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NUREG-2192

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

Draft Report for Comment

Office of Nuclear Reactor Regulation

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COMMENTS ON DRAFT REPORT

Any interested party may submit comments on this report for consideration by the U.S. Nuclear Regulatory Commission (NRC) staff. Comments may be accompanied by additional relevant information or supporting data. Please specify the report number **NUREG–2191, Volume 2,** in your comments, and send them by the end of the comment period specified in the *Federal Register* notice announcing the availability of this report.

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Federal Rulemaking Website: Go to http://www.regulations.gov and search for documents filed under Docket ID **NRC–2015–0251**. Address questions about NRC dockets to Carol Gallagher at 301-415-3463 or by e-mail at Carol.Gallagher@nrc.gov.

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ABSTRACT

The U.S. Nuclear Regulatory Commission (NRC) staff has defined subsequent license renewal to be the period of extended operation from 60 years to 80 years following initial licensing. The Standard Review Plan for Review of Subsequent License Renewal Applications (SRP-SLR) for Nuclear Power Plants provides guidance to NRC staff reviewers in the Office of Nuclear Reactor Regulation. These reviewers perform safety reviews of applications to renew nuclear power plant licenses in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 54 "Requirements for Renewal of Operating Licenses for Nuclear Power Plants." The NRC regulations in 10 CFR 54.29 establish the standards for issuance of a renewed license. For nuclear power plants that have received a renewed license, the regulations in 10 CFR 54.31(d) state that "a renewed license may be subsequently renewed in accordance with all applicable requirements." The NRC has stated that the requirements for subsequent renewal "include the provisions of part 54 (unless the Commission subsequently adopts special provisions applicable only to subsequent renewals)." Statement of Consideration, "Nuclear Power Plant License Renewal," 56 FR 64,943, 64,964-65 (Dec. 13, 1991). To date, the NRC has not adopted special provisions that apply only to subsequent renewal, so that the requirements in 10 CFR Part 54 continues to govern subsequent license renewal.

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

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ABBREVIATIONS

ACI	American Concrete Institute
AFW	auxiliary feedwater
AMPs	aging management programs
AMR	aging management review
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATWS	anticipated transients without scram
B&PV	Boiler and Pressure Vessel
B&W	Babcock & Wilcox
BWR	boiling water reactor
BWRVIP	Boiling Water Reactor Vessel and Internals Project
CASS	cast austenitic stainless steel
CDF	core damage frequency
CE	Combustion Engineering
CFR	*Code of Federal Regulations*
CLB	current licensing basis
CRD	control rod drive
CRDM	control rod drive mechanism
CUF	cumulative usage factor
DBA	design basis accident
DBEs	design basis events
DE	Division of Engineering
DG	Draft Regulatory Guide
DIRS	Division of Inspection and Regional Support
DLR	Division of License Renewal
DOR	Division of Operating Reactors
DORL	Division of Operating Reactor Licensing
DPR	Division of Policy and Rulemaking
DSS	Division of Safety Systems
ECCS	emergency core cooling system
EDG	emergency diesel generator
EFPY	effective full power year
EMA	equivalent margins analysis
EOL	end-of-life
EPRI	Electric Power Research Institute
EPU	extended power uprate
EQ	Environmental Qualification
FAC	flow-accelerated corrosion
FE	further evaluation
FMECA	failure modes, effects, and criticality analysis
FR	*Federal Register*
FRN	*Federal Register Notice*
FSAR	Final Safety Analysis Report
FSER	Final Safety Evaluation Report

GALL	Generic Aging Lessons Learned
GALL-SLR	Generic Aging Lessons Learned for Subsequent License Renewal
GE	General Electric
GL	generic letter
GSI	generic safety issue
HELB	high-energy line break
HPCI	high-pressure coolant injection
HPSI	high-pressure safety injection
HVAC	heating, ventilation, and air conditioning
I&C	instrumentation and control
IASCC	Irradiation-assisted stress corrosion cracking
IEEE	Institute of Electrical and Electronics Engineers
IGSCC	intergranular stress corrosion cracking
IN	information notice
INPO	Institute of Nuclear Power Operations
IPA	integrated plant assessment
IPE	individual plant examination
IPEEE	individual plant examination of external events
ISI	inservice inspection
ISG	interim staff guidance
LBB	leak-before-break
LCOs	limiting conditions of operations
LER	licensee event report
LOCA	loss of coolant accident
LRAs	license renewal applications
LWR	light-water reactor
MEB	metal enclosed bus
MIC	microbiologically-induced corrosion
MRP	Materials Reliability Program
NEI	Nuclear Energy Institute
NPS	nominal pipe size
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
ODSCC	outside diameter stress corrosion cracking
OE	operating experience
P&ID	piping and instrumentation diagram
PH	precipitation-hardened
PM	Project Manager
P-T	pressure-temperature
PTLRs	pressure-temperature limit reports
PTS	pressurized thermal shock
PVC	polyvinyl chloride
PWR	pressurized water reactor
PWSCC	primary water stress corrosion cracking

QA	quality assurance
RAI	request for additional information
RG	Regulatory Guide
RPV	reactor pressure vessel
RT	reference temperature
RTD	resistance temperature detector
RVI	reactor vessel internal
SBO	station blackout
SC	structures and components
SCC	stress corrosion cracking
SEEIN	Significant Event Evaluation and Information Network
SEs	safety evaluations
SER	safety evaluation report
SG	steam generator
S/G	standards and guides
SLR	subsequent license renewal
SLRA	subsequent license renewal application
SOC	statements of consideration
SOER	significant operating experience report
SRM	staff requirements memorandum
SRP	standard review plan
SRP-SLR	Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants
SS	stainless steel
SSCs	systems, structures, and components
SSE	safe shutdown earthquake
TC	thermocouples (nozzles)
TGSCC	transgranular stress corrosion cracking
TLAAs	time-limited aging analysis
TR	topical report
TS	Technical Specifications
UFSAR	updated final safety analysis report
USAR	updated safety analysis report
USE	upper-shelf energy
UV	ultraviolet

INTRODUCTION

The Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) provides guidance to U.S. Nuclear Regulatory Commission (NRC) staff reviewers in the Office of Nuclear Reactor Regulation (NRR). These reviewers perform safety reviews of applications to renew nuclear power plant licenses in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 54. The NRC regulations in 10 CFR 54.29 establish the standards for issuance of a renewed license. For nuclear power plants that have received a renewed license, the regulations in 10 CFR 54.31(d) state that "a renewed license may be subsequently renewed in accordance with all applicable requirements." The NRC has stated that the requirements for subsequent renewal "include the provisions of part 54 (unless the Commission subsequently adopts special provisions applicable only to subsequent renewals)." Statement of Consideration, "Nuclear Power Plant License Renewal," 56 FR 64,943, 64,964-65 (Dec. 13, 1991). To date, the NRC has not adopted special provisions that apply only to subsequent renewal, so that the requirements in 10 CFR Part 54 continues to govern subsequent license renewal.

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

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

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

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

The SRP-SLR references the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report, which evaluates existing programs generically, to document (i) the conditions under which existing programs are considered adequate to manage identified aging effects without change and (ii) the conditions under which existing programs should be augmented for this purpose. The SRP-SLR also includes the NRC staff's resolutions of License Renewal Interim Staff Guidance (LR-ISG) from 2011 through 2013 as listed below. The NRC issued a draft ISG-2015-01 for public comment on June 29, 2015 (ADAMS No. ML15125A377). The staff is in the final process of reviewing the ISG for issuance as a final document. Upon issuance, the changes to aging management program (AMP) XI.M41, "Buried and Underground Piping and Tanks," will be incorporated into the GALL- SLR Report and the associated section of the SRP- SLR. Under the LR-ISG process the NRC staff, industry, or stakeholders can propose a change to certain license renewal guidance documents. The NRC staff evaluates the issue, develops proposed interim staff guidance (ISG), and issues an ISG for public comment. The NRC reviews any comments received, and, as appropriate, issues a final ISG. The ISG is then used until the NRC staff incorporates it into a formal license renewal guidance document revision.

- LR–ISG–2011–01: Aging Management of Stainless Steel Structures and Components in Treated Borated Water, Revision 1
- LR–ISG–2011–02: Aging Management Program for Steam Generators
- LR–ISG–2011–03: Generic Aging Lessons Learned (GALL) Report Revision 2 Aging Management Program (AMP) XI.M41, "Buried and Underground Piping and Tanks"
- LR–ISG–2011–04: Updated Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors
- LR–ISG–2011–05: Ongoing Review of Operating Experience
- LR–ISG–2012–01: Wall Thinning Due to Erosion Mechanisms
- LR–ISG–2012–02: Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation
- LR–ISG–2013–01: Aging Management of Loss of Coating or Lining Integrity for Internal Coatings/Linings on In-Scope Piping, Piping Components, Heat Exchangers, and Tanks
- LR–ISG–2015–01: Changes to Buried and Underground Piping and Tank Recommendations

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

The SRP-SLR is divided into five major chapters:

Chapter 1—Administrative Information

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

Chapter 3—Aging Management Review Results

Chapter 4—Time-Limited Aging Analyses

Chapter 5—Technical Specifications Changes and Additions

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

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

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

1. Areas of Review

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

2. Acceptance Criteria

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

Consistent with the approach described in Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report, the technical bases for some sections of the SRP-SLR can be provided in branch technical positions or appendices as they are developed and can be included in the SRP-SLR.

3. Review Procedures

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

4. Evaluation Findings

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

5. Implementation

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

6. References

This subsection lists the references used in the review process.

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

1 ADMINISTRATIVE INFORMATION

1.1 Docketing of Timely and Sufficient Renewal Application

Review Responsibilities

Primary—Program responsible for subsequent license renewal projects

Secondary—Branches responsible for technical review, as appropriate

1.1.1 Areas of Review

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

The review described in this section is not a detailed, in-depth review of the technical aspects of the application. The docketing and subsequent finding of a timely and sufficient renewal application does not preclude the NRC staff from requesting additional information as the review progresses, and also does not imply the NRC's final determination regarding the approval or denial of the renewal application. A plant's current license will not expire upon the passing of the license's expiration date if the renewal application was found to be timely and sufficient. During this time, and until a license renewal determination has been made by the NRC, the licensee must continue to perform its activities in accordance with the facility's current licensing basis (CLB), including all applicable license conditions, orders, rules, and regulations. However, if the NRC staff approves the aging management activities provided in the renewal application before the NRC makes a final determination on the SLRA, the approved applicant may conduct aging management activities during the timely renewal period using the aging management programs (AMPs) included in the SLRA.

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

1.1.1.1 Docketing and Sufficiency of Application

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

1.1.1.2 Timeliness of Application

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

1.1.2 Acceptance Criteria

1.1.2.1 Docketing and Sufficiency of Application

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

1.1.2.2 Timeliness of Application

In accordance with 10 CFR 2.109(b), a license renewal application is timely if it is submitted at least 5 years before the expiration of the current operating license (unless an exemption is granted) and if it is determined to be sufficient.

1.1.3 Review Procedures

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

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

1.1.3.1 Docketing and Sufficiency of Application

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

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

Items II, III, IV, and V in the checklist address scoping, technical information, the Final Safety Analysis Report (FSAR) supplement, and technical specification changes, respectively. Chapters 2, 3, and 4 of the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) provide information regarding the technical review. Although the purpose of the docketing and sufficiency review is not to determine the technical adequacy of the application, the reviewer should determine whether the applicant has provided reasonably complete information in the application to address the renewal rule requirements. The reviewer may request assistance from appropriate technical review branches to determine whether the application provides sufficient information to address the items in the checklist so that the NRC staff can begin their technical review. The reviewer should check the “Yes” column for a checklist item if the applicant has provided reasonably complete information in the application to address the checklist item.

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

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

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

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

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

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

1.1.3.2 Timeliness of Application

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

If the reviewer checks the "No" column in Item VII in the checklist, indicating that a sufficient renewal application has not been submitted at least 5 years before the expiration of the current operating license, the letter (typically preceded by a management call between the NRC staff and the applicant) to the applicant should clearly state that (i) the application is not timely, (ii) the provisions in 10 CFR 2.109(b) have not been satisfied, and (iii) the current license will expire on the expiration date. However, if the application is otherwise determined to be acceptable for docketing, the technical review can begin.

1.1.4 Evaluation Findings

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

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

- On the basis of its review, as discussed above, the NRC staff has determined that the application is *not acceptable* for docketing as a timely and/or sufficient renewal application.

1.1.5 Implementation

Except for cases in which the applicant proposes an acceptable alternative method for complying with specified portions of NRC regulations, NRC staff members follow the methods described herein in their evaluation of conformance with NRC regulations.

1.1.6 References

1. NRC. NUREG–1555, “Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1, Operating License Renewal.” Washington, DC: U.S. Nuclear Regulatory Commission. October 1999.

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

	Yes	No
I. General Information		
1. Application identifies specific unit(s) applying for subsequent license renewal	☐	☐
2. Filing of renewal application 10 CFR 54.17(a) is in accordance with:		
A. 10 CFR Part 2, Subpart A; 10 CFR 2.101	☐	☐
B. 10 CFR 50.4		
a. Application is addressed to the Document Control Desk as specified in 10 CFR 50.4(a)	☐	☐
b. Signed original application and 13 copies are provided to the Document Control Desk. One copy is provided to the appropriate Regional office [10 CFR 50.4(b)(3)]	☐	☐
c. Form of the application meets the requirements of 10 CFR 50.4(c)	☐	☐
C. 10 CFR 50.30		
a. Application is filed in accordance with 10 CFR 50.4 [10 CFR 50.30(a)(1)]	☐	☐
b. Application is submitted under oath or affirmation [10 CFR 50.30(b)]	☐	☐
3. Applicant is eligible to apply for a license and is not a foreign-owned or foreign-controlled entity [10 CFR 54.17(b)]	☐	☐
4. Application is not submitted earlier than 20 years before expiration of current license [10 CFR 54.17(c)]	☐	☐
5. Application states whether it contains applications for other kinds of licenses [10 CFR 54.17(d)]	☐	☐
6. Information incorporated by reference in the application is contained in other documents previously filed with the Commission, and the references are clear and specific [10 CFR 54.17(e)]	☐	☐
7. Restricted data or other defense information, if any, is separated from unclassified information in accordance with 10 CFR 50.33(j) [10 CFR 54.17(f)]	☐	☐
8. If the application contains restricted data, written agreement on the control of accessibility to such information is provided [10 CFR 54.17(g)]	☐	☐
9. Information specified in 10 CFR 50.33(a) through (e), (h), and (i) is provided or referenced [10 CFR 54.19(a)]:	☐	☐
A. Name of applicant	☐	☐
B. Address of applicant	☐	☐
C. Business description	☐	☐
D. Citizenship and ownership details	☐	☐
E. License information	☐	☐
F. Construction or alteration dates	☐	☐
G. Regulatory agencies and local publications	☐	☐
10. Conforming changes, as needed, to the standard indemnity agreement have been submitted (10 CFR 140.92, Appendix B) to account for the proposed change in the expiration date [10 CFR 54.19(b)]	☐	☐

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

II. Technical Information

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

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

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

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

2.1 Scoping and Screening Methodology

Review Responsibilities

Primary—Assigned branch

Secondary—None

2.1.1 Areas of Review

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

1. They perform such functions without moving parts or without a change in configuration or properties, as set forth in 10 CFR 54.21(a)(1)(i) [denoted as "passive" components and structures in this standard review plan (SRP)], and

2. They are not subject to replacement based on a qualified life or specified time period, as set forth in 10 CFR 54.21(a)(1)(ii) [denoted as "long-lived" structures and components (SCs)].

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

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

The following areas relating to the applicant's scoping and screening methodology are reviewed.

2.1.1.1 Scoping

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

2.1.1.2 Screening

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

2.1.2 Acceptance Criteria

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

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

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

2.1.2.1 Scoping

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

2.1.2.2 Screening

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

2.1.3 Review Procedures

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

- The NRC’s safety evaluation report (SER) that was issued along with the operating license for the facility.
- The SER that was issued on the facility’s license renewal. This review is conducted for the purpose of familiarization with the principal design criteria for the facility and its current licensing basis (CLB), as defined in 10 CFR 54.3(a).
- Chapters 1 through 12 of the updated final safety analysis report (UFSAR) and the facility’s technical specifications for the purposes of familiarization with the facility design and the nomenclature that is applied to SSCs within the facility (including the bases for such nomenclature). During this review, the SSCs should be identified that are relied upon to remain functional during and after design basis events (DBEs), as defined in 10 CFR 50.49(b)(1)(ii), for which the facility was designed, to ensure that the functions described in 10 CFR 54.4(a)(1) are successfully accomplished. This review should also

yield information regarding seismic Category I SSCs as defined in RG 1.29, "Seismic Design Classification" (Ref. 2). For a newer plant, this information is typically contained in Section 3.2.1, "Seismic Classification," of the UFSAR consistent with the Standard Review Plan (NUREG–0800) (Ref. 3).

- Chapter 15 (or equivalent) of the UFSAR to identify the anticipated operational occurrences and postulated accidents that are explicitly evaluated in the accident analyses for the facility. During this review, the SSCs that are relied upon to remain functional during and following design basis events [as defined in 10 CFR 50.49(b)(1)] to ensure the functions described in 10 CFR 54.4(a)(1) should be identified.

- The set of DBEs as defined in the rule is not limited to Chapter 15 (or equivalent) of the UFSAR. Examples of DBEs that may not be described in this chapter include external events, such as floods, storms, earthquakes, tornadoes, or hurricanes, and internal events, such as a high-energy line break. Information regarding DBEs as defined in 10 CFR 50.49(b)(1) may be found in any chapter of the facility UFSAR, the Commission's regulations, NRC orders, exemptions, or license conditions within the CLB. These sources should also be reviewed to identify SSCs that are relied upon to remain functional during and following DBEs [as defined in 10 CFR 50.49(b)(1)] to ensure the functions described in 10 CFR 54.4(a)(1).

- The facility's Probabilistic Risk Analysis (PRA) Summary Report that was prepared by the licensee in response to Generic Letter (GL) 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities–10 CFR 50.54(f)," dated November 23, 1988 (Ref. 4). This review should yield additional information regarding the impact of the individual plant examination (IPE) on the CLB for the facility. While the license renewal (LR) Rule is "deterministic," the NRC in the statements of consideration (SOC) accompanying the Rule also states that "In license renewal, probabilistic methods may be most useful, on a plant-specific basis, in helping to assess the relative importance of structures and components that are subject to an AMR by helping to draw attention to specific vulnerabilities (e.g., results of an IPE or IPEEE)" (60 FR 22468). For example, the reviewer should focus on IPE information pertaining to plant changes or modifications that are initiated by the licensee in accordance with the requirements of 10 CFR 50.59 or 10 CFR 50.90.

- The results of the facility's IPEEE study conducted as a follow-up to the IPE performed as a result of GL 88-20 to identify any changes or modifications made to the facility in accordance with the requirements of 10 CFR 50.59 or 10 CFR 50.90.

- The applicant's docketed correspondence related to the following regulations:

  (a) 10 CFR 50.48, "Fire Protection"

  (b) 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants"

  (c) 10 CFR 50.61, "Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events" or 10 CFR 50.61a, "Alternate fracture toughness requirements for protection against pressurized thermal shock events," in accordance with the applicant's CLB [applicable only to pressurized water reactor (PWR) plants]

(d) 10 CFR 50.62, “Requirements for Reduction of Risk from Anticipated Transients without Scram Events for Light-Water-Cooled Nuclear Power Plants”

(e) 10 CFR 50.63, “Loss of All Alternating Current Power” (applicable to PWR plants)

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

2.1.3.1 Scoping

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

With respect to technical specifications, the NRC has stated (60 FR 22467):

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

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

For licensee commitments, such as licensee responses to NRC Bulletins, GLs, or enforcement actions, and those documented in NRC staff safety evaluations or licensee event reports, and which make up the remainder of an applicant's CLB, many of the associated SSCs need not be considered under SLR. Generic communications, safety evaluations, and other similar documents found on the docket are not regulatory requirements, and commitments made by a licensee to address any associated safety concerns are not typically considered to be design requirements. However, any generic communication, safety evaluation, or licensee commitment that specifically identifies or describes a function associated with a SSC necessary to fulfill the requirement of a particular regulation, order, license condition, and/or exemption may need to be considered when scoping for SLR. For example, NRC Bulletin 88-11, "Pressurizer Surge Line Thermal Stratification," states:

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

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

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

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

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

Table 2.1-2 contains specific NRC staff guidance on certain subjects of scoping.

2.1.3.1.1 Safety-Related

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

- The integrity of the reactor coolant pressure boundary;
- The capability to shut down the reactor and maintain it in a safe shutdown condition; or
- The capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1), 50.67(b)(2), or 100.11, as applicable.

2.1.3.1.2 Nonsafety-Related

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

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

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

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

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

Therefore, to satisfy the scoping criterion under 10 CFR 54.4(a)(2), the applicant must identify those nonsafety-related SSCs (including certain second-, third-, or fourth-level support systems) whose failures are considered in the CLB and could prevent the satisfactory accomplishment of a safety-related function identified under 10 CFR 54.4(a)(1). In order to identify such systems, the applicant should consider those failures identified in (1) the documentation that makes up its CLB, (2) plant-specific operating experience, and (3) industrywide operating experience that is specifically applicable to its facility. The applicant need not consider hypothetical failures that are not part of the CLB, have not been previously experienced, or are not applicable to its facility.

In part, 10 CFR 54.4(a)(2) requires that the applicant consider all nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), 10 CFR 54.4(a)(1)(ii), or 10 CFR 54.4(a)(1)(iii) to be within the scope of license renewal. By letters dated December 3, 2001 and March 15, 2002, the NRC issued a staff position to NEI that provided NRC staff guidance for determining what SSCs meet the 10 CFR 54.4(a)(2) criterion. The December 3, 2001 letter, "License Renewal Issue: Scoping of Seismic II/I Piping Systems," provided specific examples of operating experience that identified pipe failure events [summarized in Information Notice (IN) 2001-09, "Main Feedwater System Degradation in Safety-Related ASME Code Class 2 Piping Inside the Containment of a Pressurized Water Reactor"] and the approaches the NRC considers acceptable to determine which piping systems should be included in scope based on the 10 CFR 54.4(a)(2) criterion.

The March 15, 2002 letter, "License Renewal Issue: Guidance on the Identification and Treatment of Structures, Systems, and Components Which Meet 10 CFR 54.4(a)(2)," further described the NRC staff's recommendations for the evaluation of nonpiping SSCs to determine which additional nonsafety-related SSCs are within the scope of SLR. The position states that the applicants should not consider hypothetical failures, but rather should base their evaluation on the plant's CLB, engineering judgment and analyses, and relevant operating experience. The paper further describes operating experience as all documented plant-specific and industrywide 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 significant operating experience report (SOERs), and engineering evaluations.

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

In order to comply, in part, with the requirements of 10 CFR 54.4(a)(2), all applicants must include in scope all nonsafety-related piping attached directly to safety-related piping (within the scope of SLR) up to a defined anchor point consistent with the plant CLB. This anchor point may be served by a true anchor [a device or structure that ensures forces and moments are restrained in three (3) orthogonal directions] or an equivalent anchor, such as a large piece of plant equipment (e.g., a heat exchanger,) determined by an evaluation of the plant-specific piping design (i.e., design documentation, such as piping stress analysis for the facility). Applicants should be able to define an equivalent anchor consistent with their CLB (e.g., described in the UFSAR or other CLB documentation), which is being credited for the 10 CFR 54.4(a)(2) evaluation, and be able to describe the SCs that are part of the nonsafety-related piping segment boundary up to and including the anchor point or equivalent anchor point within the scope of SLR.

There may be isolated cases where an equivalent anchor point for a particular piping segment is not clearly described within the existing CLB information. In those instances the applicant may use a combination of restraints or supports such that the nonsafety-related piping and associated SCs attached to safety-related piping is included in scope up to a boundary point that encompasses at least two (2) supports in each of three (3) orthogonal directions.

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

2.1.3.1.3 “Regulated Events”

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

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

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

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

In addition, the last sentence of the second paragraph in Section III.c(iii) of the SOC provides the following guidance for limiting the application of the scoping criterion under 10 CFR 54.4(a)(3) as it applies to the use of hypothetical failures: Consideration of hypothetical failures that could result from system interdependencies, that are not part of the current licensing bases and that have not been previously experienced is not required. (60 FR 22467)

The SOC does not provide any additional guidance relating to the use of hypothetical failures or the need to consider second-, third-, or fourth-level support systems for scoping under10 CFR 54.4(a)(3). Therefore, in the absence of any guidance, an applicant need not consider hypothetical failures or second-, third-, or fourth-level support systems in determining the SSCs within the scope of the rule under 10 CFR 54.4(a)(3). For example, if a nonsafety-related diesel generator is relied upon only to remain functional to demonstrate compliance with the NRC SBO regulation, the applicant need not consider the following SSCs: (1) an alternate/backup cooling water system, (2) nonseismically-qualified building walls, or (3) an overhead segment of nonseismically-qualified piping (in a Seismic II/I configuration). This guidance is not intended to exclude any support system (whether identified by an applicant's CLB, or as indicated from actual plant-specific experience, industrywide experience [as applicable], safety analyses, or plant evaluations) that is specifically relied upon for compliance with the applicable NRC regulation. For example, if analysis of a nonsafety-related diesel generator (relied upon to demonstrate compliance with an applicable NRC regulation) specifically relies upon a second cooling system to cool the diesel generator jacket water cooling system for the generator to be operable, then both cooling systems must be included within the scope of the rule under 10 CFR 54.4(a)(3).

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

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

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

2.1.3.2 Screening

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

2.1.3.2.1 "Passive"

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

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

Table 2.1-5 provides a list of typical SCs identifying whether they meet

10 CFR 54.21(a)(1)(i). 10 CFR 54.21(a)(1)(i) explicitly excludes instrumentation, such as pressure transmitters, pressure indicators, and water level indicators, from an AMR. The applicant does not have to identify pressure-retaining boundaries of this instrumentation because 10 CFR 54.21(a)(1)(i) excludes this instrumentation without exception, unlike pumps and valves. Further, instrumentation is sensitive equipment and degradation of its pressure retaining boundary would be readily determinable by surveillance and testing. If an applicant determines that certain SCs listed in Table 2.1-5 as meeting 10 CFR 54.21(a)(1)(i) do not meet that requirement for its plant, the reviewer reviews the applicant's basis for that determination.

2.1.3.2.2 "Long-Lived"

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

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

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

A qualified life does not necessarily have to be based on calendar time. A qualified life based on run time or cycles are examples of qualified life references that are not based on calendar time.

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

> It is important to note, however, that the Commission has decided not to generically exclude passive structures and components that are replaced based on performance or condition from an aging management review. Absent the specific nature of the performance or condition replacement criteria and the fact that the Commission has determined that the components with "passive" functions are not as readily monitor able as components with active functions, such generic exclusion is not appropriate. However, the Commission does not

intend to preclude a license renewal applicant from providing site-specific justification in a license renewal application that a replacement program on the basis of performance or condition for a passive structure or component provides reasonable assurance that the intended function of the passive structure or component will be maintained in the period of extended operation. [60 FR 22478]

2.1.4 Evaluation Findings

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

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

2.1.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of NRC regulations, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

2.1.6 References

1. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54–The License Renewal Rule." Revision 6. Washington, DC: Nuclear Energy Institute.

2. NRC. Regulatory Guide 1.29, "Seismic Design Classification." Revision 3. Washington, DC: U.S. Nuclear Regulatory Commission. March 2007.

3. NRC. NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. March 2007.

4. NRC. Generic Letter (GL) 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities-10 CFR 50.54(f)." Washington, DC: U.S. Nuclear Regulatory Commission. November 1988.

Table 2.1-1. Sample Listing of Potential Information Sources
Verified databases (databases that are subject to administrative controls to assure and maintain the integrity of the stored data or information)
Master equipment lists (including NSSS vendor listings)
Q-lists
Updated Final Safety Analysis Reports
Piping and instrument diagrams
NRC Orders, exemptions, or license conditions for the facility
Design-basis documents
General arrangement or structural outline drawings
Probabilistic risk assessment summary report
Maintenance rule compliance documentation
Design-basis event evaluations (including plant-specific 10 CFR 50.59 evaluation procedures)
Emergency operating procedures
Docketed correspondence
System interaction commitments
Technical specifications
Environmental qualification program documents
Regulatory compliance reports (including Safety Evaluation Reports)
Severe Accident Management Guidelines

Table 2.1-2. Specific Staff Guidance on Scoping

Issue	Guidance
Commodity groups	The applicant may also group like SCs into commodity groups. Examples of commodity groups are pipe supports and cable trays. The basis for grouping SCs can be determined by such characteristics as similar function, similar design, and similar materials of construction, similar aging management practices, or similar environments. If the applicant uses commodity groups, the reviewer verifies that the applicant has described the basis for the groups.
Complex assemblies	Some SCs, when combined, are considered a complex assembly (for example, diesel generator starting air skids or heating, ventilating, and air conditioning refrigerant units). For purposes of performing an AMR, it is important to clearly establish the boundaries of review. An applicant should establish the boundaries for such assemblies by identifying each structure and component that make up the complex assembly and determining whether or not each structure and component is subject to an AMR (Ref. 1). NEI 95-10, Revision 0, Appendix C, Example 5 (Ref. 1), illustrates how the evaluation boundary for a control room chiller complex assembly might be determined. The control room chillers were purchased as skid-mounted equipment. These chillers are part of the control room chilled water system. There are two (2) control room chillers. Each is a 100 percent capacity refrigeration unit. The functions of the control room chillers are to provide a reliable source of chilled water at a maximum temperature of 7 °C [44 °F], to provide a pressure boundary for the control room chilled water system, to provide a pressure boundary for the service water system, and to provide a pressure boundary for the refrigerant. All of these functions are considered intended functions. Typically, control room chillers are considered as one functional unit; however, for purposes of evaluating the effects of aging, it is necessary to consider the individual components. Therefore, the boundary of each control room chiller is established as follows: 1. At the inlet and outlet flanges of the service water system connections on the control room chiller condenser. Connected piping is part of the service water system. 2. At the inlet and outlet flanges of the control room chilled water system piping connections on the control room chiller evaporator. Connected piping is part of the control room chilled water system. 3. For electrical power supplies, the boundary is the output terminals on the circuit breakers supplying power to the skid. This includes the cables from the circuit breaker to the skid and applies for 480 VAC and 120 VAC. 4. The interface for instrument air supplies is at the instrument air tubing connection to the pressure control regulators, temperature controllers and transmitters, and solenoid valves located on the skid. The tubing from the instrument air header to the device on the skid is part of the instrument air system. 5. The interface with the annunciator system is at the external connection of the contacts of the device on the skid (limit switch, pressure switch, level

Table 2.1-2. Specific Staff Guidance on Scoping	
Issue	**Guidance**
	switch, etc.) that indicates the alarm condition. The cables are part of the annunciator system. Based on the boundary established, the following components would be subject to an AMR: condenser, evaporator, economizer, chiller refrigerant piping, refrigerant expansion orifice, foundations and bolting, electrical cabinets, cables, conduit, trays and supports, valves
Hypothetical failures	For 10 CFR 54.4(a)(2), an applicant should consider those failures identified in (1) the documentation that makes up its CLB, (2) plant-specific operating experience, and (3) industrywide operating experience that is specifically applicable to its facility. The applicant need not consider hypothetical failures that are not part of CLB and that have not been previously experienced. For example, an applicant should consider including (1) the portion of a fire protection system identified in the UFSAR that supplies water to the refueling floor that is relied upon in a DBA analysis as an alternate source of cooling water that can be used to mitigate the consequences from the loss of spent fuel pool cooling, (2) a nonsafety-related, non-seismically-qualified building whose intended function as described in the plant's CLB is to protect a tank that is relied upon as an alternate source of cooling water needed to mitigate the consequences of a DBE, and (3) a segment of nonsafety-related piping identified as a Seismic II/I component in the applicant's CLB.
Cascading	For 10 CFR 54.4(a)(3), an applicant need not consider hypothetical failures or second-, third, or fourth-level support systems. For example, if a nonsafety-related diesel generator is only relied upon to remain functional to demonstrate compliance with the NRC's SBO regulations, an applicant may not need to consider (1) an alternate/backup cooling water system, (2) the diesel generator non-seismically-qualified building walls, or (3) an overhead segment of non-seismically-qualified piping (in a Seismic II/I configuration). An applicant may not exclude any support system (identified by its CLB, actual plant-specific experience, industrywide experience, as applicable, or existing engineering evaluations) that is specifically relied upon for compliance with, or operation within, applicable NRC regulation. For example, if the analysis of a nonsafety-related diesel generator (relied upon to demonstrate compliance with an applicable NRC regulation) specifically relies upon a second cooling system to cool the diesel generator jacket water cooling system for the diesel to be operable, then both cooling systems must be included within the scope of the rule.

