switchyard bus (i.e., the bus is of short length, is rigid itself and is connected to rigid components). The applicant stated that review of operating experience has identified no concerns related to the occurrence of loss of material due to mechanical wear as a result of wind blowing on transmission conductors and the switchyard high-voltage insulators. Therefore, the applicant concluded that loss of material due to mechanical wear is not an AERM for the high-voltage insulators at Columbia.

The staff reviewed LRA Section 3.6.2.2.2 against SRP-LR Section 3.6.2.2.2, which states that degradation of insulator quality due to salt deposits or surface contamination may occur in high-voltage insulators. The GALL Report recommends further evaluation of plant-specific AMPs for plants at locations of potential salt deposits or surface contamination (e.g., in the vicinity of salt water bodies or industrial pollution). Loss of material due to mechanical wear caused by wind on transmission conductors may occur in high-voltage insulators. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that these aging effects are adequately managed.

The staff noted that various airborne materials—such as dust, salt, and industrial effluents—can contaminate insulator surfaces. However, the buildup of surface contamination is gradual, and, in most areas, such contamination is washed away by rain; the glazed insulator surface aids this contamination removal. Surface contamination can be a problem in areas where the greatest concentration of airborne particles such as near facilities that discharge soot or near the sea coast where salt spray is prevalent. Columbia has experienced the deposition of contamination on the high-voltage insulator that caused plant trips in the past. The root cause was the wind blowing the plume from the cooling towers allowing a coating of ice to form, which also trapped liquid water containing minerals on the surface of the insulators, allowing electrical tracking to occur. The applicant proposed a plant-specific, High-Voltage Porcelain Insulators AMP, to manage the aging effect of surface contamination. The staff evaluated this program in Section 3.0.3 of the SER. The staff determined that this AMP is acceptable because visual inspection is appropriate to inspect surface contamination and degradation of coating.

The staff noted that EPRI 1003057, states that, typically, transmission conductors do not normally swing significantly. When transmission conductors swing due to a substantial wind, it does not continue to swing for very long once the wind has subsided. Wind loading that can cause a transmission line to sway is considered in design and installation. Furthermore, the applicant confirmed that its review of plant-specific operating experience has not identified any occurrence of loss of material due to mechanical wear of high-voltage insulators. Therefore, the staff finds that loss of material due to mechanical wear caused by wind on transmission conductors is not an significant AERM at Columiba.

Based on the programs identified above, the staff concludes that the applicant met the SRP-LR Section 3.6.2.2.2 criteria. For those line items that apply to LRA Section 3.6.2.2.2, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.2.3 Loss of Material Due to Wind–Induced Abrasion and Fatigue, Loss of Conductor Strength Due to Corrosion, and Increased Resistance of Connection Due to Oxidation or Loss of Preload

In LRA Section 3.6.2.2.3, the applicant stated that the in-scope switchyard bus is connected to flexible connectors that do not normally vibrate and are supported by insulators and, ultimately, by structural supports such as concrete footing and structural steel. The applicant also stated that with no connection to moving or vibrating equipment; therefore, vibration is not an applicable aging mechanism.

The applicant stated, in LRA Section 3.6.2.2.3, that wind-induced abrasion and fatigue are not aging effects applicable to the in-scope transmission conductors. Industry experience has shown that transmission conductors do not normally swing unless subjected to substantial winds, and it stops swinging after a short period once the wind subsides. The applicant further stated that, because the transmission conductors are not normally moving, the loss of material due to wind-induced abrasion and fatigue is not an AERM.

The applicant also stated, in LRA Section 3.6.2.2.3, that the transmission conductors within the scope of license renewal are “Drake” aluminum conductor steel reinforced (ACSR) 795 MCM (thousand circular mils) with a 26/7 stranding (for the 230-kV system). The applicant also stated that Ontario Hydro testing included ACSR with the same stranding configuration as the Columbia transmission conductors. The applicant further stated that Columbia transmission conductors have an ultimate strength of 31,200 pounds (lb) for the “Drake” configuration. The “Drake” conductor has a maximum design working tension of 8,000 lb. Because the Ontario Hydro Study demonstrated a 30 percent loss of ultimate strength in an 80 year-old conductor, Columbia transmission conductors are shown to demonstrate the following:

- Normal margin (ultimate versus maximum design tension):
  “Drake” - (31,200-8,000)/(31,200)=0.74x100=74 percent
- Aged margin (assuming a 30 percent loss of ultimate strength):
  “Drake” - [(0.7)*(31,200)-8,000]/[(31,200)*(0.7)]=0.63x100=63 percent

The applicant stated that this demonstrates that (using the Ontario Hydroelectric test data) the Columbia transmission conductors will have greater than 63 percent ultimate strength margin remaining after 80 years. Therefore, based on the expected low corrosion rates due to plant location and the margins included in the design, the applicant concludes that corrosion of the transmission conductors is not an AERM for the period of extended operation.