Table 2.1-3. Specific Staff Guidance on Screening	
Issue	**Guidance**
Consumables	Consumables may be divided into the following four categories for the purpose of license renewal: (a) packing, gaskets, component seals, and O-rings; (b) structural sealants; (c) oil, grease, and component filters; and (d) system filters, fire extinguishers, fire hoses, and air packs. The consumables in both categories (a) and (b) are considered as subcomponents and are not explicitly called out in the scoping and screening procedures. Rather, they are implicitly included at the component level (e.g., if a valve is identified as being in scope, a seal in that valve would also be in scope as a subcomponent of that valve). For category (a), the applicant would generally be able to exclude these subcomponents using a clear basis. For category (b), these subcomponents may perform functions without moving parts or a change in configuration, and they are not typically replaced. The applicant's structural AMP should address these items with respect to an AMR program on a plant-specific basis. The consumables in category (c) are usually short-lived and periodically replaced, and can normally be excluded from an AMR on that basis. Likewise, the consumables that fall within category (d) are typically replaced based on performance or condition monitoring that identifies whether these components are at the end of their qualified lives and may be excluded, on a plant-specific basis, from AMR under 10 CFR 54.21(a)(1)(ii). The applicant should identify the standards that are relied on for the replacement as part of the methodology description (for example, NFPA standards for fire protection equipment).
Heat exchanger intended functions	Both the pressure boundary and heat transfer functions for heat exchangers should be considered because heat transfer may be a primary safety function of these components. There may be a unique aging effect associated with different materials in the heat exchanger parts that are associated with the heat transfer function and not the pressure boundary function. Normally the programs that effectively manage aging effects of the pressure boundary function can, in conjunction with the procedures for monitoring heat exchanger performance, effectively manage aging effects applicable to the heat transfer function.
Multiple functions	SCs may have multiple functions. The intended functions as delineated in 10 CFR 54.4(b) are to be reviewed for SLR. For example, a flow orifice that is credited in a plant's accident analysis to limit flow would have two intended functions. One intended function is pressure boundary. The other intended function is to limit flow. The reviewer verifies that the applicant has considered multiple functions in identifying structure- and component-intended functions.

Table 2.1-4(a). Typical "Passive" Structure-Intended Functions	
Structures	
Intended Function	**Description**
Direct Flow	Provide spray shield or curbs for directing flow (e.g., safety injection flow to containment sump)
Expansion/Separation	Provide for thermal expansion and/or seismic separation
Fire Barrier	Provide rated fire barrier to confine or retard a fire from spreading to or from adjacent areas of the plant
Flood Barrier	Provide flood protection barrier (internal and external flooding event)
Gaseous Release Path	Provide path for release of filtered and unfiltered gaseous discharge
Heat Sink	Provide heat sink during station blackout or design-basis accidents
HELB Shielding	Provide shielding against HELB
Missile Barrier	Provide missile barrier (internally or externally generated)
Pipe Whip Restraint	Provide pipe whip restraint
Pressure Relief	Provide over-pressure protection
Shelter, Protection	Provide shelter/protection to safety-related components
Shielding	Provide shielding against radiation
Shutdown Cooling Water	Provide source of cooling water for plant shutdown
Structural Pressure Barrier	Provide pressure boundary or essentially leak-tight barrier to protect public health and safety in the event of any postulated design-basis events.

Table 2.1-4(b). Typical “Passive” Component-Intended Functions	
Components	
Intended Function	**Description**
Absorb Neutrons	Absorb neutrons
Electrical Continuity	Provide electrical connections to specified sections of an electrical circuit to deliver voltage, current, or signals
Insulate (electrical)	Insulate and support an electrical conductor
Filter	Provide filtration
Heat Transfer	Provide heat transfer
Leakage Boundary (Spatial)	Nonsafety-related component that maintains mechanical and structural integrity to prevent spatial interactions that could cause failure of safety-related SSCs
Pressure Boundary	Provide pressure-retaining boundary so that sufficient flow at adequate pressure is delivered, or provide fission product barrier for containment pressure boundary, or provide containment isolation for fission product retention
Spray	Convert fluid into spray
Structural Integrity (Attached)	Nonsafety-related component that maintains mechanical and structural integrity to provide structural support to attached safety-related piping and components
Structural Support	Provide structural and/or functional support to safety-related and/or nonsafety-related components
Throttle	Provide flow restriction

Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment			
Item	**Category**	**Structure, Component, or Commodity Grouping**	**Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)**
1	Structures	Category I Structures	Yes
2	Structures	Primary Containment Structure	Yes
3	Structures	Intake Structures	Yes
4	Structures	Intake Canal	Yes
5	Structures	Other Non-Category I Structures within the Scope of SLR	Yes
6	Structures	Equipment Supports and Foundations	Yes
7	Structures	Structural Bellows	Yes
8	Structures	Controlled Leakage Doors	Yes
9	Structures	Penetration Seals	Yes
10	Structures	Compressible Joints and Seals	Yes
11	Structures	Fuel Pool and Sump Liners	Yes
12	Structures	Concrete Curbs	Yes
13	Structures	Offgas Stack and Flue	Yes
14	Structures	Fire Barriers	Yes
15	Structures	Pipe Whip Restraints and Jet Impingement Shields	Yes
16	Structures	Electrical and Instrumentation and Control Penetration Assemblies	Yes
17	Structures	Instrumentation Racks, Frames, Panels, and Enclosures	Yes
18	Structures	Electrical Panels, Racks, Cabinets, and Other Enclosures	Yes
19	Structures	Cable Trays and Supports	Yes
20	Structures	Conduit	Yes
21	Structures	TubeTrack®	Yes
22	Structures	Reactor Vessel Internals	Yes
23	Structures	ASME Class 1 Hangers and Supports	Yes

Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment			
Item	**Category**	**Structure, Component, or Commodity Grouping**	**Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)**
24	Structures	Non-ASME Class 1 Hangers and Supports	Yes
25	Structures	Snubbers	No
26	Reactor Coolant Pressure Boundary Components (Note: the components of the RCPB are defined by each plant's CLB and site-specific documentation)	ASME Class 1 Piping	Yes
27	Reactor Coolant Pressure Boundary Components	Reactor Vessel	Yes
28	Reactor Coolant Pressure Boundary Components	Reactor Coolant Pumps	Yes (Casing)
29	Reactor Coolant Pressure Boundary Components	Control Rod Drives	No
30	Reactor Coolant Pressure Boundary Components	Control Rod Drive Housing	Yes
31	Reactor Coolant Pressure Boundary Components	Steam Generators	Yes
32	Reactor Coolant Pressure Boundary Components	Pressurizers	Yes
33	Non-Class I Piping Components	Underground Piping	Yes
34	Non-Class I Piping Components	Piping in Low Temperature Demineralized Water Service	Yes
35	Non-Class I Piping Components	Piping in High Temperature Single Phase Service	Yes
36	Non-Class I Piping Components	Piping in Multiple Phase Service	Yes
37	Non-Class I Piping Components	Service Water Piping	Yes

Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment			
Item	**Category**	**Structure, Component, or Commodity Grouping**	**Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)**
38	Non-Class I Piping Components	Low Temperature Gas Transport Piping	Yes
39	Non-Class I Piping Components	Stainless Steel Tubing	Yes
40	Non-Class I Piping Components	Instrument Tubing	Yes
41	Non-Class I Piping Components	Expansion Joints	Yes
42	Non-Class I Piping Components	Ductwork	Yes
43	Non-Class I Piping Components	Sprinkler Heads	Yes
44	Non-Class I Piping Components	Miscellaneous Appurtenances (Includes fittings, couplings, reducers, elbows, thermowells, flanges, fasteners, welded attachments, etc.)	Yes
45	Pumps	ECCS Pumps	Yes (Casing)
46	Pumps	Service Water and Fire Pumps	Yes (Casing)
47	Pumps	Lube Oil and Closed Cooling Water Pumps	Yes (Casing)
48	Pumps	Condensate Pumps	Yes (Casing)
49	Pumps	Borated Water Pumps	Yes (Casing)
50	Pumps	Emergency Service Water Pumps	Yes (Casing)
51	Pumps	Submersible Pumps	Yes (Casing)
52	Turbines	Turbine Pump Drives (excluding pumps)	Yes (Casing)
53	Turbines	Gas Turbines	Yes (Casing)
54	Turbines	Controls (Actuator and Overspeed Trip)	No
55	Engines	Fire Pump Diesel Engines	No
56	Emergency Diesel Generators	Emergency Diesel Generators	No
57	Heat Exchangers	Condensers	Yes

Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment			
Item	**Category**	**Structure, Component, or Commodity Grouping**	**Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)**
58	Heat Exchangers	Heating, ventilation, and air conditioning (HVAC) Coolers (including housings)	Yes
59	Heat Exchangers	Primary Water System Heat Exchangers	Yes
60	Heat Exchangers	Treated Water System Heat Exchangers	Yes
61	Heat Exchangers	Closed Cooling Water System Heat Exchangers	Yes
62	Heat Exchangers	Lubricating Oil System Heat Exchangers	Yes
63	Heat Exchangers	Raw Water System Heat Exchangers	Yes
64	Heat Exchangers	Containment Atmospheric System Heat Exchangers	Yes
65	Miscellaneous Process Components	Gland Seal Blower	No
66	Miscellaneous Process Components	Recombiners	The applicant shall identify the intended function and apply the IPA process to determine if the grouping is active or passive.
67	Miscellaneous Process Components	Flexible Connectors	Yes
68	Miscellaneous Process Components	Strainers	Yes
69	Miscellaneous Process Components	Rupture Disks	Yes
70	Miscellaneous Process Components	Steam Traps	Yes
71	Miscellaneous Process Components	Restricting Orifices	Yes
72	Miscellaneous Process Components	Air Compressor	No
73	Electrical and instrumentation and control	Alarm Unit (e.g., fire detection devices)	No

Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment			
Item	**Category**	**Structure, Component, or Commodity Grouping**	**Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)**
74	Electrical and I&C	Analyzers (e.g., gas analyzers, conductivity analyzers)	No
75	Electrical and I&C	Annunciators (e.g., lights, buzzers, alarms)	No
76	Electrical and I&C	Batteries	No
77	Electrical and I&C	Cables and Connections, Bus, electrical portions of Electrical and I&C Penetration Assemblies, includes fuse holders outside of cabinets of active electrical SCs (e.g., electrical penetration assembly cables and connections, connectors, electrical splices, fuse holders, terminal blocks, power cables, control cables, instrument cables, insulated cables, communication cables, uninsulated ground conductors, transmission conductors, isolated-phase bus, non-segregated-phase bus, segregated-phase bus, switchyard bus)	Yes

Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment			
Item	**Category**	**Structure, Component, or Commodity Grouping**	**Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)**
78	Electrical and I&C	Chargers, Converters, Inverters (e.g., converters-voltage/current, converters-voltage/pneumatic, battery chargers/inverters, motor-generator sets)	No
79	Electrical and I&C	Circuit Breakers (e.g., air circuit breakers, molded case circuit breakers, oil-filled circuit breakers)	No
80	Electrical and I&C	Communication Equipment (e.g., telephones, video or audio recording or playback equipment, intercoms, computer terminals, electronic messaging, radios, transmission line traps, and other power-line carrier equipment)	No
81	Electrical and I&C	Electric Heaters	No Yes for a Pressure Boundary if applicable
82	Electrical and I&C	Heat Tracing	No
83	Electrical and I&C	Electrical Controls and Panel Internal Component Assemblies (may include internal devices such as, but not limited to, switches, breakers, indicating lights, etc.) (e.g., main control board, HVAC control board)	No

Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment			
Item	**Category**	**Structure, Component, or Commodity Grouping**	**Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)**
84	Electrical and I&C	Elements, RTDs, Sensors, Thermocouples, Transducers (e.g., conductivity elements, flow elements, temperature sensors, radiation sensors, watt transducers, thermocouples, RTDs, vibration probes, amp transducers, frequency transducers, power factor transducers, speed transducers, var. transducers, vibration transducers, voltage transducers)	No Yes for a pressure boundary if applicable
85	Electrical and I&C	Fuses	No
86	Electrical and I&C	Generators, Motors (e.g., emergency diesel generators, ECCS and emergency service water pump motors, small motors, motor-generator sets, steam turbine generators, combustion turbine generators, fan motors, pump motors, valve motors, air compressor motors)	No
87	Electrical and I&C	High-Voltage Insulators (e.g., porcelain switchyard insulators, transmission line insulators)	Yes

Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment			
Item	**Category**	**Structure, Component, or Commodity Grouping**	**Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)**
88	Electrical and I&C	Surge Arresters (e.g., switchyard surge arresters, lightning arresters, surge suppressers, surge capacitors, protective capacitors)	No
89	Electrical and I&C	Indicators (e.g., differential pressure indicators, pressure indicators, flow indicators, level indicators, speed indicators, temperature indicators, analog indicators, digital indicators, LED bar graph indicators, LCD indicators)	No
90	Electrical and I&C	Isolators (e.g., transformer isolators, optical isolators, isolation relays, isolating transfer diodes)	No
91	Electrical and I&C	Light Bulbs (e.g., indicating lights, emergency lighting, incandescent light bulbs, fluorescent light bulbs)	No

Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment			
Item	**Category**	**Structure, Component, or Commodity Grouping**	**Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)**
92	Electrical and I&C	Loop Controllers (e.g., differential pressure indicating controllers, flow indicating controllers, temperature controllers, controllers, speed controllers, programmable logic controller, single loop digital controller, process controllers, manual loader, selector station, hand/auto station, auto/manual station)	No
93	Electrical and I&C	Meters (e.g., ammeters, volt meters, frequency meters, var meters, watt meters, power factor meters, watt-hour meters)	No
94	Electrical and I&C	Power Supplies	No
95	Electrical and I&C	Radiation Monitors (e.g., area radiation monitors, process radiation monitors)	No
96	Electrical and I&C	Recorders (e.g., chart recorders, digital recorders, events recorders)	No
97	Electrical and I&C	Regulators (e.g., voltage regulators)	No
98	Electrical and I&C	Relays (e.g., protective relays, control/logic relays, auxiliary relays)	No
99	Electrical and I&C	Signal Conditioners	No
100	Electrical and I&C	Solenoid Operators	No

Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment

Item	Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)
101	Electrical and I&C	Solid-State Devices (e.g., transistors, circuit boards, computers)	No
102	Electrical and I&C	Switches (e.g., differential pressure indicating switches, differential pressure switches, pressure indicator switches, pressure switches, flow switches, conductivity switches, level-indicating switches, temperature-indicating switches, temperature switches, moisture switches, position switches, vibration switches, level switches, control switches, automatic transfer switches, manual transfer switches, manual disconnect switches, current switches, limit switches, knife switches)	No

Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment			
Item	**Category**	**Structure, Component, or Commodity Grouping**	**Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)**
103	Electrical and I&C	Switchgear, Load Centers, Motor Control Centers, Distribution Panel Internal Component Assemblies (may include internal devices such as, but not limited to, switches, breakers, indicating lights, etc.) (e.g., 4.16 kV switchgear, 480V load centers, 480V motor control centers, 250 VDC motor control centers, 6.9 kV switchgear units, 240/125V power distribution panels)	No
104	Electrical and I&C	Transformers (e.g., instrument transformers, load center transformers, small distribution transformers, large power transformers, isolation transformers, coupling capacitor voltage transformers)	No
105	Electrical and I&C	Transmitters (e.g., differential pressure transmitters, pressure transmitters, flow transmitters, level transmitters, radiation transmitters, static pressure transmitters)	No
106	Valves	Hydraulic-Operated Valves	Yes (Bodies)
107	Valves	Explosive Valves	Yes (Bodies)
108	Valves	Manual Valves	Yes (Bodies)

Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment			
Item	**Category**	**Structure, Component, or Commodity Grouping**	**Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)**
109	Valves	Small Valves	Yes (Bodies)
110	Valves	Motor-Operated Valves	Yes (Bodies)
111	Valves	Air-Operated Valves	Yes (Bodies)
112	Valves	Main Steam Isolation Valves	Yes (Bodies)
113	Valves	Small Relief Valves	Yes (Bodies)
114	Valves	Check Valves	Yes (Bodies)
115	Valves	Safety Relief Valves	Yes (Bodies)
116	Valves	Dampers, louvers, and gravity dampers	Yes (Housings)
117	Tanks	Air Accumulators	Yes
118	Tanks	Discharge Accumulators (Dampers)	Yes
119	Tanks	Boron Acid Storage Tanks	Yes
120	Tanks	Above Ground Oil Tanks	Yes
121	Tanks	Underground Oil Tanks	Yes
122	Tanks	Demineralized Water Tanks	Yes
123	Tanks	Neutron Shield Tank	Yes
124	Fans	Ventilation Fans (includes intake fans, exhaust fans, and purge fans)	Yes (Housings)
125	Fans	Other Fans	Yes (Housings)
126	Miscellaneous	Emergency Lighting	No
127	Miscellaneous	Hose Stations	Yes

2.2 Plant-Level Scoping Results

Review Responsibilities

Primary—Assigned branch(s)

Secondary—None

2.2.1 Areas of Review

This section addresses the plant-level scoping results for subsequent license renewal (SLR). Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(a)(1) requires the applicant to identify and list structures and components (SCs) subject to an aging management review (AMR). These are "passive," "long-lived" SCs that are within the scope of SLR. In addition, 10 CFR 54.21(a)(2) requires the applicant to describe and justify the methods used to identify these SCs. The U.S. Nuclear Regulatory Commission (NRC) staff reviews the applicant's methodology separately, following the guidance in Section 2.1.

The applicant should provide a list of all the plant systems and structures, identifying those that are within the scope of SLR. If the list exists elsewhere, such as in the updated final safety analysis report (UFSAR), it is acceptable to merely identify the reference. The license renewal rule does not require the identification of all plant systems and structures within the scope of SLR. However, providing such a list may make the review more efficient.

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

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

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

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

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

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

The following areas relating to the methodology implementation results for the plant-level systems and structures are reviewed.

2.2.1.1 Systems and Structures Within the Scope of Subsequent License Renewal

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

2.2.2 Acceptance Criteria

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

2.2.2.1 Systems and Structures Within the Scope of Subsequent License Renewal

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

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

2.2.3 Review Procedures

The reviewer verifies the applicant's scoping and screening results. If the reviewer requests additional information from the applicant regarding why a certain system or structure was not identified by the applicant as being within the scope of SLR for the applicant's plant, the reviewer should provide a focused question, clearly explaining what information is needed, explaining why it is needed, and how it will allow the NRC staff to make its safety finding. In addition, other NRC staff members review the applicant's scoping and screening methodology separately following the guidance in Section 2.1. The reviewer should keep these other NRC staff members informed of findings that may affect their review of the applicant's methodology. The reviewer should coordinate this sharing of information through the SLR project manager.

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

2.2.3.1 Systems and Structures Within the Scope of Subsequent License Renewal

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

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

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

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

- The applicant does not identify the radiation monitoring system as being within the scope of SLR. The reviewer may review the UFSAR to verify that this particular system does not perform any intended functions at the applicant's plant.

- The applicant does not identify the polar crane as being within the scope of SLR. The reviewer may review the UFSAR to verify that this particular structure is not "Seismic II over I," denoting a structure that is not seismic Category I interacting with a Seismic Category I structure as described in Position C.2 of Regulatory Guide (RG) 1.29, "Seismic Design Classification" (Ref. 1).

- The applicant does not identify the fire protection pump house as within the scope of SLR. The reviewer may review the plant's commitments to the fire protection regulation (10 CFR 50.48) to verify that this particular structure does not perform any intended functions at the plant.

- The applicant uses the "spaces" approach for scoping electrical equipment and elects to include all electrical equipment onsite to be within the scope of SLR except for the 525 kV switchyard and the 230 kV transmission lines. The reviewer may review the UFSAR and commitments to the SBO regulation (10 CFR 50.63) to verify that the

525 kV switchyard and the 230 kV transmission lines do not perform any intended functions at the applicant's plant.

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

Section 2.1 contains additional guidance on the following:

- Commodity groups
- Complex assemblies
- Hypothetical failure
- Cascading

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

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

2.2.4 Evaluation Findings

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

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

2.2.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specific portions of NRC regulations, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

2.2.6 References

1. NRC. Regulatory Guide 1.29, "Seismic Design Classifications." Revision 3. Washington, DC: U.S. Nuclear Regulatory Commission. March 2007.

Table 2.2-1. Examples of System and Structure Scoping and Basis for Disposition	
Example	**Disposition**
Recirculation cooling water system	One function of the recirculation cooling water system is to remove decay heat from the stored fuel in the spent fuel pool via the spent fuel pool cooling system. However, the spent fuel pool cooling system at the subject facility is not safety-related, and, following a seismic event, the safety-related spent fuel pool structure and spent fuel pool makeup water supplies ensure the adequate removal of decay heat to prevent potential offsite exposures comparable to those described in 10 CFR Part 100. Therefore, the recirculation cooling water system is not within the scope of SLR based on the spent fuel decay heat removal function.
SBO diesel generator building	The plant's UFSAR indicates that certain structural components of the SBO diesel generator building for the plant are designed to preclude seismic failure and subsequent impact of the structure on the adjacent safety-related emergency diesel generator building. In addition, the UFSAR indicates that certain equipment attached to the roof of the building has been anchored to resist tornado wind loads. Thus, the SBO diesel generator building is within the scope of SLR.

2.3 Scoping And Screening Results: Mechanical Systems

Review Responsibilities

Primary—Assigned branch(s)

Secondary—None

2.3.1 Areas of Review

This section addresses the mechanical systems scoping and screening results for subsequent license renewal (SLR). Typical mechanical systems consist of the following:

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

Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(a)(1) requires an applicant to identify and list structures and components (SCs) subject to an aging management review (AMR). These are "passive," "long-lived" SCs that are within the scope of SLR. In addition, 10 CFR 54.21(a)(2) requires an applicant to describe and justify the methods used to identify these SCs. The U.S. Nuclear Regulatory Commission (NRC) staff reviews the applicant's methodology separately following the guidance in Section 2.1. To verify that the applicant has properly implemented its methodology, the NRC staff focuses its review on the implementation results. Such a focus allows the NRC staff to confirm that there is no omission of mechanical system components that are subject to an AMR by the applicant. If the review identifies no omission, the NRC staff has the basis to find that there is reasonable assurance that the applicant has identified the mechanical system components that are subject to an AMR.

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

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

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

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

2.3.2 Acceptance Criteria

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

2.3.2.1 Components Within the Scope of Subsequent License Renewal

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

- Safety-related systems, structures, and components (SSCs) that are relied upon to remain functional during and following DBEs [as defined in 10 CFR 50.49(b)(1)] to ensure the following functions:
  - — The integrity of the reactor coolant pressure boundary;
  - — The capability to shut down the reactor and maintain it in a safe shutdown condition; or
  - — The capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2), or 10 CFR 100.11, as applicable.
- All nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii), or (iii).
- All SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with NRC regulations for fire protection (10 CFR 50.48), environmental qualification (10 CFR 50.49), pressurized thermal shock (PTS) (10 CFR 50.61), anticipated transients without scram (10 CFR 50.62), and station blackout (10 CFR 50.63).

2.3.2.2 Components Subject to an Aging Management Review

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

2.3.3 Review Procedures

The reviewer verifies the applicant's scoping and screening results. If the reviewer requests additional information from the applicant regarding why a certain component was not identified by the applicant as being within the scope of SLR or subject to an AMR for the applicant's plant, the reviewer should provide a focused question that clearly explains what information is needed, why the information is needed, and how the information will allow the NRC staff to make its safety finding. In addition, other NRC staff members review the applicant's scoping and screening methodology separately, following the guidance in Section 2.1. The reviewer should keep these other NRC staff members informed of findings that may affect their review of the applicant's methodology. The reviewer should coordinate this sharing of information through the SLR project manager.

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

2.3.3.1 Components Within the Scope of Subsequent License Renewal

In this step, the NRC staff determines whether the applicant has properly identified the components that are within the scope of SLR. The Rule requires applicants to identify components that are within the scope of SLR and subject to an AMR. In the past, LRAs have included a table of components that are within the scope of license renewal; that information need not be submitted with SLRAs. Although a list of within the scope of SLR components will be available at plant sites for inspection, the reviewer should determine through sampling of P&IDs, and review of the updated final safety analysis report (UFSAR) and other plant documents, what portion of the components are within the scope of SLR. The reviewer should check to see if any components exist that the NRC staff believes are within the scope of SLR but are not identified by the applicant as being subject to an AMR (and request that the applicant provide justification for omitting those components that are "passive" and "long-lived").

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

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

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

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

Section 2.1 contains additional guidance on the following:

- Commodity groups
- Complex assemblies
- Hypothetical failure
- Cascading

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

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

2.3.3.2 Components Subject to an Aging Management Review

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

Starting with the boundary verified in Subsection 2.3.3.1, the reviewer should sample components that are within the scope of SLR for that system, but were not identified by the applicant as subject to an AMR. Only components that are "passive" and "long-lived" are subject to an AMR. Table 2.1-5 is provided for the reviewer to assist in identifying whether certain components are "passive." The applicant should justify omitting a component from an AMR that is within the scope of SLR at their facility and is listed as "passive" on Table 2.1-5. Although Table 2.1-5 is extensive, it may not be all-inclusive. Thus, the reviewer should use other available information sources, such as prior application reviews, to determine whether a component may be subject to an AMR.

For example, an applicant has marked a boundary of a certain system that is within the scope of SLR. The marked-up diagram shows that there are pipes, valves, and air compressors within this boundary. The applicant has identified piping and valve bodies as subject to an AMR. Because Table 2.1-5 indicates that air compressors are not subject to an AMR, the reviewer should find the applicant's determination acceptable.

Section 2.1 contains additional guidance on screening the following:

- Consumables
- Heat exchanger-intended functions
- Multiple functions

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

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

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

2.3.4 Evaluation Findings

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

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

2.3.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specific portions of NRC regulations, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

2.3.6 References

None

Table 2.3-1. Examples of Mechanical Components Scoping and Basis for Disposition	
Example	**Disposition**
Piping segment that provides structural support	The safety-related/nonsafety-related boundary along a pipe run may occur at a valve location. The nonsafety-related piping segment between this valve and the next seismic anchor provides structural support in a seismic event. This piping segment is within the scope of SLR.
Containment heating and ventilation system ductwork downstream of the fusible links providing cooling to the steam generator compartment and reactor vessel annulus	This nonsafety-related ductwork provides cooling to support the applicant's environmental qualification program. However, the failure of the cavity cooling system ductwork will not prevent the satisfactory completion of any critical safety function during and following a DBE. Thus, this ductwork is not within the scope of SLR.
Standpipe installed inside the fuel oil storage tank	The standpipe as described in the applicant's CLB ensures that there is sufficient fuel oil reserve for the emergency diesel generator to operate for the number of days specified in the plant technical specifications following DBEs. Therefore, this standpipe is within the scope of SLR.
Insulation on boron injection tank	The temperature is high enough that insulation is not necessary to prevent boron precipitation. The plant technical specifications require periodic verification of the tank temperature. Thus, the insulation is not relied on to ensure the function of the emergency system and is not within the scope of SLR.
Pressurizer spray head	The spray head is not credited for the mitigation of any accidents addressed in the UFSAR accident analyses for many plants. The function of the pressurizer spray is to reduce reactor coolant system pressure during normal operating conditions. However, some plants rely on this component for pressure control to achieve cold shutdown during certain fire events. Failure of the spray head should be evaluated in terms of any possible damage to surrounding safety grade components, in addition to the need for spray. Therefore, this component should be evaluated on a plant-specific basis.

Table 2.3-2. Examples of Mechanical Components Screening and Basis for Disposition	
Example	**Disposition**
Diesel engine jacket water heat exchanger and portions of the diesel fuel oil system and starting air system supplied by a vendor on a diesel generator skid	These are “passive,” “long-lived” components having intended functions. They are subject to an AMR for SLR even though the diesel generator is considered “active.”
Fuel assemblies	The fuel assemblies are replaced at regular intervals based on the fuel cycle of the plant. They are not subject to an AMR.
Valve internals (such as disk and seat)	10 CFR 54.21(a)(1)(i) excludes valves, other than the valve body, from AMR. The statements of consideration of the license renewal rule provide the basis for excluding SCs that perform their intended functions with moving parts or with a change in configuration or properties. Although the valve body is subject to an AMR, valve internals are not.

Table 2.3-3. Examples of Mechanical Component-Intended Functions	
Component	**Intended Function***
Piping	Pressure boundary
Valve body	Pressure boundary
Pump casing	Pressure boundary
Orifice	Pressure boundary flow restriction
Heat exchanger	Pressure boundary heat transfer
Reactor vessel internals	Structural support of fuel assemblies, control rods, and incore instrumentation, to maintain core configuration and flow distribution
*The component-intended functions are those that support the system-intended functions. For example, a heat exchanger in the spent fuel cooling system has a pressure boundary-intended function, but may not have a heat transfer function. Similarly, not all orifices have flow restriction as an intended function.	

2.4 Scoping and Screening Results: Structures

Review Responsibilities

Primary—Assigned branch(s)

Secondary—None

2.4.1 Areas of Review

This section addresses the scoping and screening results of structures and structural components for subsequent license renewal (SLR). Typical structures include the following:

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

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

Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(a)(1) requires an applicant to identify and list structures and components (SCs) subject to an aging management review (AMR). These are “passive,” “long-lived” SCs that are within the scope of SLR. In addition, 10 CFR 54.21(a)(2) requires an applicant to describe and justify the methods used to identify these SCs. The U.S. Nuclear Regulatory Commission (NRC) staff reviews the applicant’s methodology separately following the guidance in Section 2.1. To verify that the applicant has properly implemented its methodology, the NRC staff focuses its review on the implementation results. Such a focus allows the NRC staff to confirm that there is no omission of structures that are subject to an AMR by the applicant. If the review identifies no omission, the NRC staff has the basis to find that there is reasonable assurance that the applicant has identified the SCs that are subject to an AMR.

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

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

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

2.4.2 Acceptance Criteria

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

2.4.2.1 Structural Components Subject to an Aging Management Review

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

- Safety-related systems, structures, and components that are relied upon to remain functional during and following DBEs [as defined in 10 CFR 50.49(b)(1)] to ensure the following functions:
  - — The integrity of the reactor coolant pressure boundary;
  - — The capability to shut down the reactor and maintain it in a safe shutdown condition; or
  - — The capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2), or 10 CFR 100.11, as applicable.
- All nonsafety-related systems, structures and components whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii), or (iii).
- All systems, structures, and components relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with NRC regulations for fire protection (10 CFR 50.48), environmental qualification (10 CFR 50.49), pressurized thermal shock (PTS) (10 CFR 50.61), anticipated transients without scram (ATWS) (10 CFR 50.62), and station blackout (SBO) (10 CFR 50.63).

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

2.4.3 Review Procedures

The reviewer verifies the applicant’s scoping and screening results. If the reviewer requests additional information from the applicant regarding why a certain structure was not identified by the applicant as being within the scope of SLR or subject to an AMR for the applicant’s plant, the reviewer should provide a focused question that clearly explains what information is needed, why the information is needed, and how the information will allow the NRC staff to make its safety finding. In addition, other NRC staff members review the applicant’s scoping and screening methodology separately following the guidance in Section 2.1. The reviewer should keep these other NRC staff members informed of findings that may affect their review of the applicant’s methodology. The reviewer should coordinate this sharing of information through the SLR project manager.

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

2.4.3.1 Structural Components Within the Scope of Subsequent License Renewal

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

2.4.3.2 Structural Components Subject to an Aging Management Review

In general, structural components are “passive” and “long-lived.” Thus, they are subject to an AMR if they are within the scope of SLR. For each of the plant-level structures within the scope of SLR, an applicant should identify those structural components that have intended functions. For example, the applicant may identify that its auxiliary building is within the scope of SLR. For this auxiliary building, the applicant may identify the structural components of beams, concrete walls, blowout panels, etc., that are subject to an AMR. The applicant should justify omitting a component from an AMR that is within the scope of SLR at its facility and is listed as “passive” on Table 2.1-5. Although Table 2.1-5 is extensive, it may not be all-inclusive. Thus, the reviewer should use other available information, such as prior application reviews, to determine whether a component may be subject to an AMR.

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

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

The reviewer should focus the review on those structural components that have not been identified as being within the scope of SLR. For example, for a building within the scope of SLR, if an applicant did not identify the building roof as subject to an AMR, the reviewer should verify that the roof has no intended functions, such as a “Seismic Category II structures over Category I structures” concern in accordance with the plant’s CLB. The reviewer need not verify all structural components that have been identified as subject to an AMR by the applicant because the applicant has the option to include more structural components than the rule requires.

Further, the reviewer should select functions described in the UFSAR to verify that structural components having intended functions were not omitted from the scope of the review. For example, if the UFSAR indicates that a dike within the fire pump house prevents a fuel oil fire from spreading to the electrically driven fire pump, the reviewer should verify that this dike has been identified as being within the scope of SLR. Similarly, if a nonsafety-related structure or component is included in the plant’s CLB as a part of the safe shutdown path resulting from the resolution of unresolved safety issue (USI) A-46 (Ref. 1), the reviewer should verify that the structure or component has been included within the scope of SLR.

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

The NRC staff has developed additional scoping/screening guidance (Ref. 2). For example, some structural components may be grouped together as a commodity, such as pipe hangers, and some structural components are considered consumable materials, such as sealants. Additional guidance on these and other components are contained in Section 2.1 for the following:

- Commodity groups
- Hypothetical failure
- Cascading
- Consumables
- Multiple functions

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

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

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

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

2.4.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants, then the NRC staff's evaluation would support conclusions of the following type, to be included in the safety evaluation report:

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

2.4.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specific portions of NRC regulations, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

2.4.6 References

2. NRC. NUREG–1211, "Regulatory Analysis for Resolution of Unresolved Safety Issue A-46, Seismic Qualification of Equipment in Operating Plants." Washington, DC: U.S. Nuclear Regulatory Commission. February 1987.

3. NRC. NUREG–0933, "Resolution of Generic Safety Issues." Supplement 32. Washington, DC: U.S. Nuclear Regulatory Commission. August 2008

Table 2.4-1. Examples of Structural Components Scoping/Screening and Basis for Disposition	
Example	**Disposition**
Roof of turbine building	An applicant indicates that degradation or loss of its turbine building roof will not result in the loss of any intended functions. The turbine building contains safety-related SSCs in the basement, which would remain sheltered and protected by several reinforced concrete floors if the turbine building roof were to degrade. Because this roof does not perform an intended function, it is not within the scope of subsequent license renewal.
Post-tensioned containment tendon gallery	The intended function of the post-tensioning system is to impose compressive forces on the concrete containment structure to resist the internal pressure resulting from a DBA with no loss of structural integrity. Although the tendon gallery is not relied on to maintain containment integrity during DBEs, operating experience indicates that water infiltration and high humidity in the tendon gallery can contribute to a significant aging effect on the vertical tendon anchorages that could potentially result in loss of the ability of the post-tensioning system to perform its intended function. However, containment inspections provide reasonable assurance that the tendon anchorages, including those in the gallery, will continue to perform their intended functions. Because the tendon gallery itself does not perform an intended function, it is not within the scope of subsequent license renewal.
Water-stops	Ground water leakage into the auxiliary building could occur as a result of degradation to the water-stops. This leakage may cause flooding of equipment within the scope of subsequent license renewal. (The plant's UFSAR discusses the effects of flooding.) The water-stops perform their functions without moving parts or a change in configuration, and they are not typically replaced. Thus, the water-stops are subject to an AMR. However, they need not be called out explicitly in the scoping/screening results if they are included as parts of structural components that are subject to an AMR.

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

Review Responsibilities

Primary—Assigned branch(s)

Secondary—None

2.5.1 Areas of Review

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

Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(a)(1) requires an applicant to identify and list structures and components (SCs) subject to an AMR. These are “passive,” “long-lived” SCs that are within the scope of SLR. In addition, 10 CFR 54.21(a)(2) requires an applicant to describe and justify the methods used to identify these SCs. The U.S. Nuclear Regulatory Commission (NRC) staff reviews the applicant’s methodology separately following the guidance in Section 2.1. To verify that the applicant has properly implemented its methodology, the NRC staff focuses its review on the implementation results. Such a focus allows the NRC staff to confirm that there is no omission of electrical and I&C components that are subject to an AMR by the applicant. If the review identifies no omission, the NRC staff has the basis to find that there is reasonable assurance that the applicant has identified the electrical and I&C components that are subject to an AMR.

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

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

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

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

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

2.5.2. Acceptance Criteria

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

2.5.2.1 Components Within the Scope of Subsequent License Renewal

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

- Safety-related systems, structures, and components (SSCs) that are relied upon to remain functional during and following DBEs [as defined in 10 CFR 50.49(b)(1)] to ensure the following functions:
    - — The integrity of the reactor coolant pressure boundary;
    - — The capability to shut down the reactor and maintain it in a safe shutdown condition; or
    - — The capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2) or 10 CFR 100.11, as applicable.
- All nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii) or (iii).

- All SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with NRC regulations for fire protection (10 CFR 50.48), environmental qualification (10 CFR 50.49), pressurized thermal shock (PTS) (10 CFR 50.61), anticipated transients without scram (ATWS) (10 CFR 50.62), and station blackout (SBO) (10 CFR 50.63).

2.5.2.1.1 Components Within the Scope of SBO (10 CFR 50.63)

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

- The onsite power system meeting the requirements under 10 CFR 54.4(a)(1) (safety-related systems)

- Equipment that is required to cope with an SBO (e.g., alternate ac power sources) meeting the requirements under 10 CFR 54.4(a)(3)

- The plant system portion of the offsite power system that is used to connect the plant to the offsite power source meeting the requirements under 10 CFR 54.4(a)(3). The electrical distribution equipment out to the first circuit breaker with the offsite distribution system (i.e., equipment in the switchyard). This path typically includes the circuit breakers that connect to the offsite system power transformers (startup transformers), the transformers themselves, the intervening overhead or underground circuits between circuit breaker and transformer and transformer and onsite electrical distribution system, and the associated control circuits and structures. However, the NRC staff's review is based on the plant-specific CLB, regulatory requirements, and offsite power design configurations.

2.5.2.2 Components Subject to an Aging Management Review

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

2.5.3 Review Procedures

The reviewer verifies the applicant's scoping and screening results. If the reviewer requests additional information from the applicant regarding why a certain component was not identified by the applicant as being within the scope of SLR or subject to an AMR for the applicant's plant, the reviewer should provide a focused question that clearly explains what information is needed, why the information is needed, and how the information will allow the NRC staff to make its safety finding. In addition, other NRC staff members review the applicant's scoping and screening methodology separately following the guidance in Section 2.1. The reviewer should keep these other NRC staff members informed of findings that may affect their review of the applicant's methodology. The reviewer should coordinate this sharing of information through the SLR project manager.

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

Some of the electrical equipment that is in the scope of 10 CFR 50.49 that have a qualified life of 40 years or greater are also within the scope of SLR under 10 CFR 54.4(a)(3). They have already been identified by licenses under 10 CFR 50.49(b). Licensees may rely upon their listing of environmental qualification (EQ) equipment, as required by 10 CFR 50.49(d), for the purposes of identifying electrical equipment satisfying 10 CFR 54.4(a)(3) that is also within the scope of 10 CFR 50.49 (60 FR 22466). However, the license renewal rule has a requirement [10 CFR 54.21(c)] on the evaluation of TLAAs, including EQ (10 CFR 50.49). EQ equipment is not limited to "passive" equipment. The applicant may identify EQ equipment separately for TLAA evaluation and not include such equipment as subject to an AMR under 10 CFR 54.21(a)(1). The EQ equipment identified for TLAA evaluation would include the "passive" EQ equipment subject to an AMR. The TLAA evaluation would ensure that the EQ equipment would be functional for the period of extended operation. The NRC staff reviews the applicant's EQ TLAA evaluation separately following the guidance in Section 4.4.

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

2.5.3.1 Components Within the Scope of Subsequent License Renewal

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

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

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

The applicant would use the "plant spaces" approach for the subsequent AMR of the electrical and I&C components. The applicant would evaluate the environment of the "plant spaces" to determine the appropriate aging management activities for equipment located there. The applicant has the option to further refine this encompassing scope on an as-needed basis. For example, if the applicant identified elevated temperatures in a particular area within a building ("plant space"), the applicant may elect to identify only those "passive," "long-lived" electrical and I&C components that perform an intended function in this particular area as subject to an AMR. This approach of limiting the "plant spaces" is consistent with the "plant spaces" approach. In this case, the reviewer verifies that the applicant has specifically identified the electrical and I&C components that may be within the scope of SLR in these limited "plant spaces." The reviewer should verify that the electrical and I&C components that the applicant has elected to further exclude do not indeed have any intended functions as defined in 10 CFR 54.4(b).

Section 2.1 contains additional guidance on scoping the following:

- Commodity groups
- Complex assemblies
- Scoping events
- Hypothetical failure
- Cascading

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

2.5.3.2 Components Subject to an Aging Management Review

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

Only components that are "passive" and "long-lived" are subject to an AMR. Table 2.1-5 lists many typical components and structures, and their associated intended functions, and identifies whether they are "passive." The reviewer should use Table 2.1-5 in identifying whether certain components are "passive." The reviewer should verify that electrical and I&C components identified as "passive" in Table 2.1-5 have been included by the applicant as being subject to an AMR. Although Table 2.1-5 is extensive, it may not be all-inclusive. Thus, the reviewer should use other available information sources, such as prior application reviews, to determine whether a component may be subject to an AMR.

Section 2.1 contains additional guidance on screening the following:

- Consumables
- Multiple intended functions

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

2.5.4 Evaluation Findings

If the reviewer determines that the applicant has provided information sufficient to satisfy the provisions of the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants, then the NRC staff's evaluation would support conclusions of the following type, to be included in the safety evaluation report.

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

2.5.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specific portions of NRC regulations, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

2.5.6 References

1. SNL. SAND96-0344, "Aging Management Guideline for Commercial Nuclear Power Plants-Electrical Cable and Terminations." Albuquerque, New Mexico: Sandia National Laboratories. September 1996.

Table 2.5-1. Examples of "Plant Spaces" Approach for Electrical and I&C Scoping and Corresponding Review Procedures

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

3 AGING MANAGEMENT REVIEW

3.0 Integrated Plant Assessments and Aging Management Reviews

The U.S. Nuclear Regulatory Commission (NRC) Project Manager (PM) responsible for the safety review of the subsequent license renewal application (SLRA) is responsible for assigning to appropriate NRC Office of Nuclear Reactor Regulation divisions the review or audit of aging management reviews (AMRs) of systems, structures and components (SSCs) or aging management programs (AMPs) identified in the applicant's SLRA. The PM documents to which organization each AMR or AMP is assigned. The assigned AMRs and AMPs are reviewed per the criteria described in Sections 3.1 through 3.6 of this Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR), for review of SLRAs, as directed by the scope of each of these sections. Chapter 4 of this standard review plan provides guidelines for using time-limited aging analyses (TLAAs) as the basis for evaluating and managing aging effects by analysis. Specifically, Section 4.1 of this standard review plan (SRP) provides the NRC staff's guidance for identifying TLAAs in accordance with the requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(c)(1) and the definitions of TLAAs in 10 CFR 54.3. TLAAs are reviewed in accordance with the acceptance criteria and guidance described in Sections 4.2 through 4.7 of this SRP.

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

Table 3.01 is a supplement to the FSAR and contains a list of programs that are applicable to each SRP-SLR and subsection. It also contains the programs that are applicable to managing the aging effects associated with various systems.

3.0.1 Background on the Types of Reviews

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

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

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

- New, Modified, Deleted Item: The description of this column identifies whether the AMR line item is new, was modified, or deleted. The NRC will publish the technical bases for these new, modified, and deleted AMR items in a NUREG containing the disposition of public comments and the technical bases for changes in the guidance documents when the final subsequent license renewal (SLR) guidance documents are published.

- "ID" column: The description for this column provides an identification number for the AMR item of a given commodity grouping of components that have common materials of fabrication, environmental conditions, and aging effects.

- "Type" column: The description for this column identifies whether the specific AMR item in the table is applicable to BWR or PWR plant designs.

- "Component" column: The description for this column identifies the specific components that are within the scope of the commodity grouping in the AMR item and the materials of fabrication and environmental conditions that are applicable to the components in the AMR item.

- "Aging Effect/Mechanism" column: The description for this column identifies the aging effects and mechanisms that are applicable to the material-environmental combinations for the components in the commodity grouping of the AMR item.

- "Aging Management Program/TLAA" column: The description for this column provides AMPs or TLAAs that may be used to manage the aging effects that apply to the components in the commodity grouping of the AMR item and to demonstrate compliance with the aging management requirement in 10 CFR54.21(a)(3).

- "Further Evaluation" column: The description for this column identifies whether the AMP or TLAA recommended in the "Aging Management Program/TLAA" column of the AMR item requires additional evaluation (further evaluation) by an applicant adopting the AMR item. This column also references specific subsection(s) in SRP-SLR Section 3.1.2.2 that applies to the evaluation of the components in the commodity grouping of the AMR item.

- "GALL-SLR Item" column: The description for this column identifies the component-specific AMR items in the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report that derives from the commodity-group-based item in the SRP-SLR AMR table.

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

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

The GALL-SLR Report does not address scoping of SSCs for subsequent license renewal (SLR). The determination of SSCs that need to be within the scope of SLR is plant-specific aspect of the application and is required to be performed in accordance with the requirements in 10 CFR 54.4. Consistent with the scoping guidelines in Chapter 2 of this SRP-SLR Report, the scoping results for an SLRA are dependent on the plant design and CLB. Therefore, the inclusion of a certain structure or component in a given AMR line item of the GALL-SLR Report does not mean that this particular structure or component is within the scope of SLR for all plants.

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

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

3.X.2.2 subsections of this report. The related review procedures for these "further evaluation" topics are provided in the 3.X.3.2 subsections of this report.

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

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

If a GALL-SLR Report AMP is selected to manage aging, the applicant may take one or more exceptions to specific GALL-SLR Report AMP program elements. However, any deviation or exception to the GALL-SLR Report AMP should be described and justified. Exceptions are portions of the GALL-SLR Report AMP that the applicant does not intend to implement.

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

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

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

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

Reviews are also performed to address those AMRs or AMPs related to emergent issues, stated to be not consistent with the GALL-SLR Report, or based on an NRC-approved precedent (e.g., AMRs and AMPs addressed in an NRC SER of a previous SLRA) or technical or topical report. SRP-SLR Section 3.0.3 provides additional guidance on reviewing those GALL-based or plant-specific AMPs that are based on NRC-endorsed technical or topical reports. As a result of the criteria established in 10 CFR Part 54, the guidance provided in SRP-SLR, GALL-SLR Report, and the applicant's exceptions and/or enhancements to a GALL-SLR Report AMP, the following types of AMRs and AMPs are audited or reviewed by the NRC staff.

<u>AMRs</u>

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

<u>AMPs</u>

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

<u>FSAR Supplement</u>

- Each SLRA AMP will provide an FSAR Supplement which defines changes to the FSAR that will be made as a condition of a renewed license. This FSAR Supplement defines the AMPs the applicant is crediting to satisfy 10 CFR 54.21(a)(3).

- The FSAR Supplement should also contain a commitment to implement the SLRA AMP enhancement prior to the subsequent period of extended operation.

3.0.2 Applications With Approved Extended Power Uprates

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

3.0.3 Aging Management Programs that Rely on Implementation of Nuclear Regulatory Commission-Approved Technical or Topical Reports

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

Generic Aging Lessons Learned for Subsequent License Renewal Report(GALL-SLR) aging management programs (AMPs) that rely on the recommended activities in NRC-endorsed TRs identify those TRs that are within the scope of the AMPs. Examples of GALL-SLR AMPs that rely on NRC-approved industry reports include, but are not limited to, (1) GALL-SLR Report AMP XI.M4, "BWR ID Attachment Welds," (2) GALL-SLR Report AMP XI.M5, "BWR Feedwater Nozzles," (3) GALL-SLR Report AMP XI.M8, "BWR Penetrations," and (4) GALL-SLR Report AMP XI.M9, "BWR Vessel Internals." Plant-specific AMPs may also be based on NRC-approved TRs.

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

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

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
XI.E1	Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	The program provides reasonable assurance that the intended functions of electrical cable insulating material (e.g., power, control, and instrumentation) and connection insulating material that are not subject to the environmental qualification requirements of 10 CFR 50.49 are maintained consistent with the current licensing basis through the subsequent period of extended operation. The program is a cable and connection insulation material condition monitoring program that utilizes sampling. The component sampling methodology utilizes a population that includes a representative sample of in-scope electrical cable and connection types regardless of whether or not the component was included in a previous aging management or maintenance program. The technical basis for the sample selection is documented. The program applies to accessible electrical cable and connection electrical insulation material within the scope of license renewal including in-scope cables and connections subjected to an adverse localized environment. Accessible in-scope electrical cable and connection electrical insulation material is visually inspected and tested for cable and connection insulation surface anomalies indicating signs of reduced electrical insulation resistance. Visual Inspection and testing may include thermography and one or more proven condition monitoring test methods applicable to the cable and connection insulation material. Electrical cable and connection insulation material test results are to be within the acceptance criteria, as identified in the applicant's procedures. Visual inspection results show that accessible cable and connection insulation material are free from visual indications of surface abnormalities that indicate cable or connection electrical insulation aging effects exist.	First inspection for license renewal completed prior to the subsequent period of extended operation	GALL VI / SRP 3.6

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		When acceptance criteria are not met, a determination is made as to whether the surveillance, inspection, or tests, including frequency intervals, need to be modified. The program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry operating experience including research and development (e.g., test methods, aging models, acceptance criterion) such that the effectiveness of the AMP is evaluated consistent with the discussion in Appendix B of the GALL-SLR Report.[The FSAR Summary description also includes a plant specific discussion of applicable commitments, license conditions, enhancements, or exceptions applied to the applicants aging management program]		
XI.E2	Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	The program applies to electrical cables and connections (cable system) electrical insulation material used in circuits with sensitive, high voltage, low-level current signals. Examples of these circuits include radiation monitoring and nuclear instrumentation that are subject to aging management review and subjected to adverse localized environments caused by temperature, radiation, or moisture. The program evaluates electrical insulation material for cable and connection subjected to an adverse localized environment. In addition to the evaluation and identification of adverse localized environments, either of two methods can be used to identify the existence of cable and connection insulation material aging degradation. In the first method, calibration results or findings of surveillance testing programs are evaluated to identify the existence of electrical cable and connection insulation material aging degradation.	First review of calibration results or findings of surveillance test results or cable tests for license renewal completed prior to the subsequent period of extended operation	GALL VI / SRP 3.6

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		In the second method, direct testing of the cable system is performed. By reviewing the results obtained during normal calibration or surveillance, an applicant may detect severe aging degradation prior to the loss of the cable and connection intended function. The review of calibration results or findings of surveillance tests is performed at least once every 10 years. The test frequency of the cable system is determined by the applicant based on engineering evaluation, but the test frequency is at least once every 10 years. In cases where cables are not included as part of calibration or surveillance program testing circuit, a proven cable test shown to be effective in determining cable system electrical insulation condition as justified in the applicant's aging management program is performed. The first reviews and tests are completed prior to the subsequent period of extended operation. The program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry operating experience including research and development (e.g., test methods, aging models, acceptance criterion) such that the effectiveness of the AMP is evaluated consistent with the discussion in Appendix B of the GALL-SLR Report. [The FSAR Summary description also includes a plant specific discussion of applicable commitments, license conditions, enhancements, or exceptions applied to the applicants aging management program]		
XI.E3A	Electrical Insulation for Inaccessible Medium Voltage Power Cables Not Subject To	The program applies to inaccessible or underground (e.g., installed in buried conduits, cable trenches, cable troughs, duct banks, underground vaults, or direct buried installations) medium voltage power cable (operating voltage; 2.3kV to 35kv) within the scope of license renewal exposed to adverse localized	First tests or first inspections for subsequent license renewal completed prior to the subsequent period	GALL VI / SRP 3.6

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
	10 CFR 50.49 Environmental Qualification Requirements	environments due primarily to significant moisture. An adverse localized environment is based on the most limiting environment (e.g., temperature, radiation, or moisture) for the cable electrical insulation. Significant moisture is considered an adverse localized environment for these in scope inaccessible cables. The cables included in this program are not subject to the environmental qualification requirements of 10 CFR 50.49. Electrical insulation subjected to an adverse localized environment could increase the rate of aging of a component and therefore have an adverse effect on operability, or potentially lead to failure of the cable's insulation system. Although a condition monitoring program, periodic inspections are performed to prevent inaccessible cable from being exposed to significant moisture. These inspections are performed periodically based on water accumulation over time. The periodic inspection occurs at least annually with the first inspection for subsequent license renewal completed prior to the subsequent period of extended operation. Inspections are performed after event driven occurrences, such as heavy rain, thawing of ice and snow, or flooding. Both the periodic and event driven inspections include direct indication that cables are not wetted or submerged, and that cable/splices and cable support structures are intact, Dewatering systems (e.g., sump pumps and drains) and associated alarms are inspected and their operation verified. Inspections include documentation that either automatic or passive drainage	of extended operation	

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		systems, or manually pumping manholes and vaults is effective in preventing inaccessible cable submergence. Test frequencies are adjusted based on test results (including trending of degradation where applicable) and plant specific operating experience. The first tests for subsequent license renewal are to be completed prior to the subsequent period of extended operation with tests performed at least every 6 years thereafter. The specific type of test performed is determined prior to the initial test, and is to be a proven test for detecting deterioration of the cable insulation system (e.g., one or more tests may be required depending to the specific cable construction: shielded and non-shielded, and the insulation material under test). Tests may include combinations of situ or laboratory; electrical, physical, or chemical testing. Testing may include inspection and testing of cable subjected to the same environment (e.g., the use of coupons – abandoned or removed cable). A plant specific inaccessible medium voltage test matrix is developed to document inspections, test methods, and acceptance criteria applicable to the applicant's in-scope inaccessible medium voltage power cable types. [The FSAR Summary description also includes a plant specific discussion of applicable commitments, license conditions, enhancements, or exceptions applied to the applicants aging management program]		
XI.E3B	Electrical Insulation for Inaccessible Instrument and Control Cables	The program applies to inaccessible or underground (e.g., installed in buried conduits, cable trenches, cable troughs, duct banks, underground vaults, or direct buried installations) instrument and control cable, within the scope of license renewal exposed to adverse	First tests or first inspections for subsequent cense renewal completed prior to the	GALL VI / SRP 3.6

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
	Not Subject To 10 CFR 50.49 Environmental Qualification Requirements	localized environments due primarily to significant moisture. An adverse localized environment is based on the most limiting environment (e.g., temperature, radiation, or moisture) for the cable electrical insulation. Significant moisture is considered an adverse localized environment for these in scope inaccessible cables. The cables included in this program are not subject to the environmental qualification requirements of 10 CFR 50.49. Electrical insulation subjected to an adverse localized environment could increase the rate of aging of a component and therefore have an adverse effect on operability, or potentially lead to failure of the cable's insulation system. In scope inaccessible instrument and control cables submarine or other cables designed for continuous wetting or submergence are also included in this program as a onetime inspection with additional test and inspection frequencies determined by the onetime test, inspection results, and plant specific operating history. Although a condition monitoring program, periodic inspections are performed to prevent inaccessible cable from being exposed to significant moisture. These inspections are performed periodically based on water accumulation over time. The periodic inspection occurs at least annually with the first inspection for subsequent license renewal completed prior to the subsequent period of extended operation. Inspections are performed after event driven occurrences, such as heavy rain, thawing of ice and snow, or flooding. Both	subsequent period of extended operation	

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		the periodic and event driven inspections include direct indication that cables are not wetted or submerged, and that cable/splices and cable support structures are intact, Dewatering systems (e.g., sump pumps and drains) and associated alarms are inspected and their operation verified. Inspections include documentation that either automatic or passive drainage systems, or manually pumping manholes and vaults is effective in preventing inaccessible cable submergence. Test frequencies are adjusted based on test results (including trending of degradation where applicable) and plant specific operating experience. The first tests for subsequent license renewal are to be completed prior to the subsequent period of extended operation with tests performed at least every 6 years thereafter. The specific type of test performed is determined prior to the initial test, and is to be a proven test for detecting deterioration of the cable insulation system (e.g., one or more tests may be required depending to the specific cable construction: shielded and non-shielded, and the insulation material under test). Tests may include combinations of situ or laboratory; electrical, physical, or chemical testing. Testing may include inspection and testing of cable subjected to the same environment (e.g., the use of coupons – abandoned or removed cable). For a large installed number of inaccessible instrumentation and control cables, a sample test methodology may be employed. A plant specific inaccessible instrument and control cables voltage test matrix is developed to document inspections, test methods, and acceptance criteria applicable to the applicant’s in-scope inaccessible instrument and control cable types.		

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
XI.E3C	Electrical Insulation for Inaccessible Low Voltage Power Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements	The program applies to inaccessible or underground (e.g., installed in buried conduits, cable trenches, cable troughs, duct banks, underground vaults, or direct buried installations) low voltage power cable (operating voltage; 1000v – but less than 2kV) within the scope of license renewal exposed to adverse localized environments due primarily to significant moisture. An adverse localized environment is based on the most limiting environment (e.g., temperature, radiation, or moisture) for the cable electrical insulation. Significant moisture is considered an adverse localized environment for these in scope inaccessible cables. The cables included in this program are not subject to the environmental qualification requirements of 10 CFR 50.49. Electrical insulation subjected to an adverse localized environment could increase the rate of aging of a component and therefore have an adverse effect on operability, or potentially lead to failure of the cable's insulation system. In-scope inaccessible low voltage power cable splices subjected to wetting or submergence are also included within the scope of this program. In scope inaccessible low voltage submarine or other cables designed for continuous wetting or submergence are also included in this program as a onetime inspection with additional test and inspection frequencies determined by the onetime test, inspection results, and plant specific operating history. Although a condition monitoring program, periodic inspections are performed to prevent inaccessible cable from being exposed to significant moisture. These inspections are performed periodically based on water accumulation over time. The periodic inspection occurs at least annually with the first inspection for subsequent license renewal completed prior to the subsequent period of extended operation. Inspections are performed after event driven occurrences, such as heavy rain,	First tests or first inspections for license renewal completed prior to the subsequent period of extended operation	GALL VI / SRP 3.6

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		thawing of ice and snow, or flooding. Both the periodic and event driven inspections include direct indication that cables are not wetted or submerged, and that cable/splices and cable support structures are intact, Dewatering systems (e.g., sump pumps and drains) and associated alarms are inspected and their operation verified. Inspections include documentation that either automatic or passive drainage systems, or manually pumping manholes and vaults is effective in preventing inaccessible cable submergence. Test frequencies are adjusted based on test results (including trending of degradation where applicable) and plant specific operating experience. The first tests for subsequent license renewal are to be completed prior to the subsequent period of extended operation with tests performed at least every 6 years thereafter. The specific type of test performed is determined prior to the initial test, and is to be a proven test for detecting deterioration of the cable insulation system (e.g., one or more tests may be required depending to the specific cable construction: shielded and non-shielded, and the insulation material under test). Tests may include combinations of situ or laboratory; electrical, physical, or chemical testing. Testing may include inspection and testing of cable subjected to the same environment (e.g., the use of coupons – abandoned or removed cable). For a large installed number of inaccessible low voltage power cables, a sample test methodology may be employed. A plant specific inaccessible low voltage test matrix is developed to document inspections, test methods, and acceptance criteria applicable to the applicant's in-scope inaccessible low voltage power cable types.		
XI.E4	Metal Enclosed Bus	The program requires the visual inspection of metal enclosed bus (MEB) internal surfaces to detect age- related degradation, including cracks, corrosion, foreign debris, excessive dust	First inspection for subsequent license renewal completed	GALL VI / SRP 3.6

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		buildup, and evidence of moisture intrusion. MEB insulating material is visually inspected for signs of embrittlement, cracking, chipping, melting, swelling, discoloration, or surface contamination, which may indicate overheating or aging degradation. The internal bus insulating supports are visually inspected for structural integrity and signs of cracks. MEB external surfaces are visually inspected for loss of material due to general, pitting, and crevice corrosion. Accessible elastomers (e.g., gaskets, boots, and sealants) are inspected for degradation, including surface cracking, crazing, scuffing, and changes in dimensions (e.g., “ballooning” and “necking”), shrinkage, discoloration, hardening and loss of strength. Bolted connections are inspected for increased resistance of connection by using thermography or by measuring connection resistance using a micro-ohmmeter. When thermography is employed by the applicant, the applicant demonstrates with a documented evaluation that thermography is effective in identifying MEB increased resistance of connection (e.g., infrared viewing windows installed, or demonstrated test equipment capability). The first inspection using thermography or measuring connection resistance is completed prior to the subsequent period of extended operation and at least every 10 years thereafter. As an alternative to thermography or measuring connection resistance of accessible bolted connections covered with heat shrink tape, sleeving, insulating boots, etc., the applicant may use visual inspection of the electrical insulation to detect surface anomalies, such as embrittlement, cracking, chipping, melting, discoloration, swelling, or surface contamination. When alternative visual inspection is used to check MEB bolted connections, the first inspection is completed prior to the	prior to the subsequent period of extended operation	

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		subsequent period of extended operation and every 5 years thereafter. Cable bus is a variation on MEB with similar in construction to an MEB, but instead of segregated or non-segregated electrical buses, cable bus is comprised of a fully enclosed metal enclosure that utilizes three-phase insulated power cables installed on insulated support blocks. Cable bus may omit the top cover or use a louvered top cover and enclosure. Both cable bus enclosures are not sealed against the intrusion of dust, industrial pollution, moisture, rain, or ice and therefore may be allow debris into the internal cable bus assembly. Cable bus construction and arrangement are such that it does not readily fall under a specific GALL Report AMP (e.g., GALL-SLR Report AMP XI.E4 or GALL-SLR Report AMP XI.E1). Therefore, cable bus is evaluated as a plant specific aging management program with a plant specific further evaluation. The program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry operating experience including research and development (e.g., test methods, aging models, acceptance criterion) such that the effectiveness of the AMP is evaluated consistent with the discussion in Appendix B of the GALL-SLR Report. [The FSAR Summary description also includes a plant specific discussion of applicable commitments, license conditions, enhancements, or exceptions applied to the applicants aging management program]		
XI.E5	Fuse Holders	The program was developed to specifically address aging management of fuse holder insulation material and fuse holder metallic clamp aging mechanisms and effects. In scope fuse holders located inside an active device (e.g., switchgear, power supplies, power inverters, control boards, battery chargers) and	First tests for subsequent license renewal completed prior to the subsequent period	GALL VI / SRP 3.6

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		subject to fatigue caused by frequent fuse removal and replacement (e.g., surveillance, functional testing, and calibration) are also within the scope of this AMP. The scope of GALL-SLR Report AMP XI.E1, “Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements,” includes cable and connection electrical insulation material but not the metallic portion of cables and connections. This AMP inspects both the fuse holder electrical insulation material and the metallic portion of the fuse holder (metallic clamps). The program utilizes visual inspection and testing to identify age-related degradation for both fuse holder electrical insulation material and fuse holder metallic clamps. The specific type of test performed is determined prior to the initial test and is to be a proven test for detecting increased resistance of connection of fuse holder metallic clamps, or other appropriate testing justified in the applicant’s aging management program. Fuse holders within the scope of license renewal are visually inspected and tested at least once every 10 years to provide an indication of the condition of the fuse holder. The first visual inspections and tests for license renewal are to be completed prior to the subsequent period of extended operation. When acceptance criteria are not met, a determination is made as to whether the inspections, or tests, including frequency intervals, need to be modified. This program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry operating experience including research and development (e.g., test methods, aging models, acceptance criterion) such that the effectiveness of the AMP is evaluated	of extended operation	