The applicant further stated, in LRA Section 3.6.2.2.3, that increased connection resistance is not identified as an AERM. Bolted connections associated with the transmission conductors employ the use of good bolting practices consistent with the recommendations of EPRI 1003471, “Electrical Connector Application Guidelines.” The applicant also stated that preferred hardware for the connections is stainless steel. The Columbia applications incorporate the use of stainless steel “Belleville” washers on bolted electrical connections using stainless steel bolts, nuts, and washers to compensate for temperature changes and to maintain the proper tightness. Aluminum hardware is also used for aluminum to aluminum bus connections. The applicant further stated that use of aluminum fasteners with aluminum bus minimizes any differences in thermal expansion that could lead to loss of pre-load. In addition, design installation drawings provide guidance on bolted joints (copper to aluminum, aluminum to aluminum, and aluminum to copper). Design documents also require the use of an electrical joint compound, to be used in accordance with the manufacturer’s recommendations. These methods of assembly (particularly the use of the “Belleville” washers) are consistent with EPRI 1003471. The applicant stated that a review of site operating experience revealed no bolted connection failures associated with transmission conductors.

The staff reviewed LRA Section 3.6.2.2.3 against the criteria in SRP-LR Section 3.6.2.2.3, which states that loss of material due to wind-induced abrasion and fatigue, loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of pre-load could occur in transmission conductors and connections and in switchyard bus and connections. The GALL Report recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed.

The staff noted that EPRI 1003057 states that, typically, transmission conductors do not normally swing significantly. When transmission conductors swing due to a substantial wind, it does not continue to swing for very long once the wind has subsided. Wind loading that can cause a transmission line to sway is considered in design and installation. Therefore, the staff finds that wind-induced abrasion and fatigue is not a significant AERM at Columbia.

The staff also noted that the swichyard bus is connected to flexible connectors that do not normally vibrate and are supported by insulators and structural supports such as concrete footings and structure steel. With no connection to moving or vibrating, loss of material due to wind-induced abrasion and fatigue is not an applicable AERM for switchyard bus.

The Ontario Hydro Study showed about 30 percent loss of conductor strength of an 80 year old ACSR conductor due to corrosion. In addition, the National Electrical Safety Code (NESC) requires that tension on installed conductors be a maximum of 60 percent of the ultimate conductor strength. The NESC also sets the maximum tension a conductor must be designed to withstand under heavy load requirements, which include consideration of ½ in. of radial ice and 4 lb per ft^2 wind. The staff reviewed these requirements concerning the specific conductors included in the AMR at Columbia. Based on the Ontario Hydro Study, a loss of conductor strength of 30 percent on ACSR transmission conductors would mean that the conductor strength would be 21,850 lbs. (31,200 lbs. x 0.7). The ratio between the heavy loading and the ultimate conductor strength would be approximately 37 percent. The NESC requires that tension on installed conductor be a maximum of 60 percent of the ultimate conductor strength. The tension (heavy load) of a typical transmission conductor, as illustrated by the applicant, would not exceed the NESC maximum requirement of 60 percent of the ultimate conductor strength. The staff determined that with a 30 percent loss of conductor strength, there is still ample margin between the NESC requirements and the actual conductor strength. Therefore, the staff finds that loss of conductor strength due to corrosion is not a significant AERM at Columbia.

The staff noted that the design of the transmission conductor and switchyard bus bolted connections at Columbia precludes torque relaxation and corrosion, and the plant-specific operating experience has not identified any failures of bolted connections. The type of bolted joints (copper to copper, aluminum to aluminum, and aluminum to copper) and the use of stainless steel Belleville washers preclude torque relaxation. Columbia design incorporates the use of Belleville washers on bolted electrical connections to compensate for temperature changes, maintain the proper torque, and prevent loosening. This method of assembly is consistent with the good bolting practices recommended by industry guidelines (EPRI TR-104213, “Bolted Joint Maintenance and Application Guide”). The bolted connections and washers are coated with an antioxidant compound (electrical joint compound) prior to tightening the connection to prevent the formation of oxides on the metal surface and to prevent moisture from entering the connection, thus reducing the chances of corrosion. The staff finds that increased resistance of connection due to oxidation or loss of pre-load are not significant AERMs for transmission conductor and switchyard bus connections.