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		consistent with the discussion in Appendix B of the GALL-SLR Report. [The FSAR Summary description also includes a plant specific discussion of applicable commitments, license conditions, enhancements, or exceptions applied to the applicants aging management program]		
XI.E6	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	The program provides reasonable assurance that the metallic parts of electrical cable connections that are not subject to the environmental qualification requirements of 10 CFR 50.49 and susceptible to age-related degradation resulting in increased resistance of the connection are adequately managed. External cable connections associated with in-scope cables that terminate at active or passive devices are in the scope of this AMP. Wiring connections internal to an active assembly are considered part of the active assembly and, therefore, are not within the scope of this AMP. The cable connections covered under the Environmental Qualification (EQ) program are not included in the scope of this program. This AMP does not include high-voltage (>35 kilovolts) switchyard connections. This program is a sampling program. The following factors are considered for sampling: voltage level (medium and low voltage), circuit loading (high loading), connection type, and location (high temperature, high humidity, vibration, etc.). Twenty percent of a connector type population with a maximum sample of 25 constitutes a representative connector sample size. Otherwise a technical justification of the methodology and sample size used for selecting components under test should be included as part of the applicant's AMP documentation. The specific type of test to be performed is a proven test for detecting increased resistance of connection.	First tests for subsequent license renewal completed prior to the subsequent period of extended operation	GALL VI / SRP 3.6

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		As an alternative to thermography or resistance measurement of cable connections for the accessible cable connections that are covered with electrical insulation materials such as tape, the applicant may perform visual inspection of the electrical insulation material to detect aging effects for covered cable connections. The basis for performing only a periodic visual inspection is documented. A representative sample of electrical connections within the scope of license renewal will be tested at least once every 10 years or at least once every 5 years if only visual inspection is used to provide an indication of the connection integrity. The first visual inspections and tests for license renewal are to be completed prior to the subsequent period of extended operation. This program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry operating experience including research and development (e.g., test methods, aging models, acceptance criterion) such that the effectiveness of the AMP is evaluated consistent with the discussion in Appendix B of the GALL-SLR Report. [The FSAR Summary description also includes a plant specific discussion of applicable commitments, license conditions, enhancements, or exceptions applied to the applicants aging management program]		
XI.E7	High Voltage Insulators New AMP	The program was developed specifically to address aging management of high voltage insulator aging mechanisms and effects. This AMP manages the age related degradation effects of within scope high voltage insulators susceptible to airborne contaminates including dust, salt, fog, cooling tower plume, industrial effluent or loss of material. The high voltage insulators within the scope of the subsequent period of extended operation are those credited for recovery of offsite power.	New AMP	GALL VI / SRP 3.6

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		This program includes visual inspections to identify insulation and metallic component degradation. High voltage insulator surfaces are visually inspected to detect reduced insulation resistance aging effects including cracks, foreign debris, and excessive salt, dust, cooling tower plume and industrial effluent contamination. Metallic parts of the insulator are visually inspected to detect loss of material due to mechanical wear or corrosion. The high-voltage insulators within the scope of this program are to be visually inspected at least twice per year. For high voltage insulators that are coated, the visual inspection is performed at least once every 5 years. The first inspections for the subsequent period of extended operation are to be completed prior to the subsequent period of extended operation. This program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry operating experience including research and development (e.g., test methods, aging models, acceptance criterion) such that the effectiveness of the AMP is evaluated consistent with the discussion in Appendix B of the GALL-SLR Report. [The FSAR Summary description also includes a plant specific discussion of applicable commitments, license conditions, enhancements, or exceptions applied to the applicants aging management program]		
XI.M1	ASME Section XI Inservice Inspection, Subsections	The program consists of periodic volumetric, surface, and/or visual examination of American Society of Mechanical Engineers (ASME) Class 1, 2, and 3 pressure-retaining components, including welds, pump casings, valve bodies, integral	SLR program is implemented prior to the subsequent period of extended	GALL IV / SRP 3.1 GALL VII / SRP 3.3

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
	IWB, IWC, and IWD	attachments, and pressure-retaining bolting for assessment, signs of degradation, and corrective actions. This program is in accordance with the ASME Code Section XI edition and addenda approved in accordance with provisions of 10 CFR 50.55a during the period of extended operation.	operation	
XI.M2	Water Chemistry	This program mitigates aging effects of loss of material due to corrosion, cracking due to stress corrosion cracking (SCC), and related mechanisms, and reduction of heat transfer due to fouling in components exposed to a treated water environment. Chemistry programs are used to control water chemistry for impurities (e.g., chloride, fluoride, and sulfate) that accelerate corrosion. This program relies on monitoring and control of water chemistry to keep peak levels of various contaminants below the system-specific limits, based on Electric Power Research Institute (EPRI) guidelines (a) BWRVIP-190 (EPRI 1016579, BWR Water Chemistry Guidelines – 2008 Revision) for BWRs or (b) EPRI 1014986 (PWR Primary Water Chemistry – Revision 6) and EPRI 1016555 (PWR Secondary Water Chemistry – Revision 7) for pressurized water reactors (PWRs).	SLR program is implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1
XI.M3	Reactor Head Closure Stud Bolting	The program includes (a) in-service inspection (ISI) in conformance with the requirements of the ASME Code, Section XI, Subsection IWB, Table IWB-2500-1, and (b) preventive measures to mitigate cracking. The program also relies on recommendations to address reactor head stud bolting degradation as delineated in NRC Regulatory Guide (RG) 1.65, Revision 1.	SLR program is implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1
XI.M4	BWR Vessel ID Attachment Welds	The program is a condition monitoring program that manages cracking in the reactor vessel inside diameter attachment welds. This program relies on visual examinations to detect cracking. The examination scope, frequencies, and methods are in accordance with ASME Code, Section XI, Table-IWB-2500-1, Examination Category B-N-2, and BWRVIP-48-A, “Vessel ID Attachment Weld Inspection and Flaw Evaluation Guidelines,” dated November 2004. The scope of the examinations is expanded when flaws are detected.	SLR program is implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		Any indications are evaluated in accordance with ASME Code, Section XI, or the guidance in BWRVIP 48-A. Crack growth evaluations follow the guidance in BWRVIP-14-A, “Evaluation of Crack Growth in BWR Stainless Steel RPV Internals, dated September 2008; BWRVIP-59-A, “Evaluation of Crack Growth in BWR Nickel-Base Austenitic Alloys in RPV Internals,” dated May 2007; or BWRVIP-60-A, “BWR Vessel and Internals Project, Evaluation of Crack Growth in BWR Low Alloy Steel RPV Internals,” dated June 2003; as appropriate. The acceptance criteria are in BWRVIP-48-A and ASME Code, Section XI, Subsubarticle IWB-3520. Repair and replacement activities are conducted in accordance with BWRVIP-52-A, “Shroud Support and Vessel Bracket Repair Design Criteria,” dated September 2005.		
XI.M5	BWR Feedwater Nozzle	*Description for plants that do not have single sleeve interference fit feedwater spargers:* This program is a condition monitoring program that manages the effects of cracking in the reactor vessel feedwater nozzles. This program implements the guidance in GE-NE-523-A71-0594-A, Revision 1, “Alternate BWR Feedwater Nozzle Inspection Requirements,” dated May 2000. Cracking is detected through ultrasonic examinations of critical regions of the BWR feedwater nozzle, as depicted in Zones 1, 2, and 3 on [“Figure 4-1,” if the nozzle is clad, or “Figure 4-2,” if the nozzle is un-clad] of GE NE 523 A71-0594-A, Revision 1. The ultrasonic examination procedures, equipment, and personnel are qualified by performance demonstration in accordance with ASME Code, Section XI, Appendix VIII. The examination frequency for all three zones is once every 10-year ASME Code, Section XI, in-service inspection interval. Examination results are evaluated in accordance with ASME Code, Section XI, Subsection IWB-3130. *Description for plants that have single sleeve interference fit*	SLR program is implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		feedwater spargers: This program is a condition monitoring program that manages the effects of cracking in the reactor vessel feedwater nozzles. This program implements the guidance in GE-NE-523-A71-0594-A, Revision 1, "Alternate BWR Feedwater Nozzle Inspection Requirements," dated May 2000. Cracking is detected through ultrasonic examinations of critical regions of the BWR feedwater nozzle, as depicted in Zones 1, 2, and 3 on ["Figure 4-1," if the nozzle is clad, or "Figure 4-2," if the nozzle is un-clad] of GE NE 523 A71-0594-A, Revision 1. The ultrasonic examination procedures, equipment, and personnel are qualified by performance demonstration in accordance with ASME Code, Section XI, Appendix VIII. The examination frequency for Zones 1 and 2 is once every [X] years, and the examination frequency for Zone 3 is once every [Y] years. Examination results are evaluated in accordance with ASME Code, Section XI, Subsection IWB-3130.		
XI.M7	BWR Stress Corrosion Cracking	The program manages cracking due to intergranular stress corrosion cracking (IGSCC) for all BWR piping and piping welds made of austenitic stainless steel and nickel alloy that are 4 inches or larger in nominal diameter containing reactor coolant at a temperature above 93 °C (200 °F) during power operation, regardless of code classification. The program performs volumetric examinations to detect and manage IGSCC in accordance with NRC Generic Letter (GL) 88-01. Modifications to the extent and schedule of inspection in GL 88-01 are allowed in accordance with the inspection guidance in staff-approved BWRVIP-75-A. This program relies on the staff-approved positions that are described in NUREG-0313, Revision 2, and GL 88-01 and its Supplement 1 regarding selection of IGSCC-resistant materials, solution heat treatment and stress improvement processes, water chemistry, weld	SLR program is implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1 GALL V / SRP 3.2 GALL VII / SRP 3.3

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		overlay reinforcement, partial replacement, clamping devices, crack characterization and repair criteria, inspection methods and personnel, inspection schedules, sample expansion, leakage detection, and reporting requirements.		
XI.M8	BWR Penetrations	The program includes BWR instrumentation penetrations, control rod drive (CRD) housing and incore-monitoring housing (ICMH) penetrations, and standby liquid control nozzles/Core ΔP nozzles. The program manages cracking due to cyclic loading or stress corrosion cracking by performing inspection and flaw evaluation in accordance with the guidelines of staff-approved BWRVIP-49-A, BWRVIP-47-A and BWRVIP-27-A and the requirements in the ASME Code, Section XI. The examination categories include volumetric examination methods (ultrasonic testing or radiography testing), surface examination methods (liquid penetrant testing or magnetic particle testing), and visual examination methods.	SLR program is implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1
XI.M9	BWR Vessel Internals	The program includes inspections and flaw evaluations in conformance with the guidelines of applicable staff-approved BWRVIP documents, and to ensure the long-term integrity and safe operation of BWR vessel internal components that are fabricated of nickel alloy and stainless steel (including martensitic stainless steel, cast stainless steel, and associated welds). The program manages the effects of cracking due to stress corrosion cracking (SCC), intergranular stress corrosion cracking (IGSCC), or irradiation-assisted stress corrosion cracking (IASCC), cracking due to cyclic loading (including flow-induced vibration), loss of material due to wear, loss of fracture toughness due to neutron or thermal embrittlement, and loss of preload due to thermal or irradiation-enhanced stress relaxation. The program performs inspections for cracking and loss of material in accordance with the guidelines of applicable staff-approved BWRVIP documents and the requirements of ASME Code, Section XI, Table IWB 2500-1. The impact of loss of	SLR program is implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		fracture toughness on component integrity is indirectly managed by using visual or volumetric examination techniques to monitor for cracking in the components. This program also manages loss of preload for core plate rim holddown bolts and jet pump assembly holddown beam bolts by performing visual inspections or stress analyses to ensure adequate structural integrity. This program performs evaluations to determine whether supplemental inspections in addition to the existing BWRVIP examination guidelines are necessary to adequately manage loss of fracture toughness due to thermal or neutron embrittlement and cracking due to IASCC for the subsequent period of extended operation. If the evaluations determine that supplemental inspections are necessary for certain components based on neutron fluence, cracking susceptibility and fracture toughness, the program conducts the supplemental inspections for adequate aging management.		
XI.M10	Boric Acid Corrosion	This program relies, in part, on the response to NRC Generic Letter 88-05, “Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants,” to identify, evaluate, and correct borated water leaks that could cause corrosion damage to reactor coolant pressure boundary components. The program also includes inspections, evaluations, and corrective actions for all components subject to aging management review that may be adversely affected by some form of borated water leakage. This program includes provisions to initiate evaluations and assessments when leakage is discovered by activities not associated with the program. This program follows the guidance described in Section 7 of WCAP-15988-NP, Revision 2, “Generic Guidance for an Effective Boric Inspection Program for Pressurized Water Reactors.”	SLR program is implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1 GALL V / SRP 3.2 GALL VI / SRP 3.6 GALL VII / SRP 3.3 GALL VIII / SRP 3.4 GALL III / SRP 3.5
XI.M11B	Cracking of Nickel-Alloy	This program addresses operating experience of degradation due to primary water stress corrosion cracking (PWSCC) of	SLR program is implemented prior to	GALL IV / SRP 3.1

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
	Components and Loss of Material due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (PWRS only)	components or welds constructed from certain nickel alloys (e.g., Alloy 600/82/182) and exposed to pressurized water reactor primary coolant at elevated temperature. The scope of this program includes the following groups of components and materials: (a) all nickel alloy components and welds which are identified in EPRI MRP-126; (b) nickel alloy components and welds identified in ASME Code Cases N-770, N-729 and N-722, as incorporated by reference in 10 CFR 50.55a; and (c) components that are susceptible to corrosion by boric acid and may be impacted by leakage of boric acid from nearby or adjacent nickel alloy components previously described. This program is used in conjunction with GALL-SLR Report AMP XI.M2, “Water Chemistry” because water chemistry can affect the cracking of nickel alloys. The completeness of the plant’s EPRI MRP-126 program is also verified prior to entering the subsequent period of extended operation. For nickel alloy components and welds addressed by the regulatory requirements of 10 CFR 50.55a, inspections are conducted in accordance with 10 CFR 50.55a. Unless required at a greater frequency by 10 CFR 50.55a, all susceptible nickel alloy components and welds (e.g., Alloy 600/82/182 branch connection nozzles and welds) are volumetrically inspected at an interval not to exceed 10 years if such components or welds are: (a) in contact with reactor coolant; and (b) relied upon for substantial strength of the components or welds, and are of sufficient size to create a loss of coolant accident (LOCA) through a completed failure (guillotine break) or ejection of the component. Other nickel alloy components and welds within the scope of this program are inspected in accordance with EPRI MRP-126. This program also performs an inspection of bottom-mounted instrumentation (BMI) nozzles of reactor pressure vessels using a qualified volumetric examination method. The inspection is	the subsequent period of extended operation	

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		conducted on all BMI nozzles prior to the subsequent period of extended operation to ensure adequate management of cracking due to PWSCC. If this inspection indicates the occurrence of PWSCC, periodic volumetric inspections are performed on these nozzles and adequate inspection periodicity is established. Alternatively, plant-proposed and staff-approved mitigation methods may be used to manage the aging effect for these components.		
XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	The program consists of the determination of the susceptibility potential significance of loss of fracture toughness due to thermal aging embrittlement of CASS piping and piping components in both the BWR and PWR reactor coolant pressure boundaries emergency core cooling system (ECCS) systems, including interfacing pipe lines to the chemical and volume control system and to the spent fuel pool; and in BWR ECCS systems, including interfacing pipe lines to the suppression chamber and to the drywell and suppression chamber spray system in regard to thermal aging embrittlement based on the casting method, molybdenum content, and ferrite percentage. For potentially susceptible piping and piping components aging management is accomplished either through enhanced volumetric examination, enhanced visual examination, or a component-specific flaw tolerance evaluation.	SLR program is implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1 GALL V / SRP 3.2
XI.M17	Flow-Accelerated Corrosion (FAC)	The program is based on the response to NRC Generic Letter 89-08, “Erosion/Corrosion-Induced Pipe Wall Thinning,” and relies on implementation of the Electric Power Research Institute guidelines in the Nuclear Safety Analysis Center 202L [(as applicable) Revision 2, 3, or 4], “Recommendations for an Effective Flow Accelerated Corrosion Program.” The program includes the use of predictive analytical software [(as applicable) CHECWORKS™, BRT CICERO™, COMSY]. This program also manages wall thinning caused by mechanisms other than FAC, in situations where periodic monitoring is used in lieu of eliminating the cause of various erosion mechanisms.]	SLR program is implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1 GALL V / SRP 3.2 GALL VII / SRP 3.3 GALL VIII / SRP 3.4

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		This program includes (a) identifying all susceptible piping systems and components; (b) developing FAC predictive models to reflect component geometries, materials, and operating parameters; (c) performing analyses of FAC models and, with consideration of operating experience, selecting a sample of components for inspections; (d) inspecting components; (e) evaluating inspection data to determine the need for inspection sample expansion, repairs, or replacements, and to schedule future inspections; and (f) incorporating inspection data to refine FAC models.		
XI.M18	Bolting Integrity	This program focuses on closure bolting for pressure-retaining components and relies on recommendations for a comprehensive bolting integrity program, as delineated in NUREG-1339, and industry recommendations, as delineated in EPRI NP-5769, with the exceptions noted in NUREG-1339 for safety-related bolting. The program also relies on industry recommendations for comprehensive bolting maintenance, as delineated in the EPRI TR-104213, 1015336 and 1015337. The program generally includes periodic inspection of closure bolting for indications of loss of preload, cracking, and loss of material due to corrosion, rust, etc. The program also includes preventive measures to preclude or minimize loss of preload and cracking. A related aging management program (AMP) XI.M1, “ASME Section XI Inservice Inspection (ISI) Subsections IWB, IWC, and IWD,” includes inspections of safety-related and non-safety-related closure bolting and supplements this bolting integrity program. Other related programs, AMPs XI.S1, “ASME Section XI, Subsection IWE”; XI.S3, “ASME Section XI Subsection IWF”; XI.S6, “Structures Monitoring”; XI.S7, “Inspection of Water-Control Structures Associated with Nuclear Power Plant”; and XI.M23, “Inspection of Overhead Heavy Load and Light Load	SLR program is implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1 GALL V / SRP 3.2 GALL VII / SRP 3.3 GALL VIII / SRP 3.4

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		(Related to Refueling) Handling Systems," manage the inspection of safety-related and non-safety related structural bolting.		
XI.M19	Steam Generators	This program consists of aging management activities for the steam generator tubes, plugs, sleeves, and secondary side components. This program is governed by plant technical specifications, commitments to NEI 97-06, Revision 3, and the associated EPRI guidelines. The program also includes foreign material exclusion as a means to inhibit wear degradation, and secondary side maintenance activities, such as sludge lancing, for removing deposits that may contribute to component degradation. The program performs volumetric examination on steam generator tubes in accordance with the requirements in the technical specifications to detect aging effects, if they should occur. The technical specifications require condition monitoring and operational assessments to be performed to ensure that the tube integrity will be maintained until the next inspection. Condition monitoring and operational assessments are done in accordance with the technical specification requirements and guidance in NEI 97-06, Revision 3. The program also includes inspections of steam generator components in accordance with the guidance in NEI 97-06, Revision 3.	SLR program is implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1
XI.M20	Open-Cycle Cooling Water System	The program relies, in part, on implementing the response to NRC Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment," [(if applicable) and includes nonsafety-related portions of the open-cycle cooling water system]. The program includes (a) surveillance and control of biofouling, (b) tests to verify heat transfer of heat exchangers, (c) routine inspection and maintenance to ensure that corrosion, erosion, protective coating failure, fouling, and biofouling cannot degrade the performance of systems serviced by the open-cycle cooling water system. This program includes enhancements to the guidance in NRC GL 89-13 that address operating experience to ensure aging effects are adequately managed.	SLR program is implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1 GALL V / SRP 3.2 GALL VII / SRP 3.3 GALL VIII / SRP 3.4

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
XI.M21A	Closed Treated Water Systems	This is a mitigation program that also includes condition monitoring to verify the effectiveness of the mitigation activities. The program consists of (a) water treatment, including the use of corrosion inhibitors, to modify the chemical composition of the water such that the effects of corrosion are minimized; (b) chemical testing of the water to ensure that the water treatment program maintains the water chemistry within acceptable guidelines; and (c) inspections to determine the presence or extent of degradation. The program uses ((as applicable) e.g., EPRI 1007820, Closed Cooling Water Chemistry Guideline, and corrosion coupon testing and microbiological testing).	Program should be implemented prior to subsequent period of extended operation	GALL IV / SRP 3.1 GALL V / SRP 3.2 GALL VII / SRP 3.3 GALL VIII / SRP 3.4
XI.M22	Boraflex Monitoring	The program consists of (a) neutron attenuation testing (“blackness testing”) to determine gap formation, (b) sampling for the presence of silica in the spent fuel pool along with boron loss, and (c) monitoring and analysis of criticality to assure that the required 5% sub-criticality margin is maintained. This program is implemented in response to NRC GL 96-04.	SLR program is implemented prior to the subsequent period of extended operation m	GALL VII / SRP 3.3
XI.M23	Inspection of Overhead Heavy Load and Light Load Handling Related to Refueling) Handling Systems	The program evaluates the effectiveness of maintenance monitoring activities for cranes and hoists. The program includes periodic visual inspections to detect degradation of bridge, rail, and trolley structural components and loss of preload on bolted connections. Volumetric or surface examinations confirm the absence of cracking in high strength bolts. This program relies on the guidance in NUREG-0612, ASME B30.2, and other appropriate standards in the ASME B30 series. These cranes must also comply with the maintenance rule requirements provided in 10 CFR 50.65.	SLR program is implemented prior to the subsequent period of extended operation	GALL VII / SRP 3.3
XI.M24	Compressed Air Monitoring	The program consists of monitoring moisture content and corrosion, and performance of the compressed air system, including (a) preventive monitoring of water (moisture), and other contaminants to keep within the specified limits and (b) inspection of components for indications of loss of material due to corrosion. This program is in response to NRC GL 88-14 and INPO’s Significant Operating Experience Report (SOER) 88-01. It also relies on the guidance from the American Society of	SLR program is implemented prior to the subsequent period of extended operation	GALL VII / SRP 3.3

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AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		Mechanical Engineers (ASME) operations and maintenance standards and guides (ASME OM-S/G-2012, Division 2, Part 28) and American National Standards Institute (ANSI)/ISA-S7.0.1-1996, and EPRI TR-10847 for testing and monitoring air quality and moisture. Additionally, periodic visual inspections of component internal surfaces are performed for signs of loss of material due to corrosion.		
XI.M25	BWR Reactor Water Cleanup System	This program includes ISI and monitoring and control of reactor coolant water chemistry. Related to the inspection guidelines for the reactor water cleanup system (RWCU) inspections of RWCU piping welds that are located outboard of the second containment isolation valve, the program includes measures delineated in per the guidelines of NUREG-0313, Revision 2, and NRC GL 88-01, GL 88-01 Supplement 1, and any applicable NRC-approved alternatives to these guidelines and ISI in conformance with the ASME Section XI.	SLR program is implemented prior to the subsequent period of extended operation	GALL VII, SRP 3.3
XI.M26	Fire Protection	This program includes fire barrier inspections. The fire barrier inspection program requires periodic visual inspection of fire barrier penetration seals, fire barrier walls, ceilings, and floors, fire damper housings, and periodic visual inspection and functional tests of fire-rated doors to ensure that their operability is maintained. The program also includes periodic inspection and testing of halon/carbon dioxide fire suppression systems.	SLR program is implemented prior to the subsequent period of extended operation	GALL VII / SRP 3.3
XI.M27	Fire Water System	This program is a condition monitoring program that manages aging effects associated with water-based fire protection system components. This program manages loss of material, fouling, and flow blockage because of fouling by conducting periodic visual inspections, tests, and flushes performed in accordance with the 2011 Edition of NFPA 25. Testing or replacement of sprinklers that have been in place for 50 years is performed in accordance with NFPA 25. In addition to NFPA codes and standards, portions of the water-based fire protection system that are: (a) normally dry but periodically subjected to flow and (b) cannot be drained or allow water to collect are subjected to augmented testing beyond that specified in NFPA 25, including:	Program is implemented 5 years before the subsequent period of extended operation. Inspections of wetted normally dry piping segments that cannot be drained or that allow water to collect begin 5 years	GALL VII / SRP 3.3

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AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		(a) periodic system full flow tests at the design pressure and flow rate or internal visual inspections and (b) piping volumetric wall-thickness examinations. The water-based fire protection system is normally maintained at required operating pressure and is monitored such that loss of system pressure is immediately detected and corrective actions initiated. Piping wall thickness measurements are conducted when visual inspections detect surface irregularities indicative of unexpected levels of degradation. When the presence of sufficient organic or inorganic material sufficient to obstruct piping or sprinklers is detected, the material is removed and the source is detected and corrected. Non-code inspections and tests follow site procedures that include inspection parameters for items such as lighting, distance offset, presence of protective coatings, and cleaning processes that ensure an adequate examination.	before the subsequent period of extended operation. The program's remaining inspections begin during the subsequent period of extended operation	
XI.M29	Aboveground Metallic Tanks	This program is a condition monitoring program that manages aging effects associated with outdoor tanks sited on soil or concrete and indoor large-volume tanks containing water designed with internal pressures approximating atmospheric pressure that are sited on concrete or soil, including the [applicant to list the specific tanks that are in the program scope]. The program includes preventive measures to mitigate corrosion by protecting the external surfaces of steel components per standard industry practice. Sealant or caulking is used for outdoor tanks at the concrete-component interface. This program manages loss of material and cracking by conducting periodic internal and external visual and surface examinations. Inspections of caulking or sealant are supplemented with physical manipulation. Surface exams are conducted to detect cracking when susceptible materials are used. Thickness measurements of tank bottoms are conducted to ensure that significant degradation is not occurring. The	Program is implemented and inspections begin 10 years before the subsequent period of extended operation.	GALL V / SRP 3.2 GALL VII / SRP 3.3 GALL VIII / SRP 3.4

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AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		external surfaces of insulated tanks are periodically sampling-based inspected. Inspections not conducted in accordance with ASME Code Section XI requirements are conducted in accordance with plant-specific procedures including inspection parameters such as lighting, distance, offset, and surface conditions.		
XI.M30	Fuel Oil Chemistry	This program relies on a combination of surveillance and maintenance procedures. Monitoring and controlling fuel oil contamination in accordance with the guidelines of American Society for Testing and Materials (ASTM) Standards D1796, D2276, D2709, and D4057 maintains the fuel oil quality. Exposure to fuel oil contaminants, such as water and microbiological organisms, is minimized by periodic cleaning/draining of tanks and by verifying the quality of new oil before its introduction into the storage tanks.	SLR program is implemented prior to the subsequent period of extended operation	GALL VII / SRP 3.3
XI.M31	Reactor Vessel Material Surveillance	This program requires implementation of a reactor vessel material surveillance program to monitor the changes in fracture toughness to the ferritic reactor vessel beltline materials which are projected to receive a peak neutron fluence at the end of the design life of the vessel exceeding 10^{17} n/cm^2 (E >1MeV). The surveillance capsules must be located near the inside vessel wall in the beltline region so that the material specimens duplicate, to the greatest degree possible, the neutron spectrum, temperature history, and maximum neutron fluence experienced at the reactor vessel's inner surface. Because of the resulting lead factors, surveillance capsules receive equivalent neutron fluence exposures earlier than the inner surface of the reactor vessel. This allows surveillance capsules to be withdrawn prior to the inner surface receiving an equivalent neutron fluence and therefore test results may bound the corresponding operating period in the capsule withdrawal schedule.	The surveillance capsule withdrawal schedule revised before the subsequent period of extended operation	Reactor Vessel Surveillance

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		This surveillance program must comply with ASTM International (formerly American Society for Testing and Materials) Standard Practice E 185-82, as incorporated by reference in 10 CFR Part 50, Appendix H. Because the withdrawal schedule in Table 1 of ASTM E 185-82 is based on plant operation during the original 40-year license term, standby capsules may need to be incorporated into the Appendix H program to ensure appropriate monitoring during the subsequent period of extended operation. Surveillance capsules are designed and located to permit insertion of replacement capsules. If standby capsules will be incorporated into the Appendix H program for the subsequent period of extended operation and have been removed from the reactor vessel, these should be reinserted so that appropriate lead factors are maintained and test results will bound the corresponding operating period. This program includes removal and testing of at least one capsule during the subsequent period of extended operation, with a neutron fluence of the capsule between one and one and one quarter (1.25) the projected peak vessel neutron fluence at the end of the subsequent period of extended operation. As an alternative to a plant-specific surveillance program complying with ASTM E 185-82, an integrated surveillance program (ISP) may be considered for a set of reactors that have similar design and operating features, in accordance with 10 CFR Part 50, Appendix H, and Paragraph III.C. The plant-specific implementation of the ISP is consistent with the latest version of the ISP plan that has received approval by the NRC for the subsequent period of extended operation.		

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AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		The objective of this Reactor Vessel Material Surveillance program is to provide sufficient material data and dosimetry to (a) monitor irradiation embrittlement to neutron fluences greater than the projected neutron fluence at the end of the subsequent period of extended operation, and (b) provide adequate dosimetry monitoring during the operational period. If surveillance capsules are not withdrawn during the subsequent period of extended operation, provisions are made to perform dosimetry monitoring. This program is a condition monitoring program that measures the increase in Charpy V-notch 30 foot-pound (ft-lb) transition temperature and the drop in the upper-shelf energy as a function of neutron fluence and irradiation temperature. The data from this surveillance program are used to monitor neutron irradiation embrittlement of the reactor vessel, and are inputs to the neutron embrittlement time-limited aging analyses (TLAAs) described in Section 4.2 of the Standard Review Plan for Subsequent License Renewal (SRP-SLR). The Reactor Vessel Material Surveillance program is also used in conjunction with GALL-SLR Report AMP X.M2, "Neutron Fluence Monitoring," which monitors neutron fluence for reactor vessel components and reactor vessel internal components. In accordance with 10 CFR Part 50, Appendix H, all surveillance capsules, including those previously removed from the reactor vessel, must meet the test procedures and reporting requirements of ASTM E 185-82, to the extent practicable, for the configuration of the specimens in the capsule. Any changes to the capsule withdrawal schedule, including the conversion of standby capsules into the Appendix H program and extension of		

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		the surveillance program for the subsequent period of extended operation, must be approved by the Nuclear Regulatory Commission (NRC) prior to implementation, in accordance with 10 CFR Part 50, Appendix H, Paragraph III.B.3. Standby capsules placed in storage (e.g., removed from the reactor vessel) are maintained for possible future insertion.		
XI.M32	One-Time Inspection	The program is a condition monitoring program consisting of a one-time inspection of selected components to verify: (a) the system-wide effectiveness of an AMP that is designed to prevent or minimize aging to the extent that it will not cause the loss of intended function during the subsequent period of extended operation; (b) the insignificance of an aging effect; and (c) that long-term loss of materials will not cause a loss of intended function for steel components exposed to environments that do not include corrosion inhibitors as a preventive action, and where periodic wall thickness measurements on a representative sample of each environment are not conducted every 5 years up to at least 10 years prior to the subsequent period of extended operation. This program provides inspections that verify that unacceptable degradation is not occurring. It also may trigger additional actions that ensure the intended functions of affected components are maintained during the subsequent period of extended operation. The elements of the program include (a) determination of the sample size of components to be inspected based on an assessment of materials of fabrication, environment, plausible aging effects, and operating experience, (b) identification of the inspection locations in the system or component based on the potential for the aging effect to occur, (c) determination of the examination technique, including acceptance criteria that would	Inspections should be conducted prior to the subsequent period of extended operation	GALL IV / SRP 3.1 GALL V / SRP 3.2 GALL VII / SRP 3.3 GALL VIII / SRP 3.4

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AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		be effective in managing the aging effect for which the component is examined, and (d) an evaluation of the need for follow-up examinations to monitor the progression of aging if age-related degradation is found that could jeopardize an intended function before the end of the subsequent period of extended operation. This program is not used for structures or components with known age-related degradation mechanisms or when the environment in the subsequent period of extended operation is not expected to be equivalent to that in the prior operating periods. Periodic inspections are conducted in these cases. Inspections not conducted in accordance with ASME Code Section XI requirements are conducted in accordance with plant-specific procedures including inspection parameters such as lighting, distance, offset, and surface conditions.		
XI.M33	Selective Leaching	This program is a condition monitoring program that includes a one-time inspection for components exposed to a closed-cycle cooling water or treated water environment when plant-specific operating experience has not revealed selective leaching in these environments. Opportunistic and periodic inspections are conducted for raw water, waste water, soil, and groundwater environments, and for closed-cycle cooling water and treated water environments when plant-specific operating experience has revealed selective leaching in these environments. Visual inspections coupled with mechanical examination techniques such as chipping or scraping are conducted. Periodic destructive examinations of components for physical properties (i.e., degree of dealloying, depth of dealloying, through wall thickness, and chemical composition) are conducted for components exposed to raw water, waste water, soil, and groundwater environments, or for closed-cycle cooling water and treated water environments when plant-specific operating experience has revealed selective leaching in these environments. Inspections and tests are conducted to	SLR program should be implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1 GALL V / SRP 3.2 GALL VII / SRP 3.3 GALL VIII / SRP 3.4

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AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		determine whether loss of material will affect the ability of the components to perform their intended function for the subsequent period of extended operation. Inspections are conducted in accordance with plant-specific procedures including inspection parameters such as lighting, distance, offset and surface conditions. When the acceptance criteria are not met such that it is determined that the affected component should be replaced prior to the end of the subsequent period of extended operation, additional inspections are performed.		
XI.M35	ASME Code Class 1 Small Bore-Piping	This program augments the existing ASME Code, Section XI requirements and is applicable to small-bore ASME Code Class 1 piping and systems with a nominal pipe size diameter less than 4 inches (NPS<4) and greater than or equal to NPS 1. This program provides a one-time volumetric inspection of a sample of this Class 1 piping. This program includes pipes, fittings, branch connections, and all full and partial penetration (socket) welds. The program includes measures to verify that degradation is not occurring, thereby either confirming that there is no need to manage aging-related degradation or validating the effectiveness of any existing program for the subsequent period of extended operation. The one-time inspection program for ASME Code Class 1 small-bore piping includes locations that are susceptible to cracking. This program is applicable to systems that have not experienced cracking of ASME Code Class 1 small-bore piping. This program can also be used for systems that experienced cracking but have implemented design changes to effectively mitigate cracking. (Measure of effectiveness includes (1) the one-time inspection sampling is statistically significant; (2) samples will be selected as described in Element 5; and (3) no repeated failures over an extended period of time.) For systems that have experienced cracking and operating experience indicates design changes have not been implemented to effectively mitigate cracking, periodic inspection is proposed, as managed by a plant-specific AMP. Should evidence of cracking be revealed by a one-time	SLR program should be implemented prior to subsequent period of extended operation	GALL IV / SRP 3.1

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AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		inspection, a periodic inspection is also proposed, as managed by a plant-specific AMP.		
XI.M36	External Surfaces Monitoring of Mechanical Components	This program is a condition monitoring program that manages loss of material, cracking, changes in material properties (of cementitious components), hardening and loss of strength (of elastomeric components), and reduced thermal insulation resistance. Periodic visual inspections, not to exceed a refueling outage interval, of metallic, polymeric, insulation jacketing (insulation when not jacketed), and cementitious components are conducted. For certain materials, such as flexible polymers, physical manipulation or pressurization to detect hardening or loss of strength is used to augment the visual examinations conducted under this program. A sample of outdoor component surfaces that are insulated and a sample of indoor insulated components exposed to condensation (due to the in-scope component being operated below the dew point), are periodically inspected every 10 years during the subsequent period of extended operation. Inspections not conducted in accordance with ASME Code Section XI requirements are conducted in accordance with plant-specific procedures including inspection parameters such as lighting, distance, offset, and surface conditions. Acceptance criteria are such that the component will meet its intended function until the next inspection or the end of the subsequent period of extended operation. Qualitative acceptance criteria are clear enough to reasonably ensure a singular decision is derived based on observed conditions.	Program is implemented 6 months before the subsequent period of extended operation and inspections begin during the subsequent period of extended operation.	GALL V / SRP 3.2 GALL VII / SRP 3.3 GALL VIII / SRP 3.4
XI.M37	Flux Thimble Tube Inspection	The program inspects for the thinning of flux thimble tube walls, which provides a path for the in-core neutron flux monitoring system detectors and forms part of the reactor coolant system pressure boundary. Flux thimble tubes are subject to loss of material at certain locations in the reactor vessel where flow-induced fretting causes wear at discontinuities in the path from the reactor vessel instrument nozzle to the fuel assembly	SLR program is implemented prior to the subsequent period of extended operation	GALL IV / SRP 3.1

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AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		instrument guide tube. A periodic nondestructive examination methodology, such as eddy current testing or other applicant-justified and US NRC-accepted inspection methods is used to monitor flux thimble tube wear. This program implements the recommendations of NRC Bulletin 88-09, "Thimble Tube Thinning in Westinghouse Reactors."		
XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	This program is a condition monitoring program that manages loss of material, cracking, and hardening and loss of strength of polymeric materials. This program consists of visual inspections of all accessible internal surfaces of metallic piping, piping components, ducting, heat exchanger components, polymeric and elastomeric components, and other components that are exposed to environments of uncontrolled indoor air, outdoor air, air with borated water leakage, condensation, moist air, diesel exhaust, and any water environment other than open-cycle cooling water, closed-cycle cooling water, and fire water. Elastomers exposed to open-cycle, closed-cycle cooling water, and fire water are managed by this program. These internal inspections are performed during the periodic system and component surveillances or during the performance of maintenance activities when the surfaces are made accessible for visual inspection. At a minimum, in each 10-year period during the period of extended operation a representative sample of 20 percent of the population (defined as components having the same combination of material, environment, and aging effect) or a maximum of 25 components per population is inspected. Where practical, the inspections focus on the bounding or lead components most susceptible to aging because of time in service, and severity of operating conditions. Opportunistic inspections continue in each period despite meeting the sampling limit. For certain materials, such as flexible polymers, physical manipulation or pressurization to detect hardening or loss of strength is used to augment the visual examinations conducted under this program. If visual	Program is implemented 6 months before the subsequent period of extended operation and inspections begin during the subsequent period of extended operation.	GALL V / SRP 3.2 GALL VII / SRP 3.3 GALL VIII / SRP 3.4 GALL VI / SRP 3.6

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AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		inspection of internal surfaces is not possible, a plant-specific program is used. Inspections not conducted in accordance with ASME Code Section XI requirements are conducted in accordance with plant-specific procedures including inspection parameters such as lighting, distance, offset, and surface conditions. Acceptance criteria are such that the component will meet its intended function until the next inspection or the end of the subsequent period of extended operation. Qualitative acceptance criteria are clear enough to reasonably ensure a singular decision is derived based on observed conditions.		
XI.M39	Lubricating Oil Analysis	This program ensures that the oil environment in the mechanical systems is maintained to the required quality. This program ensures that oil systems are maintained free of contaminants (primarily water and particulates), thereby preserving an environment that is not conducive to loss of material or reduction of heat transfer. Testing activities include sampling and analysis of lubricating oil for detrimental contaminants. The presence of water or particulates may also indicate in-leakage and corrosion product buildup.	SLR program is implemented prior to the subsequent period of extended operation	GALL V / SRP 3.2 GALL VII / SRP 3.3 GALL VIII / SRP 3.4
XI.M40	Monitoring of Neutron-Absorbing Materials other than Boraflex	This program relies on periodic inspection, testing, monitoring, and analysis of the criticality design to assure that the required 5 percent sub-criticality margin is maintained. This program consists of inspecting the physical condition of the neutron-absorbing material, such as visual appearance, dimensional measurements, weight, geometric changes (e.g., formation of blisters, pits, and bulges), and boron areal density as observed from coupons or in situ.	SLR program should be implemented prior to the subsequent period of extended operation	GALL VII / SRP 3.3
XI.M41	Buried and Underground Piping and Tanks	This program is a condition monitoring program that manages the aging effects associated with the external surfaces of buried and underground piping and tanks such as loss of material, cracking and changes in material properties (for cementitious piping). It addresses piping and tanks composed of any material, including metallic, polymeric, and cementitious	SLR program should be implemented before the subsequent period of extended operation	GALL V / SRP 3.2 GALL VII / SRP 3.3 GALL VIII / SRP 3.4

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AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		materials. The program also manages aging through preventive and mitigative actions, (i.e., coatings, backfill quality, and cathodic protection) The number of inspections is based on the effectiveness of the preventive and mitigative actions. Annual cathodic protection surveys are conducted. Where the acceptance criteria for the effectiveness of the cathodic protection is other than -850 mV instant off, actual loss of material rates are measured from in-situ coupons. Inspections are conducted by qualified individuals. Adverse inspection results result in additional inspections. If a reduction in the number of inspections recommended in GALL-SLR Report AMP XI.M41, Table XI.M41-1, is claimed based on a lack of soil corrosivity as determined by soil testing, soil testing is conducted once in each 10-year period starting 10 years prior to the subsequent period of extended operation.		
XI.M42	Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks	This program is a condition monitoring program that manages degradation of coatings/linings that can lead to loss of material of base materials and downstream effects such as reduction in flow, reduction in pressure or reduction in heat transfer when coatings/linings become debris. This program manages these aging effects by conducting periodic visual inspections of all coatings/linings applied to the internal surfaces of in-scope components exposed to closed-cycle cooling water, raw water, treated water, treated borated water, waste water, lubricating oil or fuel oil where loss of coating or lining integrity could impact the component's or downstream component's current licensing basis intended function(s). For tanks and heat exchangers, all accessible surfaces are inspected. Piping inspections are sampling-based. The training and qualification of individuals involved in coating/lining inspections of noncementitious coatings/linings are	Program is implemented no later than six months before the subsequent period of extended operation and inspections begin no later than the last refueling outage before the subsequent period of extended operation.	GALL V / SRP 3.2 GALL VII / SRP 3.3 GALL VIII / SRP 3.4

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AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		conducted in accordance with ASTM International Standards endorsed in RG 1.54 including guidance from the staff associated with a particular standard. For cementitious coatings, training and qualifications are based on an appropriate combination of education and experience related to inspecting concrete surfaces. Peeling and delamination is not acceptable. Blisters are evaluated by a coatings specialist with the blisters being surrounded by sound material and with the size and frequency not increasing. Minor cracks in cementitious coatings are acceptable provided there is no evidence of debonding. All other degraded conditions are evaluated by a coatings specialist. For coated/lined surfaces determined to not meet the acceptance criteria, physical testing is performed where physically possible (i.e., sufficient room to conduct testing) in conjunction with repair or replacement of the coating/lining.		
XI.S1	ASME Section XI, Subsection IWE Inservice Inspection (IWE)	This program is in accordance with ASME Section XI, Subsection IWE, consistent with 10 CFR 50.55a “Codes and standards,” with supplemental recommendations. The AMP includes periodic visual, surface, volumetric examinations, and leak rate testing, where applicable, of metallic pressure-retaining components of steel containments and concrete containments for signs of degradation, damage, irregularities including liner plate bulges, and for coated areas distress of the underlying metal shell or liner, and corrective actions. Acceptability of inaccessible areas of steel containment shell or concrete containment steel liner is evaluated when conditions found in accessible areas, indicate the presence of, or could result in, flaws or degradation in inaccessible areas. This program also includes aging management for the potential loss of material due to corrosion in the inaccessible areas of the BWR Mark I steel containment, and surface examination for the detection of cracking of structural bolting. In addition, the program includes supplemental surface or enhanced examinations to detect cracking for specific components [identify components], and supplemental volumetric examinations by sampling locations	SLR program is implemented prior to the subsequent period of extended operation	GALL II / SRP 3.5

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AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		susceptible to loss of thickness due to corrosion of containment shell or liner that is inaccessible from one side. Inspection results are compared with prior recorded results in acceptance of components for continued service.		
XI.S2	ASME Section XI, Subsection IWL Inservice Inspection (IWL)	This program consists of (a) periodic visual inspection of concrete surfaces for reinforced and pre-stressed concrete containments, (b) periodic visual inspection and sample tendon testing of un-bonded post-tensioning systems for pre-stressed concrete containments for signs of degradation, assessment of damage, and corrective actions, and testing of the tendon corrosion protection medium and free water. Measured tendon lift-off forces are compared to predicted tendon forces calculated in accordance with RG 1.35. The Subsection IWL requirements are supplemented to include quantitative acceptance criteria for concrete surfaces based on the "Evaluation Criteria" provided in Chapter 5 of ACI 349.3R	SLR program is implemented prior to the subsequent period of extended operation	GALL II / SRP 3.5
XI.S3	ASME Section XI, Subsection IWF Inservice inspection (IWF)	This program consists of periodic visual examination of piping and component supports for signs of degradation, evaluation, and corrective actions. This program recommends additional inspections beyond the inspections required by the 10 CFR Part 50.55a ASME Section XI, Subsection IWF program. This includes inspections of an additional 5 percent of supports outside of the existing IWF sample population. For high-strength bolting in sizes greater than 1 inch nominal diameter, volumetric examination comparable to that of ASME Code Section XI, Table IWB-2500-1, Examination Category B-G-1 should be performed to detect cracking in addition to the VT-3 examination. If a component support does not exceed the acceptance standards of IWF-3400 but is electively repaired to as-new condition, the sample is increased or modified to include another support that is representative of the remaining population of supports that were not repaired.	SLR program is implemented prior to the subsequent period of extended operation	GALL II / SRP 3.5 GALL III / SRP 3.5

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AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
XI.S4	10 CFR Part 50, Appendix J	This program consists of monitoring leakage rates through the containment system, its shell or liner, associated welds, penetrations, isolation valves, fittings, and other access openings to detect degradation of the containment pressure boundary. Corrective actions are taken if leakage rates exceed acceptance criteria. This program is implemented in accordance with 10 CFR Part 50 Appendix J, RG 1.163 and/or NEI 94-01.	SLR program is implemented prior to the subsequent period of extended operation	GALL II / SRP 3.5
XI.S5	Masonry Walls	This program consists of inspections, based on IE Bulletin 80-11 and plant-specific monitoring proposed by IN 87-67, for managing shrinkage, separation, gaps, loss of material and cracking of masonry walls such that the evaluation basis is not invalidated and intended functions are maintained.	SLR program is implemented prior to the subsequent period of extended operation	GALL III / SRP 3.5
XI.S6	Structures Monitoring	This program consists of periodic visual inspection and monitoring the condition of concrete and steel structures, structural components, component supports, and structural commodities to ensure that aging degradation (such as those described in ACI 349.3R, ACI 201.1R, SEI/ASCE 11, and other documents) will be detected, the extent of degradation determined, evaluated, and corrective actions taken prior to loss of intended functions. Inspections also include seismic joint fillers, elastomeric materials; and steel edge supports and steel bracings associated with masonry walls, and periodic evaluation of groundwater chemistry and opportunistic inspections for the condition of below grade concrete, and of protective coatings for substrate materials. Quantitative results (measurements) and qualitative data from periodic inspections are trended with photographs and surveys for the type, severity, extent, and progression of degradation. The acceptance criteria are derived from applicable consensus codes and standards. For concrete structures, the program includes personnel qualifications and quantitative acceptance criteria of ACI 349.3R.	SLR program is implemented prior to the subsequent period of extended operation	GALL VII / SRP 3.3 GALL II / SRP 3.5 GALL III / SRP 3.5 GALL VI / SRP 3.6
XI.S7	Inspection of Water-Control Structures	This program consists of inspection and surveillance of raw-water control structures associated with emergency cooling systems or flood protection. The program also includes	SLR program is implemented prior to the subsequent	GALL III / SRP 3.5

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
	Associated with Nuclear Power Plants	structural steel and structural bolting associated with water-control structures. In general, parameters monitored should be in accordance with Section C.2 of R.G. 1.127 and quantitative measurements should be recorded for all applicable parameters monitored or inspected. Inspections should occur at least once every 5 years. Structures exposed to aggressive water require additional plant-specific investigation.	period of extended operation	
XI.S8	Protective Coating Monitoring and Maintenance	This program ensures that a monitoring and maintenance program implemented in accordance with RG 1.54 is adequate for the subsequent period of extended operation. The program consists of guidance for selection, application, inspection, and maintenance of protective coatings. Maintenance of Service Level I coatings applied to carbon steel and concrete surfaces inside containment (e.g., steel liner, steel containment shell, structural steel, supports, penetrations, and concrete walls and floors) serve to prevent or minimize loss of material due to corrosion of carbon steel components and aids in decontamination. Degraded coatings in the containment are assessed periodically to ensure post-accident operability of the ECCS.	SLR program is implemented prior to the subsequent period of extended operation	GALL III / SRP 3.5
X.M1	Cyclic Load Monitoring	The aging management program monitors and tracks the number of occurrences and severity of each of the thermal and pressure transients and requires corrective actions to ensure that applicable fatigue analyses remain within their allowable limits, including those in applicable CUF analyses, CUFen analyses, maximum allowable stress range reduction analyses for ANSI B31.1 and ASME Code Class 2 and 3 components, ASME III fatigue waiver analyses, and cycle-based flaw growth, flaw tolerance, or fracture mechanics analyses. The program manages cracking induced by fatigue or cyclic loading occurrences in plant structures and components by monitoring one or more relevant fatigue parameters, which include the CUF, the CUFen, transient cycle limits, and the predicted flaw size. The program has two aspects, one to verify the continued acceptability of existing analyses through cycle counting and the		

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		other to provide periodically updated evaluations of the fatigue analyses to demonstrate that they continue to meet the appropriate limits. Plant technical specification requirements may apply to these activities.		
X.M2	Neutron Fluence Monitoring	This program monitors and tracks increasing neutron fluence exposures (integrated, time-dependent neutron flux exposures) to reactor pressure vessel and reactor internal components to ensure that applicable reactor pressure vessel neutron irradiation embrittlement analyses (i.e., TLAAs) and radiation-induced aging effect assessment for reactor internal components will remain within their applicable limits. This program has two aspects, one to verify the continued acceptability of existing analyses through neutron fluence monitoring and the other to provide periodically updated evaluations of the analyses involving neutron fluence inputs to demonstrate that they continue to meet the appropriate limits defined in the current licensing basis (CLB). Monitoring is performed in accordance with neutron flux determination methods and neutron fluence projection methods that are defined for the CLB in NRC-approved reports. For fluence monitoring activities that apply to components located in the beltline region of the reactor pressure vessel(s), the monitoring methods are performed in a manner that is consistent with the monitoring methodology guidelines in Regulatory Guide (RG) 1.190, "Calculational .and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," March 2001. Additional justifications may be necessary for neutron fluence monitoring methods that are applied to reactor pressure vessel component locations outside of the beltline region of the vessels or to reactor internal components. This program's results are compared to the neutron fluence parameter inputs used in the neutron embrittlement analyses for reactor pressure vessel components. This includes but is not		

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		limited to the neutron fluence inputs for the reactor pressure vessel upper shelf energy analyses (or equivalent margin analyses, as applicable to the CLB), pressure-temperature analyses, and low temperature overpressure protection (LTOP, PWRs only) that are required to be performed in accordance in 10 CFR Part 50, Appendix G requirements, and for PWRs, those safety analyses that are performed to demonstrate adequate protection of the reactor pressure vessels against the consequences of pressurized thermal shock (PTS) events, as required by 10 CFR 50.61 or 10 CFR 50.61a and applicable to the CLB. Comparisons to the neutron fluence inputs for other analyses (as applicable to the CLB) may include those for mean RT_{NDT} and probability of failure analyses for BWR reactor pressure vessel circumferential and axial shell welds, BWR core reflood design analyses, and aging effect assessments for PWR and BWR reactor internals that are induced by neutron irradiation exposure mechanisms. Reactor vessel surveillance capsule dosimetry data obtained in accordance with 10 CFR Part 50, Appendix H requirements and through implementation of the applicant's Reactor Vessel Surveillance Program (Refer to GALL-SLR Report AMP XI.M31) may provide inputs to and have impacts on the neutron fluence monitoring results that are tracked by this program. In addition, regulatory requirements in the plant technical specifications or in specific regulations of 10 CFR Part 50 may apply, including those in 10 CFR Part 50, Appendix G; 10 CFR 50.55a; and for PWRs, the PTS requirements in 10 CFR 50.61 or 10 CFR 50.61a, as applicable for the CLB.		
X.S1	Concrete Containment Tendon Prestress	The prestressing unbonded tendons are used to impart compressive forces in the prestressed concrete containments to resist the internal pressure inside the containment that would be generated in the event of a LOCA. The prestressing forces generated by the unbonded tendons diminish over time due to losses in prestressing forces in the tendons and in the		

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		surrounding concrete. The prestressing force analysis and evaluation has been completed and determined to remain within allowable limits to the end of the subsequent period of extended operation, and the trend lines of the measured prestressing forces will stay above the minimum required prestressing forces for each group of tendons to the end of this period.		
X.E1	Environmental Qualification (EQ) of Electric Components	This program implements the environmental qualification (EQ) requirements in 10 CFR Part 50, Appendix A, Criterion 4, and 10 CFR 50.49. 10 CFR 50.49 specifically requires that an EQ program be established to demonstrate that certain electrical equipment located in harsh plant environments will perform their safety function in those harsh environments after the effects of in-service aging. 10 CFR 50.49 requires that the effects of significant aging mechanisms be addressed as part of environmental qualification. As required by 10 CFR 50.49, EQ equipment not qualified for the current license term is refurbished, replaced, or have their qualification extended prior to reaching the designated life aging limits established in the evaluation. Aging evaluations for EQ equipment that specify a qualification of at least 60 years are time-limited aging analyses (TLAAs) for subsequent license renewal. Reanalysis of an aging evaluation to extend the qualification of equipment qualified under the program requirements of 10 CFR 50.49(e) is performed as part of an EQ program. Important attributes for the reanalysis of an aging evaluation include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions (if acceptance criteria are not met). The analytical models used in the reanalysis of an aging evaluation are the same as those previously applied during the prior evaluation. The identification of excess conservatism in electrical equipment service conditions (for example, temperature, radiation, and		

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		cycles) used in the prior aging evaluation is the chief method used for a reanalysis. A reanalysis demonstrates that adequate margin is maintained consistent with the original analysis in accordance with 10 CFR 50.59 requiring certain margins and accounting for the unquantified uncertainties established in the EQ aging evaluation of the equipment. Reanalysis of an aging evaluation is used to extend the environmental qualification of the component. If the qualification cannot be extended by reanalysis, the equipment is refurbished, replaced, or requalified prior to exceeding the current qualified life. When the reanalysis assessed margins, conservatisms, or assumptions do not support reanalysis (e.g., extending qualified life) of an EQ component, the use of on-going qualification techniques including condition monitoring or condition based methodologies may be implemented. Ongoing qualification is an alternative means to provide reasonable assurance that an equipment environmental qualification is maintained for the subsequent period of extended operation. On-going qualification of electric equipment important to safety subject to the requirements of 10 CFR 50.49 involves the inspection, observation, measurement, or trending of one or more indicators, which can be correlated to the condition or functional performance of the EQ equipment. This program is implemented in accordance 10 CFR 50.49 and 10 CFR 54.21(c)(1)(iii). Along with GALL-SLR Report AMP X.E1 the environmental qualification program demonstrates the acceptability of the TLAA analysis under 10 CFR 54.21(c)(1) and is considered an aging management programs (AMP) for the subsequent period of extended operation. This program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry operating experience including research and		

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		development (e.g., test methods, aging models, acceptance criterion) such that the effectiveness of the AMP is evaluated consistent with the discussion in Appendix B of the GALL-SLR Report. [The FSAR Summary description also includes a plant specific discussion of applicable commitments, license conditions, enhancements, or exceptions applied to the applicants aging management program]		
SRP-SLR Appendix A	Plant-Specific AMP	The [fill in name of program] Program is a [prevention, mitigation, condition monitoring, performance monitoring] program that manages aging effects associated with [list component type or system as applicable that are in the scope of the program]. Preventive or mitigative actions include [fill in key actions when applicable]. The program manages [list the AERM] by conducting [periodic, one-time] [describe inspection methods and tests] of [all components or a representative sample of components] within the scope of the program. [When applicable, Periodic inspections are conducted every XX years commencing prior to or during the subsequent period of extended operation] [Describe how inspection and test implementing procedures are controlled (e.g., non-code inspections and tests follow site procedures that include inspection parameters for items such as lighting, distance offset, presence of protective coatings, and cleaning processes that ensure an adequate examination)]. Qualitative acceptance criteria are clear enough to reasonably ensure a singular decision is derived based on observed conditions. When the acceptance criteria are not met such that it is determined that the affected component should be replaced prior to the end of the subsequent period of extended operation, additional inspections are performed.	Program should be implemented prior to subsequent period of extended operation	GALL IV / SRP 3.1 GALL V / SRP 3.2 GALL VII / SRP 3.3 GALL VIII / SRP 3.4 GALL II-III / SRP 3.5 GALL VI / SRP 3.6
GALL-SLR Appendix A	Quality Assurance	The 10 CFR Part 50, Appendix B quality assurance program provides the basis for corrective actions, the confirmation process, and administrative controls for AMPs for license	SLR program is implemented prior to the subsequent	GALL VII / SRP 3.3 GALL VIII / SRP 3.4 GALL III / SRP 3.5

Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP-SLR Chapter References
		renewal. The scope of this existing program is expanded to include non-safety-related structures and components that are subject to aging management programs.	period of extended operation	GALL VI / SRP 3.6
GALL-SLR Appendix B	Operating Experience	This program captures the operating experience from plant-specific and industry sources and is systematically reviewed on an ongoing basis in accordance with the quality assurance program, which meets the requirements of 10 CFR Part 50, Appendix B, and the operating experience program, which meets the requirements of NUREG-0737, "Clarification of TMI Action Plan Requirements," Item I.C.5, "Procedures for Feedback of Operating Experience to Plant Staff." This program interfaces with and relies on active participation in the Institute of Nuclear Power Operations' (INPO) operating experience program, as endorsed by the NRC. In accordance with these programs, all incoming operating experience items are screened to determine whether they may involve age-related degradation or aging management impacts. Items so identified are further evaluated and the AMPs are either enhanced or new AMPs are developed, as appropriate, when it is determined through these evaluations that the effects of aging may not be adequately managed. Training on age-related degradation and aging management is provided to those personnel responsible for implementing the AMPs and who may submit, screen, assign, evaluate, or otherwise process plant-specific and industry operating experience. Plant-specific operating experience associated with aging management and age-related degradation is reported to the industry in accordance with guidelines established in the operating experience program.	SLR program is implemented prior to the subsequent period of extended operation	GALL II-III / SRP 3.5 GALL IV / SRP 3.1 GALL V / SRP 3.2 GALL VI / SRP 3.6 GALL VII / SRP 3.3 GALL VIII / SRP 3.4

*An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the subsequent period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.1 Aging Management Of Reactor Vessel, Internals, And Reactor Coolant System

Review Responsibilities

Primary—The Branch's assigned responsibility by Project Manager (PM) as described in this Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Section 3.0.

3.1.1 Areas of Review

This section addresses the aging management review (AMR) and the associated aging management program (AMP) of the reactor vessel, internals, and reactor coolant system. For a recent vintage plant, the information related to the reactor vessel, internals, and reactor coolant system is contained in Chapter 5, "Reactor Coolant System and Connected Systems," of the plant's final safety analysis report (FSAR), consistent with the "Standard Review plan (SRP) for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG–0800). For older plants, the location of applicable information is plant-specific because an older plant's FSAR may have predated NUREG–0800.

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

The responsible review organization is to review the following subsequent license renewal application (SLRA) AMR and AMP items assigned to it, per SRP-SLR Section 3.0:

AMRs

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

AMPs

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

- Plant-specific AMPs

FSAR Supplement

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

3.1.2 Acceptance Criteria

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

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

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

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

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

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

3.1.2.2.1 Cumulative Fatigue Damage

The evaluations of fatigue or cyclical loading stresses may be time-limited aging analyses (TLAAs), as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). These types of TLAAs are addressed separately in Section 4.3, "Metal Fatigue Analysis," of this SRP-SLR.

3.1.2.2.2 Loss of Material Due to General, Pitting, and Crevice Corrosion

1. Loss of material due to general, pitting, and crevice corrosion could occur in the steel PWR SG upper and lower shell and transition cone exposed to secondary feedwater and steam. The existing program relies on control of water chemistry to mitigate corrosion

and inservice inspection (ISI) to detect loss of material. The extent and schedule of the existing SG inspections are designed to ensure that flaws cannot attain a depth sufficient to threaten the integrity of the welds. However, according to NRC Information Notice (IN) 90-04, “Cracking of the Upper Shell-to-Transition Cone Girth Welds in Steam Generators,” the program may not be sufficient to detect pitting and crevice corrosion if general and pitting corrosion of the shell is known to exist. Augmented inspection is recommended to manage this aging effect. Furthermore, this issue is limited to Westinghouse Model 44 and 51 Steam Generators, where a high-stress region exists at the shell to transition cone weld. Acceptance criteria are described in Branch Technical Position (BTP) RLSB-1 (Appendix A.1 of this SRP-SLR Report).

2. Loss of material due to general, pitting, and crevice corrosion could occur in the steel PWR steam generator shell assembly exposed to secondary feedwater and steam. The existing program relies on control of secondary water chemistry to mitigate corrosion. However, some applicants have replaced only the bottom part of their recirculating SGs, generating a cut in the middle of the transition cone, and, consequently, a new transition cone closure weld. It is recommended that volumetric examinations be performed in accordance with the requirements of ASME Code Section XI for upper shell and lower shell-to-transition cones with gross structural discontinuities for managing loss of material due to general, pitting, and crevice corrosion in the welds for Westinghouse Model 44 and 51 Steam Generators, where a high-stress region exists at the shell-to-transition cone weld.

   The new continuous circumferential weld, resulting from cutting the transition cone as discussed above, is a different situation from the SG transition cone welds containing geometric discontinuities. Control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant flow conditions. The new transition area weld is a field weld as opposed to having been made in a controlled manufacturing facility, and the surface conditions of the transition weld may result in flow conditions more conducive to initiation of general, pitting, and crevice corrosion than those of the upper and lower transition cone welds. Crediting of the ISI program for the new SG transition cone weld may not be an effective basis for managing loss of material in this weld, as the ISI criteria would only perform a VT-2 visual leakage examination of the weld as part of the system leakage test performed pursuant to ASME Section XI requirements. In addition, ASME Section XI does not require licensees to remove insulation when performing visual examination on nonborated treated water systems. Therefore, the effectiveness of the chemistry control program should be verified to ensure that loss of material due to general, pitting and crevice corrosion is not occurring.

   For the new continuous circumferential weld, further evaluation is recommended to verify the effectiveness of the chemistry control program. A one-time inspection at susceptible locations is an acceptable method to determine whether an aging effect is not occurring or an aging effect is progressing very slowly, such that the component’s intended function will be maintained during the subsequent period of extended operation. Furthermore, this issue is limited to replacement of recirculating SGs with a new transition cone closure weld.

3.1.2.2.3 Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement

1. Neutron irradiation embrittlement is a TLAA to be evaluated for the subsequent period of extended operation for all ferritic materials that have a neutron fluence greater than

10^{17} n/cm^2 [E >1 MeV] at the end of the subsequent period of extended operation. Certain aspects of neutron irradiation embrittlement are TLAAs as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). This TLAA is addressed separately in Section 4.2, "Reactor Vessel Neutron Embrittlement Analysis," of this SRP-SLR Report.

2. Loss of fracture toughness due to neutron irradiation embrittlement could occur in BWR and PWR reactor vessel beltline shell, nozzle, and welds exposed to reactor coolant and neutron flux. A reactor vessel material surveillance program monitors neutron irradiation embrittlement of the reactor vessel. The reactor vessel material surveillance program is plant-specific, depending on matters such as the composition of limiting materials and the availability of surveillance capsules.