Based on the programs identified above, the staff concludes that the applicant met the SRP-LR Section 3.6.2.2.3 criteria. For those line items that apply to LRA Section 3.6.2.2.3, the staff determines that the LRA is consistent with the GALL Report and that the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.6.2.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

SER Section 3.0.4 provides the staff's evaluation of the applicant's QA Program.

3.6.2.3 AMR Results that are Not Consistent with or Not Addressed in the GALL Report

In LRA Table 3.6.2-1, the staff reviewed additional details of the AMR results for material, environment, AERM, and AMP combinations not consistent with or not addressed in the GALL Report.

In LRA Table 3.6.2-1, the applicant indicated, via notes F through J, that the combination of component type, material, environment, and AERM does not correspond to a line item in the GALL Report. The applicant provided further information about how it will manage the aging effects.

For component type, material, and environment combinations not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine if the applicant demonstrated that the effects of aging will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation. The staff's evaluation is documented below in the following section.

3.6.2.3.1 Electrical and I&Cs—electrical Component Commodity Groups—Summary of Aging Management Evaluation—LRA Table 3.6.2-1

In LRA Table 3.6.2-1, under the Uninsulated Ground Conductors and Connections item, the applicant indicated that no aging effect is identified for copper exposed to outdoor air and soil environments. NUREG-1801, Volume 2, Revision 1, does not include the uninsulated ground conductor and connection as a SSC requiring AMR. The applicant further stated, in Footnote 0609, that the uninsulated ground conductors and connections are included in the license renewal scope because it is required for fire protection (from lightning-induced fires) on certain structures and for facilitating the operation of ground fault detection devices in the event of ground fault or insulator failure to any electrical load or current. The applicant further stated that there are no AERMs for the metallic components of the uninsulated ground conductors and connections.

The staff noted that the applicant did not provide technical justification of why uninsulated ground conductors and connections are not subject to aging degradation, such as loss of material due to general corrosion in a soil environment. In a letter dated August 16, 2010 (RAI 3.6-2), the staff asked the applicant to provide a technical justification as to why uninsulated ground conductors are not subject to any aging degradation. In response to the staff's request, in a letter dated November 19, 2010, the applicant stated that the uninsulated ground conductors and connections at Columbia include bare conductors used for the grounding grid and associated structure grounding. The conductors are described in the applicable electrical drawings as bare copper. The connections are not strictly electrical connections but straps, lugs, or mounting brackets that support the ground conductors. The applicant also stated that bare copper rods and conductor connections could potentially be subject to corrosion and a loss of material properties, as mentioned in the EPRI Electrical Handbook. However, the review of industry operating experience (from the Electrical Handbook) listed no findings associated with uninsulated ground conductors and connections. The applicant also stated that copper is a good choice for this application because of its high electrical conductivity, high fusing temperature, and high corrosion resistance. The applicant also stated that copper is also relatively strong, and it is easy to join by welding, compression, or clamping. Ground connections are commonly made with welds or mechanical type connections, which include compression, bolted, or wedge-type devices. The applicant further stated that it has reviewed industry technical information regarding material aging and has determined that there are no AERMs at Columbia for copper grounding materials. In addition, the applicant stated that it reviewed industry and plant operating experience and did not identify any failures of copper ground systems due to aging effects. The applicant inspected underground portions of the grounding system during a plant modification in the transformer yard in 2009, and it did not identify any aging related effects. The applicant stated that, based on industry and plant-specific operating experience, no AERMs were identified for the plant grounding system. In addition, the applicant stated that the lack of significant rainfall at Columbia, the water table being about 60 ft below the ground surface, and the moderate climate argue against any deleterious impact to the copper conductors from corrosion.

The staff finds the applicant response acceptable because copper has a high resistance to corrosion. When copper corrodes, it forms a protective oxide layer that protects the underlying material from further corrosion. In addition, the industrial and plant-specific operating experience did not identify any failure of copper grounding system due to aging effects. The aging effect due to corrosion is not significant at Columbia due lack of significant rainfall and the low water table being about 60 ft below the ground surface. Furthermore, the applicant inspected underground portions of the ground system during a plant modification in the transformer yard in 2009 and did not identify any aging effects of ground system. Based on this information, the staff determined that aging effects due to corrosion of bare copper grounding system is not a significant AERM at Columbia.