   In accordance with 10 CFR Part 50, Appendix H, an applicant is required to submit its proposed withdrawal schedule for approval prior to implementation. Untested capsules placed in storage must be maintained for future insertion. Thus, further NRC staff evaluation is required for SLR. Specific recommendations for an acceptable AMP are provided in GALL-SLR Report AMP XI.M31, "Reactor Vessel Material Surveillance."

   A neutron fluence monitoring program is used to monitor the neutron fluence levels that are used as the time-dependent inputs for the plant's reactor vessel neutron irradiation embrittlement TLAAs. These TLAAs are the subjects of the topics discussed in SRP-SLR Section 3.1.2.2.3.1 and "acceptance criteria" and "review procedure" guidance in SRP-SLR Section 4.2. Specific recommendations for an acceptable neutron fluence monitoring AMP are provided in GALL-SLR Report AMP X.M2, "Neutron Fluence Monitoring."

3. Reduction in Fracture Toughness is a plant-specific TLAA for Babcock & Wilcox (B&W) reactor internals to be evaluated for the subsequent period of extended operation in accordance with the NRC staff's safety evaluation concerning "Demonstration of the Management of Aging Effects for the Reactor Vessel Internals," B&W Owners Group report number BAW-2248, which is included in BAW-2248A, March 2000. Plant-specific TLAAs are addressed in Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses," of this SRP-SLR.

3.1.2.2.4 Cracking Due to Stress Corrosion Cracking and Intergranular Stress Corrosion Cracking

1. Cracking due to stress corrosion cracking (SCC) and intergranular stress corrosion cracking (IGSCC) could occur in the stainless steel (SS) and nickel alloy BWR top head enclosure vessel flange leak detection lines. The Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report recommends that a plant-specific AMP be evaluated because existing programs may not be capable of mitigating or detecting cracking due to SCC and IGSCC. Acceptance criteria are described in Branch Technical Position (BTP) RLSB-1 (Appendix A.1 of this SRP-SLR Report).

2. Cracking due to SCC and IGSCC could occur in SS BWR isolation condenser components exposed to reactor coolant. The existing program relies on control of reactor water chemistry to mitigate SCC and on ASME Section XI ISI to detect cracking. However, the existing program should be augmented to detect cracking due to SCC and IGSCC. An augmented program is recommended to include temperature and

radioactivity monitoring of the shell-side water and eddy current testing of tubes to ensure that the component's intended function will be maintained during the subsequent period of extended operation. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.1.2.2.5 Crack Growth Due to Cyclic Loading

Crack growth due to cyclic loading could occur in reactor vessel shell forgings clad with SS using a high-heat-input welding process. Growth of intergranular separations (underclad cracks) in the heat-affected zone under austenitic SS cladding is a TLAA to be evaluated for the subsequent period of extended operation for all the SA-508-Cl-2 forgings where the cladding was deposited with a high-heat-input welding process. The methodology for evaluating the underclad flaw should be consistent with the flaw evaluation procedure and criterion in the ASME Section XI Code[2].

See SRP-SLR, Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses," for generic guidance for meeting the requirements of 10 CFR 54.21(c).

3.1.2.2.6 Cracking Due to Stress Corrosion Cracking

1. Cracking due to SCC could occur in the PWR SS reactor vessel flange leak detection lines and bottom-mounted instrument guide tubes exposed to reactor coolant. Further evaluation is recommended to ensure that these aging effects are adequately managed. A plant-specific AMP should be evaluated to ensure that this aging effect is adequately managed. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

2. Cracking due to SCC could occur in Class 1 PWR cast austenitic stainless steel (CASS) reactor coolant system piping and piping components exposed to reactor coolant. The existing program relies on control of water chemistry to mitigate SCC; however, SCC could occur for CASS components that do not meet the NUREG–0313, "Technical Report on Material Selection and Process Guidelines for BWR Coolant Pressure Boundary Piping" guidelines with regard to ferrite and carbon content. Further evaluation is recommended of a plant-specific program for these components to ensure that this aging effect is adequately managed. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.1.2.2.7 Cracking Due to Cyclic Loading

Cracking due to cyclic loading could occur in steel and SS BWR isolation condenser components exposed to reactor coolant. The existing program relies on ASME Section XI ISI. However, the existing program should be augmented to detect cracking due to cyclic loading. An augmented program is recommended to include temperature and radioactivity monitoring of the shell-side water and eddy current testing of tubes to ensure that the component's intended

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

function will be maintained during the subsequent period of extended operation. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.1.2.2.8 Loss of Material Due to Erosion

Loss of material due to erosion could occur in steel steam generator feedwater impingement plates and supports exposed to secondary feedwater. Further evaluation is recommended of a plant-specific AMP to ensure that this aging effect is adequately managed. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

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

Electric Power Research Institute (EPRI) Topical Report (TR) No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A)" [henceforth TR Materials Reliability Program (MRP)-227-A, which may be accessed at ADAMS Accession Nos. ML12017A191 through ML12017A197 and ML12017A199], provides the industry's current aging management recommendations for the reactor vessel internal (RVI) components that are included in the design of a PWR facility. In this report, the EPRI MRP identified that the following aging mechanisms may be applicable to the design of the RVI components in these types of facilities: (a) SCC, (b) irradiation-assisted stress corrosion cracking (IASCC), (c) fatigue, (d) wear, (e) neutron irradiation embrittlement, (f) thermal aging embrittlement, (g) void swelling and irradiation growth, or (h) thermal or irradiation-enhanced stress relaxation or irradiation enhanced creep. The methodology in TR MRP-227-A was approved by the NRC in a safety evaluation dated December 16, 2011 (ML11308A770), which includes those plant-specific applicant/licensee action items that a licensee or applicant applying the MRP-227-A report would need to address and resolve and apply to its licensing basis.

The EPRI MRP's functionality analysis and failure modes, effects, and criticality analysis (FMECA) bases for grouping Westinghouse-designed, B&W-designed and Combustion Engineering (CE)-designed RVI components into these inspection categories was based on an assessment of aging effects and relevant time-dependent aging parameters through a cumulative 60-year licensing period (i.e., 40 years for the initial operating license period plus an additional 20 years during the initial period of extended operation). The EPRI MRP has yet to assess whether potential operations of Westinghouse-designed, B&W-designed and CE-designed reactors during a SLR period would have any impact on the existing susceptibility rankings and inspection categorizations for the RVI components in these designs, as defined in TR MRP-227-A or its applicable MRP background documents (e.g., TR MRP-191 for Westinghouse-designed or CE-designed RVI components or MRP-189 for B&W-designed components).

Therefore, for PWR facilities' SLRAs, a plant-specific AMP for the RVI components will be needed to demonstrate that the RVI components will be managed in accordance with the requirements of 10 CFR 54.21(a)(3) during the proposed SLR period. Components for inspection, parameters monitored, monitoring methods, inspection sample size, frequencies, expansion criteria, and acceptance criteria are to be justified in the SLRA. The NRC staff will assess the adequacy of the plant-specific AMP against the criteria for the 10 AMP program elements that are defined in Sections A.1.2.3.1 through A.1.2.3.10 of SRP-SLR Appendix A.1.

3.1.2.2.10 Loss of Material Due to Wear

1. Industry operating experience indicates that loss of material due to wear can occur in PWR control rod drive (CRD) head penetration nozzles made of nickel alloy due to the interactions between the nozzle and the thermal sleeve centering pads of the nozzle (see Ref. 31). The CRD head penetration nozzles are also called control rod drive mechanism (CRDM) nozzles or CRDM head adapter tubes. The applicant should perform a further evaluation to confirm the adequacy of a plant-specific AMP or analysis (with any necessary inspections) for management of the aging effect. The applicant may use the acceptance criteria, which are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report), to demonstrate the adequacy of a plant-specific AMP. Alternatively, the applicant may perform an analysis with any necessary inspections to confirm that loss of material due to wear does not affect the intended function(s) of these CRD head penetration nozzles, consistent with the current licensing basis (CLB).

2. Industry operating experience indicates that loss of material due to wear can occur in the SS thermal sleeves of PWR CRD head penetration nozzles due to the interactions between the nozzle and the thermal sleeve (e.g., where the thermal sleeve exits from the head penetration nozzle inside the reactor vessel as described in Ref. 32). Therefore, the applicant should perform a further evaluation to confirm the adequacy of a plant-specific AMP for management of the aging effect. The applicant may use the acceptance criteria, which are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report), to demonstrate the adequacy of a plant-specific AMP.

3.1.2.2.11 Cracking Due to Primary Water Stress Corrosion Cracking

1. Foreign operating experience in steam generators with a similar design to that of Westinghouse Model 51 has identified cracking due to primary water stress corrosion cracking (PWSCC) in SG divider plate assemblies fabricated of Alloy 600 and/or the associated Alloy 600 weld materials, even with proper primary water chemistry (EPRI TR-1014982). Cracks have been detected in the stub runner, adjacent to the tubesheet/stub runner weld. Therefore, the water chemistry program may not be effective in managing the aging effect of cracking due to PWSCC in SG divider plate assemblies. This is of particular concern for SGs where the tube-to-tubesheet welds are considered structural welds and/or where the divider plate assembly contributes to the mechanical integrity of the tube-to-tube sheet welds.

   Although these SG divider plate cracks may not have a significant safety impact in and of themselves, these cracks could impact adjacent items, such as the tube-to-tubesheet welds and the channel head, if they propagate to the boundary with these items. For the tube-to-tubesheet welds, PWSCC cracks in the divider plate could propagate to the tubesheet cladding with possible consequences to the integrity of the tube-to-tubesheet welds. For the channel head, the PWSCC cracks in the divider plate could propagate to the SG triple point and potentially affect the pressure boundary of the SG channel head.

   The existing program may rely on control of reactor water chemistry to mitigate cracking due to PWSCC. A plant-specific AMP should be evaluated, along with the primary water chemistry program, because the existing primary water chemistry program may not be capable of mitigating cracking due to PWSCC. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

2. Cracking due to PWSCC could occur in SG nickel alloy tube-to-tubesheet welds exposed to reactor coolant. Unless the NRC has approved a redefinition of the pressure boundary in which the tube-to-tubesheet weld is no longer included, the effectiveness of the primary water chemistry program should be verified to ensure cracking is not occurring:

- For plants with Alloy 600 SG tubes that have not been thermally treated and for which an alternate repair criteria such as C*, F*, or W* has been permanently approved, the weld is no longer part of the pressure boundary and no plant specific AMP is required;

- For plants with Alloy 600 steam generator tubes that have not been thermally treated and for which there is no permanently approved alternate repair criteria such as C*, F*, or W*, a plant-specific AMP is required;

- For plants with Alloy 600TT SG tubes and for which an alternate repair criteria such as H* has been permanently approved, the weld is no longer part of the pressure boundary and no plant specific AMP is required;

- For plants with Alloy 600TT SG tubes and for which no alternate repair criteria such as H* permanently approved, a plant-specific AMP is required;

- For plants with Alloy 690TT SG tubes with Alloy 690 tubesheet cladding, the water chemistry is sufficient, and no further action or plant-specific AMP is required;

- For plants with Alloy 690TT SG tubes and with Alloy 600 tubesheet cladding, either a plant-specific program or a rationale for why such a program is not needed is required.

The existing program relies on control of reactor water chemistry to mitigate cracking due to PWSCC. A plant-specific AMP should be evaluated, along with the primary water chemistry program, because the existing primary water chemistry program may not be capable of mitigating cracking due to PWSCC. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.1.2.2.12 Cracking Due to Irradiation-Assisted Stress Corrosion Cracking

1. GALL-SLR Report AMP XI.M9, “BWR Vessel Internals,” manages aging degradation of nickel alloy and SS, including associated welds, which are used in BWR vessel internal components. When exposed to the BWR vessel environment, these materials can experience cracking due to IASCC. The existing Boiling Water Reactor Vessel and Internals Project (BWRVIP) examination guidelines are mainly based on aging evaluation of BWR vessel internals for operation up to 60 years. However, increases in neutron fluence during the SLR term may need to be assessed for supplemental inspections of BWR vessel internals to adequately manage cracking due to IASCC. Therefore, the applicant should perform an evaluation to determine whether supplemental inspections are necessary in addition to those recommended in the existing BWRVIP examination guidelines. If the applicant determines that supplemental inspections are not necessary, the applicant should provide adequate technical

justification for the determination. If supplemental inspections are determined necessary for BWR vessel internals, the applicant identifies the components to be inspected and performs supplemental inspections to adequately manage IASCC. In addition, the applicant should confirm the adequacy of any necessary supplemental inspections and enhancements to the BWRVIP.

2. The GALL-SLR Report recommends AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for managing IASCC for the core shroud support plate access hole cover (welded or mechanical). GALL-SLR Report AMP XI.M1 manages the aging effect by performing visual examinations. The GALL-SLR AMP also performs augmented inspections using ultrasonic testing (UT) or other demonstrated acceptable techniques if the welded access hole cover has a crevice which is not amenable to visual examinations. Cracking due to IASCC in this component can be facilitated by the increases in neutron fluence during the subsequent period of extended operation. Therefore, an evaluation should be performed to determine whether supplemental inspections are necessary for adequate aging management in addition to the existing ASME Code examination as augmented for crevices. The applicant should also confirm the adequacy of any necessary supplemental inspections and enhancements to the ASME Section XI ISI, Subsections IWB, IWC, and IWD program.

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

GALL-SLR Report AMP XI.M9 manages aging degradation of nickel alloy and SS, including associated welds, which are used in BWR vessel internal components. When exposed to the BWR vessel environment, these materials can experience loss of fracture toughness due to neutron irradiation embrittlement. In addition, CASS, precipitation-hardened (PH) martensitic SS (e.g., 15-5 and 17-4 PH steel) and martensitic SS (e.g., 403, 410, 431 steel) can experience loss of fracture toughness due to neutron irradiation and thermal aging embrittlement.

The existing BWRVIP examination guidelines are mainly based on aging evaluation of BWR vessel internals for operation up to 60 years. Increases in neutron fluence and thermal embrittlement during the SLR term may need to be assessed for supplemental inspections of BWR vessel internals to adequately manage loss of fracture toughness due to neutron irradiation or thermal aging embrittlement. Therefore, the applicant should perform an evaluation to determine whether supplemental inspections are necessary in addition to those recommended in the existing BWRVIP examination guidelines. If the applicant determines that supplemental inspections are not necessary, the applicant should provide adequate technical justification for the determination. If supplemental inspections are determined necessary for BWR vessel internals, the applicant should identify the components to be inspected and perform supplemental inspections to adequately manage loss of fracture toughness. In addition, the applicant should confirm the adequacy of any necessary supplemental inspections and enhancements to the BWRVIP.

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

GALL-SLR Report AMP XI.M9 manages loss of preload due to thermal or irradiation-enhanced stress relaxation in BWR core plate rim holddown bolts. The issue is applicable to

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

GALL-SLR Report AMP XI.M9 states that the inspections in BWRVIP TR No. BWRVIP-25, "BWR Vessel and Internals Project, BWR Core Plate Inspection and Flaw Evaluation Guidelines (BWRVIP-25)," are used to manage loss of preload due to thermal or irradiation-enhanced stress relaxation in BWR designs with core plate rim holddown bolts. However, in previous LRAs, some applicants have identified that the inspection bases for managing loss of preload in TR No. BWRVIP-25 may not be capable of gaining access to the rim holddown bolts or are not sufficient to detect loss of preload on the components. For applicants that have identified this issue in their past LRAs, the applicants either committed to modifying the plant design to install wedges in the core plate designs or to submit an inspection plan, with a supporting core plate rim holddown bolt preload analysis for NRC approval at least 2 years prior to entering into the initial period of extended operation for the facility.

For SLRAs that apply to BWRs with core plate rim holddown bolts, the NRC staff recommends that an enhanced augmented inspection basis for the bolts be proposed and justified, with a supporting loss of preload analysis. If an existing NRC-approved analysis for the bolts exists in the CLB and conforms to the definition of a TLAA, the applicant should identify the analysis as a TLAA for the LRA and demonstrate how the analysis is acceptable in accordance with either 10 CFR 54.21(c)(1)(i), (ii), or (iii). Otherwise, if a new analysis will be performed to support an updated augmented inspection basis for the bolts for the subsequent period of extended operation, the NRC staff recommends that a license renewal commitment be placed in the FSAR supplement for the applicant to submit both the inspection plan and the supporting loss of preload analysis to the NRC staff for approval at least 2 years prior to entering into the subsequent period of extended operation for the facility.

3.1.2.2.15 Loss of Material Due to Boric Acid Corrosion

Foreign operating experience identified loss of material due to boric acid corrosion in the steel base material of a recirculating SG channel head. This corrosion primarily occurs when the plant is shutdown and the steam generators are exposed to oxygen. The observed loss of material was volumetric in the form of one large cavity. The loss of material was associated with an area where the channel head cladding did not fully cover the steel base material. The cause of the missing cladding is not currently known. This operating experience indicates that if SG head cladding is compromised (e.g., due to cracking, manufacturing defects or foreign material impingement damage), loss of material due to boric acid corrosion could occur in the steel base material of the SG head (i.e., recirculating steam generator channel head and once-through SG upper and lower heads).

The existing program may rely on control of reactor water chemistry to mitigate loss of material due to boric acid corrosion for SG head base material when the cladding of this component was compromised and the steel base material was exposed to reactor coolant. A plant-specific AMP should be evaluated, along with the Water Chemistry program, to ensure that the program is capable of managing loss of material due to boric acid corrosion for the SG head base material. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.1.2.2.16 Cracking Due to Cyclic Loading

1. Cracking due to cyclic loading could occur in BWR steel and SS welded connections between the re-routed control rod drive return line and the inlet piping system that delivers return line flow to the reactor pressure vessel, which are exposed to reactor coolant. Further evaluations of condition monitoring activities are recommended to ensure that cracking is detected before there is a loss of intended function. Periodic inspections in accordance with the recommendations in NUREG–0619, Section 8.2, are acceptable for the detection of cracking. Specifically, the welded connection that joins the re-routed control rod drive return line to the inlet piping system that returns flow to the reactor vessel should be inspected during each refueling outage. This inspection should use UT and include base metal to a distance of one-pipe-wall thickness or 0.5 inches, whichever is greater, on both sides of the weld. The inlet piping into which the control rod drive return line flow is connected should also be inspected by UT to a distance of at least one pipe diameter downstream of the welded connection. For other approaches, acceptance criteria are described in Appendix A.1 of this SRP-SLR Report. No condition monitoring activities are necessary if the control rod drive return line was removed.

2. Cracking due to cyclic loading could occur in BWR-2 steel (with or without SS cladding) CRD return line nozzles and their nozzle-to-vessel welds exposed to reactor coolant. Further evaluation of a plant-specific AMP is recommended to ensure that this aging effect is adequately managed because BWR-2 designs do not have a cut and capped CRD return line nozzle and thus may be more susceptible to cracking. Acceptance criteria are described in Appendix A.1 of this SRP-SLR.

3.1.2.2.17 Cracking Due to Stress Corrosion Cracking or Intergranular Stress Corrosion Cracking

Cracking due to SCC and IGSCC could occur in BWR SS and nickel alloy piping, and piping components greater than or equal to 4 inches nominal pipe size (NPS); nozzle safe ends and associated welds; and CRD return line nozzle caps and the associated cap-to-nozzle welds or cap-to-safe end welds in BWR-3, BWR-4, BWR-5, and BWR-6 designs that are exposed to reactor coolant. GALL-SLR Report AMP XI.M2, “Water Chemistry,” is recommended to mitigate SCC and IGSCC, and augmented inspection activities are recommended in accordance with GALL-SLR Report AMP XI.M7, “BWR Stress Corrosion Cracking,” for condition monitoring. However, these programs may need to be augmented to manage the effects of cracking in dead-legs and other piping locations with stagnant flow where localized environmental conditions could exacerbate the mechanisms of SCC and IGSCC. Further evaluation is recommended to identify any such locations and to evaluate the adequacy of the applicant’s proposed AMPs on a case-by-case basis to ensure that the intended functions of components in these locations will be maintained during the subsequent period of extended operation. Acceptance criteria are described in Appendix A.1 of this SRP-SLR.

3.1.2.2.18 Loss of Material Due to General, Crevice or Pitting Corrosion and Microbiologically-Induced Corrosion and Cracking Due to Stress Corrosion Cracking

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

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

3.1.2.2.19 Loss of Material Due to Pitting and Crevice Corrosion and Microbiologically-Induced Corrosion in Components Exposed to Treated Water, Treated Borated Water, or Sodium Pentaborate Solution

Loss of material due to crevice corrosion can occur in steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if oxygen levels are greater than 100 ppb. In addition, loss of material due to pitting can occur if oxygen levels are greater than 100 ppb, halides or sulfates levels are greater than 150 ppb, and stagnant flow conditions exist. Loss of material due to microbiologically-induced corrosion can occur with steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if the pH is less than 10.5 and temperature is less than 99 °C [210 °F].

Where oxygen levels are less than or equal to 100 ppb, GALL-SLR Report AMP XI.M2, “Water Chemistry,” and GALL-SLR Report AMP XI.M32, “One-Time Inspection,” are acceptable methods to manage loss of material due to pitting and crevice corrosion. Where oxygen levels are greater than 100 ppb, GALL-SLR Report AMP XI.M2, "Water Chemistry," and GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," are acceptable methods to manage loss of material due to crevice corrosion. Where stagnant flow conditions exist, and oxygen levels are greater than 100 ppb and halides or sulfates levels are greater than 150 ppb, GALL-SLR Report AMP XI.M2, "Water Chemistry," and GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," are acceptable methods to manage loss of material due to pitting and crevice corrosion.

Where the pH is greater than or equal to 10.5 and the temperature is greater than or equal to 99 °C [210 °F], GALL-SLR Report AMP XI.M2, "Water Chemistry," and GALL-SLR Report AMP XI.M32, "One-Time Inspection," are acceptable methods to manage loss of material due to loss of material due to microbiologically-induced corrosion. Where the pH is less than 10.5 and temperature is less than 99 °C [210 °F], GALL-SLR Report AMP XI.M2, "Water Chemistry," and GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," are acceptable methods to manage loss of material due to microbiologically-induced corrosion.

3.1.2.2.20 Quality Assurance for Aging Management of Nonsafety-Related Components

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

3.1.2.2.21 Ongoing Review of Operating Experience

Acceptance criteria are described in Appendix A.4, "Operating Experience for AMPs."

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

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

3.1.2.4 Aging Management Programs

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

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

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

If the applicant chooses to use a plant-specific program that is not a GALL-SLR AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix A.1.2.3 of this SRP-SLR Report).

3.1.2.5 Final Safety Analysis Report Supplement

The programs and activities for managing the effects of aging for the subsequent period of extended operation described in the FSAR Supplement should be sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects will be managed during the subsequent period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the subsequent period of extended operation. Table 3.0-1 of this SRP-SLR provides examples of the type of information to be included in the FSAR Supplement. Table 3.1-2 lists the programs that are applicable for this SRP-SLR subsection.

3.1.3 Review Procedures

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

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

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

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

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

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

3.1.3.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The NRC staff reviews the evaluation of this TLAA separately following the guidance in Section 4.3 of this SRP-SLR.

3.1.3.2.2 Loss of Material Due to General, Pitting, and Crevice Corrosion

1. An augmented program is recommended for the management of loss of material due to general, pitting, and crevice corrosion for steel PWR SG shell assembly exposed to secondary feedwater and steam. The existing program relies on control of water chemistry to mitigate corrosion and ISI to detect loss of material. The extent and schedule of the existing SG inspections are designed to ensure that flaws cannot attain a depth sufficient to threaten the integrity of the welds. However, according to NRC IN 90-04, the program may not be sufficient to detect pitting and crevice corrosion, if general and pitting corrosion of the shell is known to exist. Therefore, an augmented inspection is recommended to manage this aging effect. Furthermore, this issue is limited to Westinghouse Model 44 and 51 Steam Generators where a high-stress region exists at the shell to transition cone weld. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report). Loss of material due to general, pitting, and crevice corrosion could also occur for the steel top head enclosure (without cladding) top head nozzles [vent, top head spray or reactor core isolation cooling (RCIC), and spare] exposed to reactor coolant. The existing program relies on control of reactor water chemistry to mitigate corrosion. However, control of water chemistry does not preclude loss of material due to pitting and crevice corrosion at locations of stagnant flow conditions. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that corrosion is not occurring. The reviewer verifies on a case-by-case basis that the applicant has proposed a program that will manage loss of material due to general, pitting and crevice corrosion by providing enhanced inspection and supplemental methods to detect loss of material and ensure that the component-intended function will be maintained during the subsequent period of extended operation.

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

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

3.1.3.2.3 Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement

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

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

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

3. Reduction in Fracture Toughness for B&W reactor internals is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The NRC staff reviews the evaluation of this TLAA following the guidance in Section 4.7 of this SRP-SLR consistent with the action item documented in the NRC staff’s safety evaluation for MRP-227, Revision 0.

3.1.3.2.4 Cracking Due to Stress Corrosion Cracking and Intergranular Stress Corrosion Cracking

1. A plant-specific AMP should be evaluated to manage cracking due to SCC and IGSCC in SS and nickel alloy BWR top head enclosure vessel flange leak detection lines. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

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

3.1.3.2.5 Crack Growth Due to Cyclic Loading

Further evaluation is recommended of programs to manage crack growth due to cyclic loading in reactor vessel shell forgings clad with SS using a high-heat-input welding process. Growth of intergranular separations (underclad cracks) in the heat affected zone under austenitic SS cladding is a TLAA to be evaluated for the subsequent period of extended operation for all the SA-508-Cl-2 forgings where the cladding was deposited with a high-heat-input welding process. The methodology for evaluating the underclad flaw should be consistent with the current well-established flaw evaluation procedure and criterion in the ASME Section XI Code. The SRP-SLR, Section 4.7 provides generic guidance for meeting the requirements of 10 CFR 54.21(c). The NRC staff reviews the evaluation of this TLAA separately following the guidance in Section 4.7 of this SRP-SLR Report.

3.1.3.2.6 Cracking Due to Stress Corrosion Cracking

1. A plant-specific AMP should be evaluated to manage cracking due to SCC in SS PWR reactor vessel flange leak detection lines and bottom-mounted instrument guide tubes exposed to reactor coolant. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

2. A plant-specific AMP should be evaluated to manage cracking due to SCC in CASS PWR Class 1 reactor coolant system piping and piping components exposed to reactor coolant that do not meet the carbon and ferrite content guidelines of NUREG–0313. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.1.3.2.7 Cracking Due to Cyclic Loading

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

3.1.3.2.8 Loss of Material Due to Erosion

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

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

EPRI TR No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A)" (henceforth TR MRP-227-A, which may be accessed at ADAMS Accession Nos. ML12017A191 through ML12017A197 and ML12017A199), provides the industry's current aging management recommendations for the RVI components that are included in the design of a PWR facility. In this report, the EPRI MRP identified that the following aging mechanisms may be applicable to the design of the RVI components in these types of facilities: (a) SCC, (b) IASCC, (c) fatigue, (d) wear, (e) neutron irradiation embrittlement, (f) thermal aging embrittlement, (g) void swelling and irradiation growth, or (h) thermal or irradiation-enhanced stress relaxation or irradiation enhanced creep. The methodology in TR MRP-227-A was approved by the NRC in a safety evaluation dated December 16, 2011 (ML11308A770), which includes those plant-specific applicant/licensee action items that a licensee or applicant applying the MRP-227-A report would need to address and resolve and apply to its licensing basis.

The EPRI MRP does not currently assess whether potential operations of Westinghouse-designed, B&W-designed and CE-designed reactors during a subsequent period of extended operation would have any impact on the existing susceptibility rankings and inspection categorizations for the RVI components in these designs, as defined in TR MRP-227-A or its applicable MRP issued background documents (e.g., TR MRP-191 for Westinghouse-designed or CE-designed RVI components or MRP-189 for B&W-designed components). Therefore, for SLRAs of PWR facilities, a plant-specific AMP for the RVI components is needed to demonstrate that the RVI components will be managed in accordance with the requirements of 10 CFR 54.21(a)(3) during a proposed subsequent period of extended operation. The reviewer reviews the adequacy of the applicant's AMP on a case-by-case basis against the criteria for plant-specific AMP program elements defined in Sections A.1.2.3.1 through A.1.2.3.10 of SRP-SLR Appendix A.1. The reviewer verifies that the applicant has defined both the type of performance monitoring, condition monitoring, preventative monitoring, or mitigative monitoring AMP that will be used for aging management of the RVI components and the specific program element criteria for the AMP that will be used to manage age-related effects in the RVI components during the SLR period.

If a plant-specific sampling-based condition monitoring program is proposed as the AMP for the components, the reviewer verifies that the applicant has appropriately identified (with adequate justification) the population of RVI components that are within the scope of the program, and the specific RVI components that will be inspected by the AMP. The reviewer also verifies that the applicant has appropriately identified the aging effects that will be monitored, the components in the inspection sample, and the inspection methods and frequency that will be applied to the components. The reviewer also verifies that program includes applicable inspection expansion criteria that will be applied under the program if inspections of the RVI components results in identification of relevant age-related aging effects or mechanisms. In addition, the reviewer verifies that the program includes appropriate acceptance criteria for evaluating the inspection results of the AMP and appropriate corrective action criteria that will be implemented if these acceptance criteria are not met. Applicant bases for resolving specific Technical Report or TR applicant/licensee action items will be within the scope of the NRC's review of the AMP. Refer to SRP-SLR Section 3.0 and SRP-SRP Appendix A.1 for additional information.

3.1.3.2.10 Loss of Material Due to Wear

1. Loss of material due to wear can occur in PWR CRD head penetration nozzles due to the interactions between the nozzle and the thermal sleeve centering pads of the nozzle. The applicant should perform a further evaluation to confirm the adequacy of a plant-specific AMP or analysis (with any necessary inspections) for management of the aging effect. The reviewer confirms that the applicant's plant-specific AMP for managing this aging effect meets the acceptance criteria that are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report). Alternatively, the reviewer confirms that loss of material due to wear does not affect the intended function(s) of CRD head penetration nozzles, consistent with the CLB, if the applicant relies on an analysis for aging management. The reviewer also confirms whether inspections are necessary to ensure the adequacy of the analysis.

2. Loss of material due to wear can occur in the thermal sleeves of PWR CRD head penetration nozzles due to the interactions between the nozzle and the thermal sleeve. The applicant should perform a further evaluation to confirm the adequacy of a plant-specific AMP for management of the aging effect. The reviewer confirms that the applicant's plant-specific AMP for managing this aging effect meets the acceptance criteria that are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.1.3.2.11 Cracking Due to Primary Water Stress Corrosion Cracking

1. A plant-specific AMP should be evaluated, along with the primary water chemistry program, to manage cracking due to PWSCC in nickel alloy divider plate assemblies made of Alloy 600 and/or the associated Alloy 600 weld materials for SGs with a similar design to that of Westinghouse Model 51. The effectiveness of the chemistry control program should be verified to ensure that cracking due to PWSCC is not occurring. The reviewer verifies the materials of construction of the applicant's SG divider plate assembly. If these materials are susceptible to cracking, the reviewer verifies that the applicant has evaluated the potential for cracking in the divider plate to propagate into other components (e.g., tubesheet cladding). If propagation into these other components is possible, the reviewer verifies if the applicant has described an inspection program (examination technique and frequency) for ensuring that no cracks are propagating into other items (e.g., tube sheet and channel head) that could challenge the integrity of those items. The reviewer reviews the applicant's proposed program on

a case-by-case basis to ensure that an adequate program will be in place for the management of this aging effect.

2. A plant-specific AMP should be evaluated, along with the primary water chemistry program, to manage cracking due to PWSCC in recirculating SG nickel alloy tube-to-tubesheet welds exposed to reactor coolant. The effectiveness of the primary water chemistry program should be verified to ensure that cracking due to PWSCC is not occurring. The reviewer verifies the combination of materials of construction of the SG tubes and tubesheet cladding and the classification of the tube-to-tubesheet weld. If this combination requires further evaluation, the reviewer reviews the applicant’s proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of this aging effect.