GALL Report, Volume 2, Revision 1, Item VI.A-8, “Fuse Holders (Not Part of a Larger Assembly); Metallic Clamp,” identifies the aging/effect mechanism as fatigue/ohmic heating, thermal cycling, electrical transients, frequent manipulation, vibration, chemical contamination, corrosion, and oxidation. The associated AMP, XI.E5, “Fuse Holders,” states that fuse holders within the scope of license renewal should be tested to provide an indication of the condition of the metallic clamps of fuse holders. In LRA Appendix B, Table B-1, the applicant stated that Fuse Holder Program is not credited for license renewal. LRA Table 3.6.2-1, under “Fuse Holders; Metallic Clamp” component type, also states that these aging effects are not applicable at Columbia. The applicant does not provide a detailed evaluation for each aging effect identified in GALL Report AMP XI.E5. In a letter dated August 16, 2010 (RAI 3.6-3), the staff asked the applicant to provide an evaluation that addresses the aging effect/mechanisms identified in GALL Report, Volume 2, Revision 1, and Item VI.A-8 that supports the conclusions made in LRA Table 3.6.1, Item 3.6.1-06. In response to the staff’s request, in a letter dated September 21, 2010, the applicant stated that, as discussed in the GALL Report, the scope of the XI.E5 Fuse Holders Program states that “this program applies to fuse holders located outside of active devices and that are considered susceptible to aging effects. Fuse holders inside an active device (e.g., switchgears, power supplies, power inverters, battery chargers, and circuit boards) are not within the scope of this program." At Columbia, a search was done to identify fuse holders within the scope of license renewal that are located in enclosures that do not contain active devices. The result of the search was a list of 14 passive enclosures. Four of these enclosures are located in the radwaste building within the control structure on the 467 ft elevation in the battery rooms. The remaining 10 are located in the reactor building within secondary containment. The applicant provided the following a basis for the conclusion that the fuse holders (metallic clamps) are not subject to the aging effects/mechanisms identified in NUREG-1801, Volume 2, Revision 1, GALL Report Tabulation of Results, Item VI.A-8.

Fatigue. NUREG-1 760, "Aging Assessment of Safety-Related Fuses Used in Low and Medium Voltage Applications in Nuclear Power Plants," states that fatigue of fuse holders can typically occur due to elevated temperature, mechanical stress, and repeated insertion and removal of fuses. The fuse holders subject to AMR are located indoors with normal ambient temperatures of 70–90 °F (104 °F maximum). There are no significant sources of heat in close proximity to the fuse holders to elevate the ambient temperature such that elevated ambient temperatures are not expected. Therefore, fatigue due to elevated ambient temperature is not an applicable aging effect. Fatigue related to mechanical stress or repeated insertion and removal is evaluated under the "Mechanical Stress and Electrical Transients" section below. Fatigue related to thermal cycling is evaluated under the "Ohmic Heating" and "Thermal Cycling" sections below.

Mechanical Stress and Electrical Transients. The fuse holders subject to AMR are located in electrical enclosures, and the fuses are not routinely removed and reinserted into the metallic clamps. Therefore, the fuse holder metallic clamps are not subject to repeated manipulation that could lead to mechanical fatigue. The stresses due to electrical transients are mitigated by the circuit protection provided by over-current devices for high-current applications. Mechanical stress due to electrical transients or faults is not considered credible because faults are so infrequent. The Columbia Corrective Action Program is used to document adverse equipment conditions and provides corrective actions associated with electrical transients and faults that cause the actuation of circuit protection devices. Therefore, mechanical stress and electrical transients are not applicable aging mechanisms.

Vibration. These electrical enclosures are wall-mounted, not mounted on rotating equipment. Therefore, vibration is not an applicable aging mechanism for the fuse holders in these enclosures.

Chemical Contamination and Corrosion. These fuse holders are located in electrical enclosures that have covers. The boxes are not exposed to weather as it is located indoors at Columbia. It is not exposed to chemical contamination or spills. It is not exposed to mechanical stresses inside the boxes. It is not operated in an environment of industrial pollution or salt deposition due to Columbia's location in rural washingtong state. The fuse holders are not subject to moisture or chemicals inside the electrical enclosures and do not experience a corrosive environment. Therefore, chemical contamination and corrosion are not applicable aging mechanisms for these fuse holders.

Ohmic Heating and Thermal Cycling. With respect to electrical transients and ohmic heating, these fuses are not heavily loaded and do not experience frequent electrical and thermal cycling. Therefore, ohmic heating and thermal cycling are not an applicable aging mechanisms for these fuse holders.

Oxidation. The reactor building secondary containment is maintained at approximately 70–90 °F (104 °F maximum) and 40 percent RH. Oxidation in this environment is not considered an applicable aging mechanism. The radwaste battery rooms are maintained at approximately 70 °F (104 °F maximum) and 40 percent RH. Oxidation in this environment is not considered an applicable aging mechanism.