3.1.3.2.12 Cracking Due to Irradiation-Assisted Stress Corrosion Cracking

1. Cracking due to IASCC can occur in BWR vessel internals made of nickel alloy and SS. The applicant should perform an evaluation to determine whether supplemental inspections are necessary in addition to the existing BWRVIP examination guidelines to adequately manage cracking due to IASCC for BWR vessel internals. This evaluation for supplemental inspections is based on neutron fluence and cracking susceptibility (i.e., applied stress, operating temperature, and environmental conditions). The NRC staff reviews the applicant’s evaluation to ensure that adequate supplemental inspections are identified and included in the applicant’s BWR Vessel Internals Program as necessary for aging management of cracking due to IASCC. In addition, any necessary enhancements to the BWRVIP should be reviewed for adequate justification.

2. Cracking due to IASCC can occur in the BWR core shroud support plate access hole cover (welded or mechanical). The applicant should perform an evaluation to determine whether supplemental inspections are necessary in addition to the existing ISI to adequately manage cracking due to IASCC for this component for the subsequent period of extended operation. This evaluation is based on neutron fluence and cracking susceptibility (i.e., applied stress, operating temperature, and environmental conditions). The NRC staff reviews the applicant’s evaluation to ensure that adequate supplemental inspections are identified and included in the applicant’s aging management for this component as necessary. In addition, any necessary enhancements to the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program should be reviewed for adequate justification.

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

Loss of fracture toughness due to neutron irradiation embrittlement can occur in BWR vessel internals made of nickel alloy and SS. In addition, loss of fracture toughness due to neutron irradiation and thermal aging embrittlement can occur in BWR vessel internals made of CASS, PH martensitic SS (e.g., 15-5 and 17-4 PH steel) and martensitic SS (e.g., 403, 410, 431 steel).

The applicant should perform an evaluation to determine whether supplemental inspections are necessary in addition to the existing BWRVIP examination guidelines to adequately manage loss of fracture toughness for BWR vessel internals. This evaluation for supplemental inspections is based on neutron fluence, thermal aging susceptibility, fracture toughness, and cracking susceptibility (i.e., applied stress, operating temperature, and environmental conditions). The NRC staff reviews the applicant's evaluation to ensure that adequate supplemental inspections are identified and included in the applicant's BWRVIP as necessary for aging management of loss of fracture toughness. In addition, any necessary enhancements to the BWRVIP should be reviewed for adequate justification.

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

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

GALL-SLR Report AMP XI.M9 states that the inspections in BWRVIP TR No. BWRVIP-25, "BWR Vessel and Internals Project, BWR Core Plate Inspection and Flaw Evaluation Guidelines (BWRVIP-25)," is used to manage loss of preload due to thermal or irradiation-enhanced stress relaxation in BWR designs with core plate rim holddown bolts. However, in initial LRAs, some applicants have identified that the inspection bases for managing loss of preload in TR No. BWRVIP-25 may not be capable of gaining access to the rim holddown bolts or are not sufficient to detect loss of preload on the components. For applicants that have identified this issue in their past LRAs, the applicants have committed to modifying the plant design to install wedges in the core plate designs or to submitting an inspection plan, with a supporting core plate rim holddown bolt preload analysis for NRC approval at least 2 years prior to entering the subsequent period of extended operation for the facility.

For SLRAs that apply to BWRs with core plate rim holddown bolts, the reviewer assesses whether the SLRA has included an enhanced augmented inspection basis for plants' core plate rim holddown bolts and has justified the augmented inspection basis that will be applied to the components, along with a supporting loss of preload analysis that supports the augmented inspection method and frequency that will be applied to the bolts. If an existing NRC-approved analysis for the bolts exists in the CLB and conforms to the definition of a TLAA, the reviewer assesses whether the applicant has identified the analysis as a TLAA for the SLRA and has demonstrated why the analysis is acceptable in accordance with either 10 CFR 54.21(c)(1)(i), (ii), or (iii). Otherwise, if a new analysis will be performed to support an updated 80-year augmented inspection basis for the bolts for the subsequent period of extended operation, the NRC staff reviews the applicant's augmented inspection and evaluation basis to determine whether the FSAR Supplement for the LRA has included a license commitment to submit both the inspection plan and the supporting loss of preload analysis to the NRC staff at least 2 years prior to entering into the subsequent period of extended operation for the facility.

3.1.3.2.15 Loss of Material Due to Boric Acid Corrosion

A plant-specific AMP should be evaluated, along with the Water Chemistry program, to adequately manage loss of material due to boric acid corrosion for the steel base material of the SG head. The reviewer should review the plant-specific program to ensure that the program is capable of managing loss of material due to boric acid corrosion for the steam generator head base material. If the channel head cladding is compromised or steel base material is corroded, the reviewer assesses whether additional analytical evaluations or inspections are necessary in order to ensure that the potential loss of material in the SG head will not affect the integrity of the component.

3.1.3.2.16 Cracking Due to Cyclic Loading

1. As discussed in NUREG–0619, rerouting the control rod drive return line was a measure taken by some licensees to prevent high cyclic thermal loading that had led to cracking of the control rod drive return line nozzles and the reactor pressure vessel wall in BWRs. As a result, in response to NRC Generic Letter (GL) 80-95, some BWR licensees cut and capped the control rod drive return line nozzle and rerouted the return line to an inlet piping system that delivers the return line flow to the reactor pressure vessel (RPV). While this approach eliminated the thermal gradients in the control rod drive return line nozzle in the reactor pressure vessel, it introduced lower magnitude thermal gradients at the welded connection between the rerouted control rod drive return line piping and the inlet piping system. Section 8.2 of NUREG–0619 recommends periodic inspections of this welded connection to detect potential cracking caused by the cyclical loads from these thermal gradients.

   The reviewer evaluates the adequacy of the applicant's condition monitoring activities to ensure that cracking will be detected before there is a loss of intended function at this welded connection. The reviewer either confirms that the applicant will follow the recommendations in NUREG–0619, Section 8.2; or evaluates the applicant's proposed condition monitoring activities on a case-by-case basis.

   The CRD return lines were eliminated from some of the newer-vintage BWR-4, BWR-5, and BWR-6 designs that were still under construction when NUREG–0619 was published. For these cases, the reviewer confirms that the plant configuration does not include a CRD return line.

   Cracking due to cyclic loading could occur in BWR-2 steel with or without SS cladding control rod drive return line nozzles and their nozzle-to-vessel welds exposed to reactor coolant. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of this aging effect.

3.1.3.2.17 Cracking Due to Stress Corrosion Cracking or Intergranular Stress Corrosion Cracking

A review is recommended of plant-specific AMPs for managing cracking due to SCC and IGSCC in BWR SS and nickel alloy piping and piping components greater than or equal to 4 inches NPS; nozzle safe ends and associated welds; and CRD return line nozzle caps and the associated cap-to-nozzle welds or cap-to-safe end welds in BWR-3, BWR-4, BWR-5, and BWR-6 designs that are exposed to reactor coolant. Components in dead-legs and other piping locations with stagnant flow may be subject to localized environmental conditions that could exacerbate the mechanisms of SCC and IGSCC. The reviewer ensures that the applicant has identified any such locations and provided justification for the AMPs credited for managing this aging effect. The reviewer reviews the applicant's justification and proposed AMPs on a case-by-case basis to ensure that the effects of aging will be adequately managed.

3.1.3.2.18 Loss of Material Due to General, Crevice or Pitting Corrosion and Microbiologically-Induced Corrosion and Cracking Due to Stress Corrosion Cracking

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

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

3.1.3.2.19 Loss of Material Due to Pitting and Crevice Corrosion and Microbiologically-Induced Corrosion in Components Exposed to Treated Water, Treated Borated Water, or Sodium Pentaborate Solution

Loss of material due to crevice corrosion can occur in steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if oxygen levels are greater than 100 ppb. In addition, loss of material due to pitting can occur if oxygen levels are greater than 100 ppb, halides or sulfates levels are greater than 150 ppb, and stagnant flow conditions exist. Loss of material due to microbiologically-induced corrosion can occur with steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if the pH is less than 10.5 and temperature is less than 99 °C [210 °F].

The reviewer verifies the applicant's chemistry control parameters to determine whether GALL-SLR Report AMP XI.M2, "Water Chemistry," and a one-time inspection program is implemented (e.g., GALL-SLR Report AMP XI.M32, "One-Time Inspection") or GALL-SLR Report AMP XI.M2, "Water Chemistry," and a periodic inspection program is implemented (e.g., GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components") to manage loss of material.

3.1.3.2.20 Quality Assurance for Aging Management of Nonsafety-Related Components

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

3.1.3.2.21 Ongoing Review of Operating Experience

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

In addition, the reviewer confirms that the applicant has provided an appropriate summary description of these activities in the FSAR supplement. An example description is under "Operating Experience" in Table 3.0-1, "FSAR Supplement for Aging Management of Applicable Systems for SLR."

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

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

3.1.3.4 Aging Management Programs

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

3.1.3.5 Final Safety Analysis Report Supplement

The reviewer confirms that the applicant has provided in its FSAR supplement information equivalent to that in Table 3.0-1 for aging management of the reactor vessel, internals, and reactor coolant system. Table 3.1-2 lists the AMPs that are applicable for this SRP-SLR subsection. The reviewer also confirms that the applicant has provided information for Subsection 3.1.3.3, "AMR Results Not Consistent with or Not Addressed in the GALL-SLR Report," equivalent to that in Table 3.0-1.

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

As noted in Table 3.0-1, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should confirm that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.1.4 Evaluation Findings

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

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

3.1.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

3.1.6 References

1. NEI. NEI 97-06, "Steam Generator Program Guidelines." Revision 2. Washington, DC: Nuclear Energy Institute. September 2005.

2. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54–The License Renewal Rule." Revision 6. Washington, DC: Nuclear Energy Institute.

3. NRC. Information Notice 90-04, "Cracking of the Upper Shell-to-Transition Cone Girth Welds in Steam Generators." Washington, DC: U.S. Nuclear Regulatory Commission. January 26, 1990.

4. NRC. NUREG–0313, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping." Revision 2. Washington, DC: U.S. Nuclear Regulatory Commission. January 1988.

5. EPRI. EPRI 1013706, "PWR Steam Generator Examination Guidelines. Revision 7. Palo Alto, California: Electric Power Research Institute. October 2007.

6. NRC. Regulatory Guide 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes (for Comment)." Washington, DC: U.S. Nuclear Regulatory Commission. May 1976.

7. NRC. Generic Letter 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking." Washington, DC: U.S. Nuclear Regulatory Commission. August 3, 1995.

8. NRC. Information Notice 90-10, "Primary Water Stress Corrosion Cracking (PWSCC) of Inconel 600." Washington, DC: U.S. Nuclear Regulatory Commission. February 23, 1990.

9. NRC. Information Notice 90-30, "Ultrasonic Inspection Techniques for Dissimilar Metal Welds." Washington, DC: U.S. Nuclear Regulatory Commission. May 1, 1990.

10. NRC. Generic Letter 89-08, "Erosion/Corrosion-Induced Pipe Wall Thinning." Washington, DC: U.S. Nuclear Regulatory Commission. May 2, 1989.

11. EPRI. NSAC-202L-R3, "Recommendations for an Effective Flow-accelerated Corrosion Program." Palo Alto, California: Electric Power Research Institute. April 1999.

12. NRC. Information Notice 96-11, "Ingress of Demineralizer Resins Increase Potential for Stress Corrosion Cracking of Control Rod Drive Mechanism Penetrations." Washington, DC: U.S. Nuclear Regulatory Commission. February 14, 1996.

13. EPRI. BWRVIP–190 (EPRI 1016579), *BWR Vessel and Internals Project: BWR Water Chemistry Guidelines-2008 Revision.* Palo Alto, California: Electric Power Research Institute. October 2008

14. EPRI. NP–5769, "Degradation and Failure of Bolting in Nuclear Power Plants." Volumes 1 and 2. Palo Alto, California: Electric Power Research Institute. April 1988.

15. EPRI. TR 1014986, "PWR Primary Water Chemistry Guidelines." Revision 6. Volumes 1 and 2. Palo Alto, California: Electric Power Research Institute. December 2007.

16. NRC. Generic Letter 88-01, "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping." Washington, DC: U.S. Nuclear Regulatory Commission. January 25, 1988.

17. NRC. Generic Letter 97-01, "Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations." Washington, DC: U.S. Nuclear Regulatory Commission. April 1, 1997.

18. NRC. Information Notice 97-46, "Unisolable Crack in High-Pressure Injection Piping." Washington, DC: U.S. Nuclear Regulatory Commission. July 9, 1997.

19. NRC. Regulatory Guide 1.99, "Radiation Embrittlement of Reactor Vessel Materials." Washington, DC: U.S. Nuclear Regulatory Commission. May 1988.

20. NRC. NUREG–0619, "BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking." Washington, DC: U.S. Nuclear Regulatory Commission. November 1980.

21. NRC. NUREG–1339, "Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. June 1990.

22. EPRI. TR-104213, "Bolted Joint Maintenance & Application Guide, Electric Power Research Institute." Palo Alto, California: Electric Power Research Institute. December 1995.

23. Dave Modeen. NEI Letter (December 11) to Gus Lainas, "Responses to NRC Requests for Additional Information (RAIs) on GL 97-01." Washington, DC: Nuclear Energy Institute. 1998.

24. EPRI. TR 1016555, "PWR Secondary Water Chemistry Guidelines–Revision 7." Palo Alto, California: Electric Power Research Institute. February 2009.

25. NRC. Information Notice 91-19, "Steam Generator Feedwater Distribution Piping Damage." Washington, DC: U.S. Nuclear Regulatory Commission. March 12, 1991.

26. EPRI. TR 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A)." Palo Alto, California: Electric Power Research Institute. December 2011.

27. Entergy Operations, Inc. “Demonstration of the Management of Aging Effects for the Reactor Vessel Internals.” Topical Report BAW-2248A. Russellville, Arkansas: Entergy Operations, Inc. March 2000.

28. EPRI. TR-1014982, “Divider Plate Cracking in Steam Generators - Results of Phase 1: Analysis of Primary Water Stress Corrosion Cracking and Mechanical Fatigue in the Alloy 600 Stub Runner to Divider Plate Weld Material.” Palo Alto, California: Electric Power Research Institute. June 2007.

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	1	BWR/PWR	Steel reactor vessel closure flange assembly components exposed to air with potential for reactor coolant leakage	Cumulative fatigue damage: cracking due to fatigue, cyclical loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.A1.RP-201 IV.A2.RP-54
M	2	PWR	Nickel alloy tubes and sleeves exposed to reactor coolant, secondary feedwater/steam	Cumulative fatigue damage: cracking due to fatigue, cyclical loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.D1.R-46 IV.D2.R-46
M	3	BWR/PWR	Stainless steel, nickel alloy reactor vessel internal components exposed to reactor coolant, neutron flux	Cumulative fatigue damage: cracking due to fatigue, cyclical loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.B1.R-53 IV.B2.RP-303 IV.B3.RP-339 IV.B4.R-53
M	4	BWR/PWR	Steel pressure vessel support skirt and attachment welds	Cumulative fatigue damage: cracking due to fatigue, cyclical loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.A1.R-70 IV.A2.R-70
M	5	PWR	Steel, stainless steel, steel (with stainless steel or nickel alloy cladding) steam generator components, pressurizer relief tank components, piping components, bolting	Cumulative fatigue damage: cracking due to fatigue, cyclical loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.C2.R-13 IV.C2.R-18 IV.D1.R-33 IV.D2.R-33
M	6	BWR	Steel (with or without nickel-alloy or stainless steel cladding), stainless steel; nickel alloy reactor coolant pressure	Cumulative fatigue damage: cracking due to fatigue, cyclical loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR, Section 3.1.2.2.1)	IV.C1.R-220

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			boundary components: piping, piping components; other pressure retaining components exposed to reactor coolant				
M	7	BWR	Steel (with or without nickel-alloy or stainless steel cladding), or stainless steel; or nickel alloy reactor vessel components: nozzles; penetrations; safe ends; thermal sleeves; vessel shells, heads and welds exposed to reactor coolant	Cumulative fatigue damage: cracking due to fatigue, cyclical loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR, Section 3.1.2.2.1)	IV.A1.R-04
M	8	PWR	Steel (with or without nickel-alloy or stainless steel cladding), or stainless steel; or nickel alloy steam generator components exposed to reactor coolant	Cumulative fatigue damage: cracking due to fatigue, cyclical loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR, Section 3.1.2.2.1)	IV.D1.R-221 IV.D2.R-222
M	9	PWR	Steel (with or without nickel-alloy or stainless steel cladding), stainless steel; nickel alloy reactor coolant pressure boundary piping, piping components; other pressure retaining components exposed to	Cumulative fatigue damage: cracking due to fatigue, cyclical loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR, Section 3.1.2.2.1)	IV.C2.R-223

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			reactor coolant				
M	10	PWR	Steel (with or without nickel-alloy or stainless steel cladding), stainless steel, or nickel alloy reactor vessel components: nozzles; penetrations; pressure housings; safe ends; thermal sleeves; vessel shells, heads and welds exposed to reactor coolant	Cumulative fatigue damage: cracking due to fatigue, cyclical loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR, Section 3.1.2.2.1)	IV.A2.R-219
M	11	BWR	Steel or stainless steel pump and valve closure bolting exposed to high temperatures and thermal cycles	Cumulative fatigue damage: cracking due to fatigue, cyclical loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.C1.RP-44
M	12	PWR	Steel steam generator components: upper and lower shells, transition cone; new transition cone closure weld exposed to secondary feedwater or steam	Loss of material due to general, pitting, crevice corrosion	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Sections 3.1.2.2.2.1 and 3.1.2.2.2.2)	IV.D1.RP-368
M	13	BWR/PWR	Steel (with or without stainless steel or nickel alloy cladding) reactor vessel beltline shell, nozzle, and weld	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA, SRP-SLR Section 4.2 "Reactor Vessel Neutron Embrittlement"	Yes (SRP-SLR Section 3.1.2.2.3.1)	IV.A1.R-62 IV.A2.R-84

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			components exposed to reactor coolant and neutron flux				
M	14	BWR/PWR	Steel (with or without cladding) reactor vessel beltline shell, nozzle, and weld components; exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	AMP XI.M31, "Reactor Vessel Material Surveillance," and X.M2, "Neutron Fluence Monitoring"	Yes (SRP-SLR Section 3.1.2.2.3.2)	IV.A1.RP-227 IV.A2.RP-229
M	15	PWR	Stainless steel Babcock & Wilcox (including CASS, martensitic SS, and PH SS) and nickel alloy reactor vessel internal components exposed to reactor coolant and neutron flux	Reduction in fracture toughness due to neutron irradiation	TLAA, SRP-SLR Section 4.7 "Other Plant-Specific TLAAs"	Yes (SRP-SLR Section 3.1.2.2.3.3)	IV.B4.RP-376
M	16	BWR	Stainless steel and nickel alloy top head enclosure vessel flange leak detection line	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	Plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.4.1)	IV.A1.R-61
M	17	BWR	Stainless steel isolation condenser components exposed to reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Section 3.1.2.2.4.2)	IV.C1.R-15
M	18	PWR	Reactor vessel shell fabricated of SA508-Cl 2 forgings clad with stainless steel using a	Crack growth due to cyclic loading	TLAA, SRP-SLR Section 4.7 "Other Plant-Specific TLAAs"	Yes (SRP-SLR Section 3.1.2.2.5)	IV.A2.R-85

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			high-heat-input welding process exposed to reactor coolant				
M	19	PWR	Stainless steel reactor vessel closure head flange leak detection line and bottom-mounted instrument guide tubes (external to reactor vessel)	Cracking due to stress corrosion cracking	Plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.6.1)	IV.A2.R-74 IV.A2.RP-154
M	20	PWR	Cast austenitic stainless steel Class 1 piping, piping components exposed to reactor coolant	Cracking due to stress corrosion cracking	AMP XI.M2, "Water Chemistry" and plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.6.2)	IV.C2.R-05
M	21	BWR	Steel and stainless steel isolation condenser components exposed to reactor coolant	Cracking due to cyclic loading	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD."	Yes (SRP-SLR Section 3.1.2.2.7)	IV.C1.R-225
M	22	PWR	Steel steam generator feedwater impingement plate and support exposed to secondary feedwater	Loss of material due to erosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.8)	IV.D1.R-39
M	25	PWR	Steel (with nickel-alloy cladding) or nickel alloy steam generator primary side components: divider plate and tube-to-tube sheet welds exposed to reactor	Cracking due to primary water stress corrosion cracking	AMP XI.M2, "Water Chemistry" and plant-specific aging management program	Yes (SRP-SLR Sections 3.1.2.2.11.1 for divider plates and 3.1.2.2.11.2 for tube to tube sheet welds)	IV.D1.RP-367 IV.D1.RP-385 IV.D2.RP-185

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			coolant				
D	28						
M	29	BWR	Nickel alloy core shroud and core plate access hole cover (welded covers) exposed to reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Section 3.1.2.2.12.2)	IV.B1.R-94
	30	BWR	Stainless steel, nickel alloy penetration: drain line exposed to reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, cyclic loading	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	No	IV.A1.RP-371
	31	BWR	Steel and stainless steel isolation condenser components exposed to reactor coolant	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	No	IV.C1.RP-39
D	32						

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	33	PWR	Stainless steel, steel with stainless steel cladding Class 1 reactor coolant pressure boundary components exposed to reactor coolant	Cracking due to stress corrosion cracking	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	No	IV.C2.R-09 IV.C2.R-217 IV.C2.R-30 IV.C2.RP-344 IV.D1.RP-232
M	34	PWR	Stainless steel, steel with stainless steel cladding pressurizer relief tank (tank shell and heads, flanges, nozzles) exposed to treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	No	IV.C2.RP-231
M	35	PWR	Stainless steel, steel with stainless steel cladding reactor coolant system cold leg, hot leg, surge line, and spray line piping and fittings exposed to reactor coolant	Cracking due to cyclic loading	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	IV.C2.R-56
M	36	PWR	Steel, stainless steel pressurizer integral support exposed to air with metal temperature up to 288°C (550°F)	Cracking due to cyclic loading	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	IV.C2.R-19
M	37	PWR	Steel reactor vessel flange	Loss of material due to wear	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	IV.A2.R-87

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	38	BWR/PWR	Cast austenitic stainless steel Class 1 valve bodies and bonnets exposed to reactor coolant >250 °C (>482 °F)	Loss of fracture toughness due to thermal aging embrittlement	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD." For pump casings and valve bodies, screening for susceptibility to thermal aging is not necessary. The ASME Section XI inspection requirements are sufficient for managing the effects of loss of fracture toughness due to thermal aging embrittlement of CASS valve bodies.	No	IV.C1.R-08 IV.C2.R-08
M	39	BWR/PWR	Steel (with or without stainless steel or nickel alloy cladding), stainless steel, or nickel alloy Class 1 piping, fittings and branch connections < NPS 4 exposed to reactor coolant	Cracking due to stress corrosion cracking (for stainless steel or nickel alloy surfaces exposed to reactor coolant only), intergranular stress corrosion cracking (for stainless steel or nickel alloy surfaces exposed to reactor coolant only), or thermal, mechanical, or vibratory loading	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," AMP XI.M2, "Water Chemistry," and XI.M35, "One-Time Inspection of ASME Code Class 1 Small-Bore Piping"	No	IV.C1.RP-230 IV.C2.RP-235

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	40	PWR	Steel with stainless steel or nickel alloy cladding; or stainless steel pressurizer components exposed to reactor coolant	Cracking due to cyclic loading	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	IV.C2.R-58
M	40a	PWR	Nickel alloy core support pads; core guide lugs exposed to reactor coolant	Cracking due to primary water stress corrosion cracking	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	No	IV.A2.RP-57
M	41	BWR	Nickel alloy core shroud and core plate access hole cover (mechanical covers) exposed to reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Section 3.1.2.2.12.2)	IV.B1.R-95
M	42	PWR	Steel with stainless steel or nickel alloy cladding; stainless steel primary side components; steam generator upper and lower heads, and tube sheet welds; pressurizer components exposed to reactor coolant	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	No	IV.C2.R-25 IV.D2.RP-47
M	43	BWR	Stainless steel and nickel alloy reactor vessel internals exposed to reactor coolant	Loss of material due to pitting, crevice corrosion	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB,	No	IV.B1.RP-26

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					IWC, and IWD," and AMP XI.M2, "Water Chemistry"		
M	44	PWR	Steel steam generator secondary manways and handholds (cover only) exposed to air with leaking secondary-side water and/or steam	Loss of material due to erosion	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	IV.D2.R-31
	45	PWR	Nickel alloy and steel with nickel-alloy cladding reactor coolant pressure boundary components exposed to reactor coolant	Cracking due to primary water stress corrosion cracking	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD," and AMP XI.M2, "Water Chemistry," and, for nickel-alloy, AMP XI.M11B, "Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-induced Corrosion in RCPB Components (PWRs Only)"	No	IV.A2.R-90 IV.A2.RP-186 IV.A2.RP-59 IV.C2.RP-156 IV.C2.RP-159 IV.C2.RP-37 IV.D1.RP-36 IV.D2.RP-36
	46	PWR	Stainless steel, nickel alloy, nickel alloy welds and/or buttering control rod drive head penetration pressure housing or nozzle safe ends and welds (inlet,	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD," and AMP XI.M2, "Water Chemistry," and, for	No	IV.A2.RP-234

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			outlet, safety injection) exposed to reactor coolant		nickel-alloy, AMP XI.M11B, "Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-induced corrosion in RCPB Components (PWRs Only)"		
	47	PWR	Stainless steel, nickel alloy control rod drive head penetration pressure housing exposed to reactor coolant	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD," and AMP XI.M2, "Water Chemistry"	No	IV.A2.RP-55
	48	PWR	Steel external surfaces: reactor vessel top head, reactor vessel bottom head, reactor coolant pressure boundary piping or components adjacent to dissimilar metal (Alloy 82/182) welds exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, "Boric Acid Corrosion," and AMP XI.M11B, "Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid- Induced Corrosion in RCPB Components (PWRs Only)"	No	IV.A2.RP-379 IV.C2.RP-380
M	49	PWR	Steel reactor vessel, piping, piping components in the reactor coolant pressure boundary of PWRs, or steel steam generators	Loss of material due to boric acid corrosion	AMP XI.M10, "Boric Acid Corrosion"	No	IV.A2.R-17 IV.C2.R-17 IV.C2.RP-167 IV.D1.R-17 IV.D2.R-17

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			in PWRs: external surfaces or closure bolting exposed to air with borated water leakage				
M	50	BWR/PWR	Cast austenitic stainless steel Class 1 piping, piping component (including pump casings and control rod drive pressure housings) exposed to reactor coolant >250 °F (>482 °C)	Loss of fracture toughness due to thermal aging embrittlement	AMP XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No	IV.A2.R-77 IV.C1.R-52 IV.C2.R-52
D	51a						
D	51b						
D	52a						
D	52b						
D	52c						

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
D	53a						
D	53b						
D	53c						
M	54	PWR	Stainless steel bottom mounted instrument system flux thimble tubes (with or without chrome plating) exposed to reactor coolant and neutron flux	Loss of material due to wear	AMP XI.M37, "Flux Thimble Tube Inspection"	No	IV.B2.RP-284
D	55a						
D	55b						
D	55c						

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
D	56a						
D	56b						
D	56c						
D	58a						
D	58b						
D	59a						
D	59b						
D	59c						

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	60	BWR	Steel piping, piping components exposed to reactor coolant	Wall thinning due to flow-accelerated corrosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	IV.C1.R-23
	61	PWR	Steel steam generator steam nozzle and safe end, feedwater nozzle and safe end, AFW nozzles and safe ends exposed to secondary feedwater/steam	Wall thinning due to flow-accelerated corrosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	IV.D1.R-37 IV.D2.R-38
	62	PWR	High-strength, low alloy steel, or stainless steel closure bolting; stainless steel control rod drive head penetration flange bolting exposed to air with reactor coolant leakage	Cracking due to stress corrosion cracking	AMP XI.M18, "Bolting Integrity"	No	IV.A2.R-78 IV.C2.R-11 IV.D1.R-10
	63	BWR	Steel or stainless steel closure bolting exposed to air with reactor coolant leakage	Loss of material due to general (steel only), pitting, crevice corrosion, wear	AMP XI.M18, "Bolting Integrity"	No	IV.C1.RP-42
	64	PWR	Steel closure bolting exposed to air – indoor uncontrolled	Loss of material due to general, pitting, crevice corrosion	AMP XI.M18, "Bolting Integrity"	No	IV.C2.RP-166
	65	PWR	Stainless steel control rod drive head penetration flange bolting exposed to air with reactor coolant leakage	Loss of material due to wear	AMP XI.M18, "Bolting Integrity"	No	IV.A2.R-79

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
	66	PWR	High-strength, low alloy steel, or stainless steel closure bolting; stainless steel control rod drive head penetration flange bolting exposed to air with reactor coolant leakage	Loss of preload due to thermal effects, gasket creep, or self-loosening	AMP XI.M18, "Bolting Integrity"	No	IV.A2.R-80 IV.C2.R-12
	67	BWR/PWR	Steel or stainless steel closure bolting exposed to air – indoor with potential for reactor coolant leakage	Loss of preload due to thermal effects, gasket creep, or self-loosening	AMP XI.M18, "Bolting Integrity"	No	IV.C1.RP-43 IV.D1.RP-46 IV.D2.RP-46
	68	PWR	Nickel alloy steam generator tubes exposed to secondary feedwater or steam	Changes in dimension ("denting") due to corrosion of carbon steel tube support plate	AMP XI.M19, "Steam Generators," and AMP XI.M2, "Water Chemistry"	No	IV.D1.R-43 IV.D2.R-226
	69	PWR	Nickel alloy steam generator tubes and sleeves exposed to secondary feedwater or steam	Cracking due to outer diameter stress corrosion cracking or intergranular attack	AMP XI.M19, "Steam Generators," and AMP XI.M2, "Water Chemistry"	No	IV.D1.R-47 IV.D1.R-48 IV.D2.R-47 IV.D2.R-48
	70	PWR	Nickel alloy steam generator tubes, repair sleeves, and tube plugs exposed to reactor coolant	Cracking due to primary water stress corrosion cracking	AMP XI.M19, "Steam Generators," and AMP XI.M2, "Water Chemistry"	No	IV.D1.R-40 IV.D1.R-44 IV.D2.R-40 IV.D2.R-44
	71	PWR	Steel, chrome plated steel, stainless steel, nickel alloy steam generator U-bend supports including anti-vibration bars exposed	Cracking due to stress corrosion cracking or other mechanism(s); loss of material due general (steel only), pitting, crevice corrosion	AMP XI.M19, "Steam Generators," and AMP XI.M2, "Water Chemistry"	No	IV.D1.RP-226 IV.D1.RP-384

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			to secondary feedwater or steam				
	72	PWR	Steel steam generator tube support plate, tube bundle wrapper, supports and mounting hardware exposed to secondary feedwater or steam	Loss of material due to erosion, general, pitting, crevice corrosion, ligament cracking due to corrosion	AMP XI.M19, "Steam Generators," and AMP XI.M2, "Water Chemistry"	No	IV.D1.R-42 IV.D1.RP-161 IV.D2.R-42 IV.D2.RP-162
	73	PWR	Nickel alloy steam generator tubes and sleeves exposed to phosphate chemistry in secondary feedwater or steam	Loss of material due to wastage, pitting corrosion	AMP XI.M19, "Steam Generators," and AMP XI.M2, "Water Chemistry"	No	IV.D1.R-50
	74	PWR	Steel steam generator upper assembly and separators including feedwater inlet ring and support exposed to secondary feedwater or steam	Wall thinning due to flow-accelerated corrosion	AMP XI.M19, "Steam Generators," and AMP XI.M2, "Water Chemistry"	No	IV.D1.RP-49
	75	PWR	Steel steam generator tube support lattice bars exposed to secondary feedwater or steam	Wall thinning due to flow-accelerated corrosion, general corrosion	AMP XI.M19, "Steam Generators," and AMP XI.M2, "Water Chemistry"	No	IV.D1.RP-48
M	76	PWR	Steel, chrome plated steel, stainless steel, nickel alloy steam generator U-bend supports including anti-	Loss of material due to wear, fretting	AMP XI.M19, "Steam Generators"	No	IV.D1.RP-225