Therefore, the applicant concluded that the fuse holders (metallic clamp) will not require an AMP (following the guidance of NUREG-1801, Section XI.E5).

The staff finds the applicant's response acceptable. The staff finds that fatigue, mechanical stress, vibration, oxidation, and chemical contamination stressors are not applicable at Columbia. Fatigue is the aging effect for plants that manipulate fuse to deenergize circuits for plant testing. The fuses at Columbia are not routinely pulled or manipulated for plant testing. Therefore, fatigue and mechanical stresses due to testing are not an applicable aging effect at Columbia. Ohmic heating and thermal cycling are for fuses that carry high current in power supply application or in heavy loading motors. With respect to electrical transients and ohmic heating, the Columbia fuses are not heavily loaded and do not experience frequent electrical and thermal cycling. Therefore, the ohmic heating and thermal cycling are not applicable stressors at Columbia. Stresses associated with mechanical stress due to electrical faults is not considered a credible aging stressor since such faults are infrequent and the fuse element design will interrupt the fault current in milliseconds. Forces associated with faults are mitigated by the fast action of fuse elements. Therefore, mechanical stress is not an applicable aging effect at Columbia. Vibration is an applicable aging stressor for fuse holders that are mounted on moving equipment such as motors, compressors, and pumps. Columbia fuses are not mounted on equipment subject to movement or vibration, it is mounted on concrete walls or support structures that do not vibrate. Therefore, vibration is not an applicable stressor at Columbia. Chemical contamination is a stress concentrator for fuse holders that are located near a chemical contamination source such as boron acid tanks. Columbia fuses are not exposed to chemical contamination or spills. During the staff audit, the staff walked down these fuses and noted that there is no potential source of chemical contamination in the areas near the fuse holders. Furthermore, fuse holders are enclosed in a protective panel that would provide protection against chemical attack. Therefore, chemical contamination is not an applicable aging effect at Columbia. The fuse holder locations are maintained at relatively low RH (40 percent RH). Oxidation in this environment is not expected. Therefore, oxidation is not considered an applicable aging mechanism. The staff's concern in RAI 3.6-3 is resolved.

3.6.3 Conclusion

The staff concludes that the applicant provided sufficient information to demonstrate that the effects of aging for the electrical and I&C components within the scope of license renewal and subject to an AMR will be adequately managed so that the intended function(s) will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.7 <u>Conclusion for AMR Results</u>

The staff reviewed the information in LRA Section 3, "Aging Management Review Results," and Appendix B, "Aging Management Programs." On the basis of its review of the AMR results and AMPs, the staff concludes that the applicant demonstrated that the aging effects will be adequately managed so that the intended functions will remain consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the applicable UFSAR supplement program summaries and concludes that the UFSAR supplement adequately describes the AMPs credited for managing aging, as required by 10 CFR 54.21(d).

With regard to these matters, the staff concludes that the activities authorized by the renewed license will continue to be conducted in accordance with the CLB, and any changes made to the CLB, to comply with 10 CFR 54.21(a)(3), are in accordance with NRC regulations.

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Arthur Cunanan, NRC Project Manager

11. ABSTRACT (200 words or less)
This safety evaluation report (SER) documents the technical review of the Columbia Generating Station (Columbia), license renewal application (LRA) by the U.S. Nuclear Regulatory Commission (NRC) staff (the staff). By letter dated January 19, 2010, Energy Northwest (the applicant) submitted the LRA in accordance with Title 10, Part 54, of the Code of Federal Regulations, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants." Energy Northwest requests renewal of the operating license (Facility Operating License Number NPF-21) for a period of 20 years beyond the current license period of December 20, 2023.

Columbia is located approximately 12 miles north of Richland, WA. The NRC issued the construction permit on March 19, 1973, and the operating license for Columbia on April 13, 1984. The unit is a Mark II boiling-water reactor (BWR) design. General Electric Company supplied the nuclear steam supply system. Burns and Roe, Inc., designed the balance of plant, and Bechtel Power Corporation constructed the plant. The licensed power output of the unit is 3,886 megawatts thermal, with a gross electrical output of approximately 1,230 megawatts electric.

This SER presents the status of the staff's review of information submitted through January 4, 2012. The six open items previously identified by the staff from the SER with open items have been closed (see SER Section 1.5); the staff did not identify any open items before the staff made a final determination. SER Section 6.0 provides the staff's final conclusion of the LRA review.

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