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			vibration bars exposed to secondary feedwater or steam				
	77	PWR	Nickel alloy steam generator tubes and sleeves exposed to secondary feedwater or steam	Loss of material due to wear, fretting	AMP XI.M19, "Steam Generators"	No	IV.D1.RP-233 IV.D2.RP-233
	78	PWR	Nickel alloy steam generator components such as, secondary side nozzles (vent, drain, and instrumentation) exposed to secondary feedwater or steam	Cracking due to stress corrosion cracking	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection," or AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD."	No	IV.D2.R-36
	79	BWR	Stainless steel; steel with nickel-alloy or stainless steel cladding; and nickel-alloy reactor coolant pressure boundary components exposed to reactor coolant	Loss of material due to pitting, crevice corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	IV.C1.RP-158
	80	PWR	Stainless steel or steel with stainless steel cladding pressurizer relief tank: tank shell and heads, flanges, nozzles (none-ASME Section XI components)	Cracking due to stress corrosion cracking	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	IV.C2.RP-383

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			exposed to treated borated water >60°C (>140°F)				
	81	PWR	Stainless steel pressurizer spray head exposed to reactor coolant	Cracking due to stress corrosion cracking	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	IV.C2.RP-41
	82	PWR	Nickel alloy pressurizer spray head exposed to reactor coolant	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	IV.C2.RP-40
	83	PWR	Steel steam generator shell assembly exposed to secondary feedwater or steam	Loss of material due to general, pitting, crevice corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	IV.D1.RP-372 IV.D2.RP-153
	84	BWR	Steel top head enclosure (without cladding) top head nozzles (vent, top head spray or RCIC, and spare) exposed to reactor coolant	Loss of material due to general, pitting, crevice corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	IV.A1.RP-50
	85	BWR	Stainless steel, nickel alloy, and steel with nickel alloy or stainless steel cladding reactor vessel flanges, nozzles, penetrations, safe ends, vessel shells, heads and welds exposed to reactor coolant	Loss of material due to pitting, crevice corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	IV.A1.RP-157

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
	86	PWR	Stainless steel steam generator primary side divider plate exposed to reactor coolant	Cracking due to stress corrosion cracking	AMP XI.M2, "Water Chemistry"	No	IV.D1.RP-17
	87	PWR	Stainless steel, nickel alloy PWR reactor internal components exposed to reactor coolant, neutron flux	Loss of material due to pitting, crevice corrosion	AMP XI.M2, "Water Chemistry"	No	IV.B2.RP-24 IV.B3.RP-24 IV.B4.RP-24
	88	PWR	Stainless steel; steel with nickel-alloy or stainless steel cladding; and nickel-alloy reactor coolant pressure boundary components exposed to reactor coolant	Loss of material due to pitting, crevice corrosion	AMP XI.M2, "Water Chemistry"	No	IV.A2.RP-28 IV.C2.RP-23
M	89	PWR	Steel piping, piping components exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	IV.C2.RP-221
M	90	PWR	Copper alloy piping, piping components exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	IV.C2.RP-222
M	91	BWR	Steel reactor vessel closure flange assembly components (including flanges, nut, studs, and washers) exposed to air with potential for reactor coolant leakage	Cracking due to stress corrosion cracking; loss of material due to general, pitting, crevice corrosion, wear	AMP XI.M3, "Reactor Head Closure Stud Bolting"	No	IV.A1.RP-165 IV.A1.RP-51

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	92	PWR	Steel reactor vessel closure flange assembly components (including flanges, nut, studs, and washers) exposed to air with potential for reactor coolant leakage	Cracking due to stress corrosion cracking; loss of material due to general, pitting, crevice corrosion, wear	AMP XI.M3, "Reactor Head Closure Stud Bolting"	No	IV.A2.RP-52 IV.A2.RP-53
M	93	PWR	Copper alloy >15% Zn or > 8% Al piping, piping components exposed to closed-cycle cooling water, treated water	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	IV.C2.RP-12
M	94	BWR	Stainless steel and nickel alloy vessel shell attachment welds exposed to reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, cyclic loading	AMP XI.M4, "BWR Vessel ID Attachment Welds," and AMP XI.M2, "Water Chemistry"	No	IV.A1.R-64
	95	BWR	Steel (with or without stainless steel cladding) feedwater nozzles exposed to reactor coolant	Cracking due to cyclic loading	AMP XI.M5, "BWR Feedwater Nozzle"	No	IV.A1.R-65
M	96	BWR	Steel (with or without stainless steel cladding) control rod drive return line nozzles and their nozzle-to-vessel welds exposed to reactor coolant in BWR-3, BWR-4, BWR-5, and BWR-6 designs	Cracking due to cyclic loading, stress corrosion cracking, or intergranular stress corrosion cracking	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	IV.A1.R-66

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	97	BWR	Stainless steel and nickel alloy piping, piping components greater than or equal to 4 NPS; nozzle safe ends and associated welds; control rod drive return line nozzle cap and associated cap-to-nozzle weld or cap-to-safe end weld in BWR-3, BWR 4, BWR 5, and BWR-6 designs	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	AMP XI.M7, "BWR Stress Corrosion Cracking," and AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Section 3.1.2.2.17)	IV.A1.R-412 IV.C1.R-20 IV.C1.R-21
	98	BWR	Stainless steel, nickel alloy penetrations: instrumentation and standby liquid control exposed to reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, cyclic loading	AMP XI.M8, "BWR Penetrations," and AMP XI.M2, "Water Chemistry"	No	IV.A1.RP-369
M	99	BWR	Stainless steel (including cast austenitic stainless steel; PH martensitic stainless steel; martensitic stainless steel); nickel alloy (including X-750 alloy) reactor internal components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to thermal aging, neutron irradiation embrittlement	AMP XI.M9, "BWR Vessel Internals"	Yes (SRP-SLR Section 3.1.2.2.13)	IV.B1.RP-182 IV.B1.RP-200 IV.B1.RP-219 IV.B1.RP-220 IV.B1.R-416 IV.B1.R-417 IV.B1.R-419

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
	100	BWR	Stainless steel reactor vessel internals components (jet pump wedge surface) exposed to reactor coolant	Loss of material due to wear	AMP XI.M9, "BWR Vessel Internals"	No	IV.B1.RP-377
M	101	BWR	Stainless steel steam dryers exposed to reactor coolant	Cracking due to flow-induced vibration, stress corrosion cracking, intergranular stress corrosion cracking; loss of material due to wear	AMP XI.M9, "BWR Vessel Internals"	No	IV.B1.RP-155
	102	BWR	Stainless steel fuel supports and control rod drive assemblies control rod drive housing exposed to reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	AMP XI.M9, "BWR Vessel Internals," and AMP XI.M2, "Water Chemistry"	No	IV.B1.R-104
M	103	BWR	Stainless steel and nickel alloy reactor internal components exposed to reactor coolant and neutron flux	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	AMP XI.M9, "BWR Vessel Internals," and AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Section 3.1.2.2.12.1)	IV.B1.R-422 IV.B1.R-100 IV.B1.R-105 IV.B1.R-92 IV.B1.R-93 IV.B1.R-96 IV.B1.R-97 IV.B1.R-98 IV.B1.R-99
M	104	BWR	Nickel alloy reactor vessel internal components exposed to reactor coolant and neutron flux	Cracking due to intergranular stress corrosion cracking	AMP XI.M9, "BWR Vessel Internals," and AMP XI.M2, "Water Chemistry"	No	IV.B1.RP-381

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	105	BWR/PWR	Steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.1.2.2.18)	IV.E.RP-353
M	106	BWR/PWR	Nickel alloy piping, piping components and piping element exposed to air – indoor uncontrolled, or air with borated water leakage	None	None	No	IV.E.RP-03 IV.E.RP-378
M	107	BWR/PWR	Stainless steel piping, piping components exposed to gas, air with borated water leakage, air – indoors, uncontrolled	None	None	No	IV.E.RP-04 IV.E.RP-05 IV.E.RP-07
M	110	BWR	Any material piping, piping components exposed to reactor coolant	Wall thinning due to erosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	IV.C1.R-406
N	111	PWR	Nickel alloy steam generator tubes exposed to secondary feedwater or steam	Reduction of heat transfer due to fouling	AMP XI.M2, "Water Chemistry," and AMP XI.M19, "Steam Generators"	No	IV.D1.R-407 IV.D2.R-407
N	113	BWR	Steel reactor vessel external attachments exposed to indoor, uncontrolled air	Loss of material due to general, pitting, crevice corrosion, wear	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry," for chemistry or corrosion-related aging effect	No	IV.A1.R-409

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					mechanisms		
N	114	BWR/PWR	Reactor coolant system components defined as ASME Section XI Code Class components (ASME Code Class 1 reactor coolant pressure boundary components or core support structure components, or ASME Class 2 or 3 components - including ASME defined appurtenances, component supports, and associated pressure boundary welds, or components subject to plant-specific equivalent classifications for these ASME code classes)	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking (stainless steel, nickel alloy components only), cyclical loading; loss of material due to general corrosion (steel only), pitting corrosion, crevice corrosion, wear	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	IV.E.R-444
N	115	BWR/PWR	Stainless steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.1.2.2.18)	IV.E.RP-06
N	116	PWR	Nickel alloy control rod drive penetration nozzles exposed to reactor coolant	Loss of material due to wear	Plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.10.1)	IV.A2.R-413

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	117	PWR	Stainless steel, nickel alloy control rod drive penetration nozzle thermal sleeves exposed to reactor coolant	Loss of material due to wear	Plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.10.2)	IV.A2.R-414
N	118	PWR	Stainless steel, nickel alloy PWR reactor vessel internal components exposed to reactor coolant, neutron flux	Cracking due to stress corrosion cracking, irradiation-assisted stress corrosion cracking, cyclical loading, fatigue	Plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.R-423 IV.B3.R-423 IV.B4.R-423
N	119	PWR	Stainless steel, nickel alloy PWR reactor vessel internal components exposed to reactor coolant, neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement or thermal aging embrittlement; changes in dimensions due to void swelling or distortion; loss of preload due to thermal and irradiation enhanced stress relaxation or creep; loss of material due to wear	Plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.R-424 IV.B3.R-424 IV.B4.R-424
N	120	BWR	Stainless steel core plate rim holddown bolts exposed to reactor coolant and neutron flux	Loss of preload due to thermal or irradiation-enhanced stress relaxation	AMP XI.M9, "BWR Vessel Internals," and TLAA SRP-SLR 4.7 "Other Plant-Specific TLAAs" (if an analysis is performed as part of the aging management basis	Yes (only if a TLAA exists for the CLB) (SRP-SLR Section 3.1.2.2.14)	IV.B1.R-420

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					and conforms to the definition of a TLAA in 10 CFR 54.3(a))		
N	121	BWR	Stainless steel jet pump assembly holddown beam bolts exposed to reactor coolant and neutron flux	Loss of preload due to thermal or irradiation-enhanced stress relaxation	AMP XI.M9, "BWR Vessel Internals"	No	IV.B1.R-421
N	122	BWR/PWR	Steel, stainless steel, nickel alloy, copper alloy Non-ASME Code Class 1 piping, piping components exposed to air – indoor, condensation	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	IV.C1.R-429 IV.C2.R-429
N	124	BWR/PWR	Steel, stainless steel, nickel alloy, copper alloy piping, piping components exposed to condensation	Loss of material due to general (steel and copper alloy only), pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	IV.C1.R-431 IV.C2.R-431
N	125	PWR	Nickel alloy steam generator tubes at support plate locations exposed to secondary feedwater or steam	Cracking due to flow-induced vibration or high-cycle fatigue	AMP XI.M2, "Water Chemistry," and AMP XI.M19, "Steam Generators"	No	IV.D1.R-437 IV.D2.R-442
N	127	PWR	Steel (with stainless steel or nickel alloy cladding) steam generator heads exposed to reactor coolant	Loss of material due to boric acid corrosion	AMP XI.M2, "Water Chemistry," and plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.15)	IV.D1.R-436 IV.D2.R-440

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	128	BWR	Stainless steel, nickel alloy nozzles safe ends and welds: high pressure core spray; low pressure core spray; recirculating water, low pressure coolant injection or RHR injection mode exposed to reactor coolant	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	AMP XI.M7, "BWR Stress Corrosion Cracking," and AMP XI.M2, "Water Chemistry"	No	IV.A1.R-68
N	129	BWR	Steel and stainless steel piping, piping components exposed to reactor coolant: welded connections between the re-routed control rod drive return line and the inlet piping system that delivers return line flow to the reactor pressure vessel exposed to reactor coolant	Cracking due to cyclic loading	Plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.16.1)	IV.C1.R-432
N	130	BWR	Steel (with or without stainless steel cladding) control rod drive return line nozzles and their nozzle-to-vessel welds exposed to reactor coolant in BWR-2 designs	Cracking due to cyclic loading	Plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.16.2)	IV.A1.R-411

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

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	133	BWR/PWR	Steel components exposed to reactor coolant or treated water	Long-term loss of material due to general corrosion	AMP XI.M32, "One-Time Inspection"	No	IV.A1.R-448 IV.C1.R-448 IV.C2.R-448 IV.D1.R-448 IV.D2.R-448
N	134	BWR/PWR	Jacketed thermal insulation in air-indoor uncontrolled, air with borated water leakage, air with reactor coolant leakage, or air with steam or feedwater leakage	Reduced thermal insulation resistance due to moisture intrusion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	IV.A1.R-450 IV.A2.R-450 IV.C1.R-450 IV.C2.R-450 IV.D1.R-450 IV.D2.R-450

Table 3.1-2. Aging Management Programs and Additional Guidance Appendices Recommended for Reactor Vessel, Internals, and Reactor Coolant System	
GALL-SLR Report Chapter/AMP	**Program Name**
AMP X.M1	Cyclic Load Monitoring
AMP XI.M1	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD
AMP XI.M2	Water Chemistry
AMP XI.M3	Reactor Head Closure Stud Bolting
AMP XI.M4	Boiling Water Reactor Vessel ID Attachment Welds
AMP XI.M5	Boiling Water Reactor Feedwater Nozzle
AMP XI.M6	Deleted
AMP XI.M7	Boiling Water Reactor Stress Corrosion Cracking
AMP XI.M8	Boiling Water Reactor Penetrations
AMP XI.M9	Boiling Water Reactor Vessel Internals
AMP XI.M10	Boric Acid Corrosion
AMP XI.M11B	Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-induced Corrosion in Reactor Coolant Pressure Boundary Components (PWRs only)
AMP XI.M12	Thermal Aging of Cast Austenitic Stainless Steel (CASS)
AMP XI.M16A	Deleted
AMP XI.M17	Flow-Accelerated Corrosion
AMP XI.M18	Bolting Integrity
AMP XI.M19	Steam Generators
AMP XI.M21A	Closed Treated Water Systems
AMP XI.M31	Reactor Vessel Surveillance
AMP XI.M32	One-Time Inspection
AMP XI.M33	Selective Leaching
AMP XI.M35	ASME Code Class 1 Small Bore-Piping
AMP XI.M37	Flux Thimble Tube Inspection
GALL-SLR Report Appendix A	Quality Assurance for Aging Management Programs
GALL-SLR Report Appendix B	Operating Experience for Aging Management Programs
SRP-SLR Appendix A.1	Aging Management Review—Generic (Branch Technical Position RLSB-1)

3.2 Aging Management of Engineered Safety Features

Review Responsibilities

Primary—Branch assigned responsibility by Project Manager (PM) as described in Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Section 3.0 of this SRP-SLR Report.

3.2.1 Areas of Review

This section addresses the aging management review (AMR) and the associated aging management programs (AMP) of the engineered safety features. For a recent vintage plant, the information related to the engineered safety features is contained in Chapter 6, "Engineered Safety Features," of the plant's Final Safety Analysis Report (FSAR), consistent with the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG–0800). The engineered safety features contained in this review plan section are generally consistent with those contained in NUREG–0800 except for the refueling water, control room habitability, and residual heat removal systems. For older plants, the location of applicable information is plant-specific because an older plant's FSAR may have predated NUREG–0800.

The engineered safety features consist of containment spray, standby gas treatment [boiling water reactor (BWRs)], containment isolation components, and emergency core cooling systems.

The responsible review organization is to review the following subsequent license renewal application (SLRA) AMR and AMP items assigned to it, per SRP-SLR Section 3.0:

AMRs

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

AMPs

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

FSAR Supplement

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

3.2.2 Acceptance Criteria

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

3.2.2.1 AMR Results Consistent With the Generic Aging Lessons Learned for Subsequent License Renewal Report

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

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

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

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

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

3.2.2.2.1 Cumulative Fatigue Damage

Fatigue is a time-limited aging analysis (TLAA) as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). This TLAA is addressed separately in Section 4.3, "Metal Fatigue Analysis," of this SRP-SLR Report.

3.2.2.2.2 Loss of Material Due to Pitting and Crevice Corrosion

Loss of material due to pitting and crevice corrosion could occur in SS piping, piping components, and tanks exposed to outdoor air or any air environment when the component is insulated or where the component is in the vicinity of insulated components. The possibility of pitting and crevice corrosion also extends to indoor components located in close proximity to sources of outdoor air (e.g., components near intake vents). Pitting and crevice corrosion is known to occur in environments containing sufficient halides (e.g., chlorides) and in which the presence of moisture is possible.

Applicable outdoor air environments (and associated local indoor air environments) include, but are not limited to, those within approximately 5 miles of a saltwater coastline, within 1/2 mile of a road which is treated with salt in the wintertime, areas in which the soil contains more than trace chlorides, plants having cooling towers where the water is treated with chlorine or chlorine compounds, and areas subject to chloride contamination from other agricultural or industrial sources.

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

The applicant may demonstrate that loss of material due to pitting and crevice corrosion is not expected to occur by one or more of the following applicable means.

- For outdoor uninsulated components, describing the outdoor air environment present at the plant and demonstrating that external pitting or crevice corrosion is not expected.
- For underground components, the applicant may demonstrate that loss of material due to pitting or crevice corrosion due to exposure to in-leakage to the vault as a result of external precipitation or groundwater is not expected.
- For insulated components, determining that the insulation does not contain sufficient contaminants to cause loss of material due to pitting or crevice corrosion. One acceptable means to demonstrate this is provided by Regulatory Guide 1.36, “Nonmetallic Thermal Insulation for Austenitic Stainless Steel.”
- For indoor components, determining that there are no liquid-filled systems with threaded or bolted connections (e.g., flanges, valve packing) that could leak onto the component.
- For all components, demonstrating that the aggressive environment is not present by isolating the component from the environment using a barrier to prevent loss of material due to pitting or crevice corrosion. An acceptable barrier includes coatings that have been demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier coating is credited for isolating a component from a potentially aggressive environment, then the barrier coating is evaluated to verify that it is impervious to the plant-specific environment. GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” is an acceptable method to manage the integrity of a barrier coating for internal or external coatings.

The GALL-SLR Report recommends further evaluation to determine whether an AMP is needed to manage this aging effect based on the environmental conditions applicable to the plant and requirements applicable to the components. GALL-SLR AMP XI.M36, “External Surfaces Monitoring,” GALL-SLR AMP XI.M29, “Aboveground Metallic Tanks,” or AMP XI.M41, “Buried and Underground Piping and Tanks,” (for underground components) are acceptable methods to manage loss of material due to pitting and crevice corrosion in SS piping, piping components, and tanks.

3.2.2.2.3 Loss of Material Due to Erosion

Loss of material due to erosion could occur in the SS high-pressure safety injection (HPSI) pump minimum flow recirculation orifice exposed to treated borated water. The GALL-SLR Report recommends a plant-specific AMP be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. Further evaluation is recommended to ensure that the aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position (BTP) RLSB-1 (Appendix A.1 of this SRP-SLR Report).

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

Loss of material due to general corrosion and flow blockage due to fouling can occur in the spray nozzles and flow orifices in the drywell and suppression chamber spray system exposed to air–indoor uncontrolled. This aging effect and mechanism will apply since the carbon steel piping upstream of the spray nozzles and flow orifices is occasionally wetted, even though the majority of the time this system is in standby. The wetting and drying of these components can accelerate corrosion in the system and lead to flow blockage from an accumulation of corrosion products. The GALL-SLR Report recommends further evaluation of a plant-specific AMP to ensure that the aging effect is adequately managed. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.2.2.2.5 Cracking Due to Stress Corrosion Cracking

Cracking due to SCC could occur for SS piping, piping components, and tanks exposed to outdoor air or any air environment when the component is insulated. The possibility of cracking also extends to indoor components located in close proximity to sources of outdoor air (e.g., components near intake vents). Cracking is known to occur in environments containing sufficient halides (e.g., chlorides) and in which moisture is possible.

Applicable outdoor air environments (and associated local indoor air environments) include, but are not limited to, those within approximately 5 miles of a saltwater coastline, within 1/2 mile of a road which is treated with salt in the wintertime, areas in which the soil contains more than trace chlorides, plants having cooling towers where the water is treated with chlorine or chlorine compounds, and areas subject to chloride contamination from other agricultural or industrial sources.

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

The applicant may demonstrate that SCC is not expected to occur by one or more of the following applicable means.

- For outdoor uninsulated components, describing the outdoor air environment present at the plant and demonstrating that SCC is not expected.
- For underground components, the applicant may demonstrate that SCC due to exposure to in-leakage to the vault as a result of external precipitation or groundwater is not expected.

- For insulated components, determining that the insulation does not contain sufficient contaminants to cause SCC. One acceptable means to demonstrate this is provided by Regulatory Guide 1.36, "Nonmetallic Thermal Insulation for Austenitic Stainless Steel."
- For indoor components, determining that there are no liquid-filled systems with threaded or bolted connections (e.g., flanges, valve packing) that could leak onto the component.
- For all components, demonstrating that the aggressive environment is not present by isolating the component from the environment using a barrier to prevent loss of material due to pitting or crevice corrosion. An acceptable barrier includes tightly-adhering coatings that have been demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier coating is credited for isolating a component from a potentially aggressive environment then the barrier coating is evaluated to verify that it is impervious to the plant-specific environment. GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," is an acceptable method to manage the integrity of a barrier coating for internal or external coatings.

The GALL-SLR Report recommends further evaluation to determine whether an AMP is needed to manage this aging effect based on the environmental conditions applicable to the plant and requirements applicable to the components. GALL-SLR AMP XI.M36, "External Surfaces Monitoring," GALL-SLR AMP XI.M29, "Aboveground Metallic Tanks," or AMP XI.M41, "Buried and Underground Piping and Tanks," (for underground components) are acceptable methods to manage cracking of SS due to SCC in piping, piping components, and tanks.

3.2.2.2.6 Quality Assurance for Aging Management of Nonsafety-Related Components

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

3.2.2.2.7 Ongoing Review of Operating Experience

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

3.2.2.2.8 Loss of Material Due to Recurring Internal Corrosion

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

The GALL-SLR Report recommends that a plant-specific AMP, or a new or existing AMP, be evaluated for inclusion of augmented requirements to ensure the adequate management of any recurring aging effect(s). Potential augmented requirements include: alternative examination methods (e.g., volumetric versus external visual), augmented inspections (e.g., a greater number of locations, additional locations based on risk insights based on susceptibility to aging effect and consequences of failure, a greater frequency of inspections), and additional trending parameters and decision points where increased inspections would be implemented. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report)."

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

Plant-specific operating experience examples should be evaluated to determine if the chosen AMP should be augmented even if the thresholds for significance of aging effect or frequency of occurrence of aging effect have not been exceeded. For example, during a 10-year search of plant specific operating experience, two instances of 360 degree 30 percent wall loss occurred at copper alloy to steel joints. Neither the significance of the aging effect nor the frequency of occurrence of aging effect threshold has been exceeded. Nevertheless, the operating experience should be evaluated to determine if the AMP that is proposed to manage the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of inspections) to provide reasonable assurance that the current licensing basis (CLB) intended functions of the component will be met throughout the subsequent period of extended operation. Likewise, the GALL-SLR Report AMR items associated with the new further evaluation items only cite raw water and waste water environments because operating experience indicates that these are the predominant environments associated with recurring internal corrosion; however, if the search of plant-specific operating experience reveals recurring internal corrosion in other water environments (e.g., treated water), the aging effect should be addressed in a similar manner.

3.2.2.2.9 Cracking Due to Stress Corrosion Cracking and Intergranular Stress Corrosion Cracking

Cracking due to SCC and intergranular stress corrosion cracking (IGSCC) could occur in BWR SS and nickel alloy piping and piping components greater than or equal to 4 inches nominal pipe size (NPS); nozzle safe ends and associated welds; and control rod drive return line nozzle caps and the associated cap-to-nozzle welds or cap-to-safe end welds in BWR-3, BWR-4, BWR-5, and BWR-6 designs that are exposed to reactor coolant. The GALL-SLR Report recommends GALL-SLR Report AMP XI.M2, "Water Chemistry," to mitigate SCC and IGSCC and augmented inspection activities in accordance with GALL-SLR Report AMP XI.M7, "BWR Stress Corrosion Cracking," for condition monitoring. However, these programs may need to be augmented to manage the effects of cracking in dead-legs and other piping locations with stagnant flow where localized environmental conditions could exacerbate the mechanisms of SCC and IGSCC. The GALL-SLR Report recommends further evaluation to identify any such locations and to evaluate the adequacy of the applicant's proposed AMPs on a case-by-case basis to ensure that the intended functions of components in these locations will be maintained during the subsequent period of extended operation. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.2.2.2.10 Cracking Due to Stress Corrosion Cracking in Aluminum Alloys

SCC is a form of environmentally assisted cracking which is known to occur in high and moderate strength aluminum alloys. The three conditions necessary for SCC to occur in a component are a sustained tensile stress, aggressive environment, and material with a susceptible microstructure. The aging effect of cracking due to SCC can be mitigated by eliminating one of the three necessary conditions. For the purposes of subsequent license renewal (SLR), acceptance criteria for this further evaluation is being provided for demonstrating that the specific material is not susceptible to SCC or an aggressive environment is not present. The susceptibility of the material is to be established prior to evaluating the environment. This further evaluation item is applicable unless it is demonstrated by the applicant that one of the two necessary conditions discussed below is absent.

<u>Susceptible Material</u>: If the material that a component is constructed of is not susceptible to SCC then the aging effect is not applicable. The microstructure of an aluminum alloy, of which alloy composition is only one factor, is what determines if the alloy is susceptible to SCC. Therefore, providing guidance based on alloy composition will not always successfully protect against SCC in aluminum alloys. The temper, condition, and product form of the alloy is considered when assessing if a material is susceptible to SCC. Aluminum alloys that are susceptible to SCC include:

- 2xxx series alloys in the F, W, Ox, T3x, T4x, or T6x temper
- 5xxx series alloys with a magnesium content of 3.5 weight percent or greater
- 6xxx series alloys in the F temper
- 7xxx series alloys in the F, T5x, or T6x temper
- 2xx.x and 7xx.x series alloys
- 3xx.x series alloys that contain copper
- 5xx.x series alloys with a magnesium content of greater than 8 weight percent

The material is evaluated to verify that it is not susceptible to SCC and that the basis used to make the determination is technically substantiated. Tempers have been specifically developed to improve the SCC resistance for some aluminum alloys. Aluminum alloy and temper combination which are not susceptible to SCC when used in piping, piping component, and tank applications include 1xxx series, 3xxx series, 6061-T6x, and 5454-x.

GALL-SLR Report AMP XI.M29, “Aboveground Metallic Tanks,” is an acceptable method to manage cracking of aluminum due to SCC in tanks. GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” is an acceptable method to manage cracking of aluminum due to SCC in piping and piping components. GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” is an acceptable method to manage cracking of aluminum due to SCC in piping and tanks which are buried or underground. GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” is an acceptable method to manage cracking of aluminum due to SCC in components that are not included in other AMPs. Additional acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

<u>Aggressive Environment</u>: If the environment that an aluminum alloy is exposed to is not aggressive, such as dry gas, controlled indoor air, or treated water, then cracking due to SCC will not occur and the aging effect is not applicable. Aggressive environments that are known to result in cracking of susceptible aluminum alloys due to SCC are aqueous solutions and atmospheric air that contain halides (e.g., chloride). Halide concentrations should generally be

considered high enough to facilitate SCC of aluminum alloys in uncontrolled or untreated aqueous solutions and atmospheric air, such as outdoor air, raw water, waste water, and condensation, unless demonstrated otherwise. If an aluminum component is encapsulated in a secondary material, such as insulation or concrete, the composition of the encapsulating material is evaluated for halides. The environment that the aluminum alloy is exposed to is evaluated to verify that it is either controlled or treated and free of halides.

An alternative strategy to demonstrating that an aggressive environment is not present is to isolate the aluminum alloy from the environment using a barrier to prevent SCC. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier coating is credited for isolating an aluminum alloy from a potentially aggressive environment then the barrier coating is evaluated to verify that it is impervious to the plant-specific environment. GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," or equivalent program is an acceptable method to manage the integrity of a barrier coating.

3.2.2.2.11 Loss of Material Due to General, Crevice or Pitting Corrosion and Microbiologically-Induced Corrosion and Cracking Due to Stress Corrosion Cracking

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

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

3.2.2.2.12 Loss of Material Due to Pitting and Crevice Corrosion and Microbiologically-Induced Corrosion in Components Exposed to Treated Water, Treated Borated Water, or Sodium Pentaborate Solution

Loss of material due to crevice corrosion can occur in steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if oxygen levels are greater than 100 ppb. In addition, loss of material due to pitting can occur if oxygen levels are greater than 100 ppb, halides or sulfates levels are greater than 150 ppb, and stagnant flow conditions exist. Loss of material due to microbiologically-induced corrosion can occur with steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if the pH is less than 10.5 and temperature is less than 99 °C [210 °F].

Where oxygen levels are less than or equal to 100 ppb, GALL-SLR Report AMP XI.M2, “Water Chemistry,” and GALL-SLR Report AMP XI.M32, “One-Time Inspection,” are acceptable methods to manage loss of material due to pitting and crevice corrosion. Where oxygen levels are greater than 100 ppb, GALL-SLR Report AMP XI.M2, “Water Chemistry,” and GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” are acceptable methods to manage loss of material due to crevice corrosion. Where stagnant flow conditions exist, and oxygen levels are greater than 100 ppb and halides or sulfates levels are greater than 150 ppb, GALL-SLR Report AMP XI.M2, “Water Chemistry,” and GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” are acceptable methods to manage loss of material due to pitting and crevice corrosion.

Where the pH is greater than or equal to 10.5 and the temperature is greater than or equal to 99 °C [210°F], GALL-SLR Report AMP XI.M2, “Water Chemistry,” and GALL-SLR Report AMP XI.M32, “One-Time Inspection,” are acceptable methods to manage loss of material due to loss of material due to microbiologically-induced corrosion. Where the pH is less than 10.5 and temperature is less than 99 °C [210°F], GALL-SLR Report AMP XI.M2, “Water Chemistry,” and GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” are acceptable methods to manage loss of material due to microbiologically-induced corrosion.

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

Loss of material due to pitting and crevice corrosion could occur in aluminum piping, piping components, and tanks exposed to an air environment for a sufficient duration of time. Air environments known to result in pitting and/or crevice corrosion of aluminum alloys are those that contain halides (e.g., chloride) and periodic moisture. The moisture level and halide concentration in atmospheric and uncontrolled air are greatly dependent on geographical location and site-specific conditions. Moisture level and halide concentration should generally be considered high enough to facilitate pitting and/or crevice corrosion of aluminum alloys in atmospheric and uncontrolled air, unless demonstrated otherwise. The periodic introduction of moisture or halides into an air environment from secondary sources should also be considered. Leakage of fluids from mechanical connections, such as bolted flanges and valve packing, through insulation onto a component in indoor controlled air is an example of a secondary source that should be considered. The operating experience (OE) and condition of aluminum alloy components are evaluated to determine if the plant-specific air environment is aggressive enough to result in pitting and crevice corrosion after prolonged exposure. The aging effect of loss of material due to pitting and crevice corrosion in aluminum alloys is not applicable and does not require management if: (a) the plant-specific OE does not reveal a history of pitting or crevice corrosion and (b) a one-time inspection demonstrates that the aging effect is not occurring or that loss of material due to pitting or crevice corrosion is occurring so slowly that it will not affect the intended function of the components.

The internal surfaces of aluminum components do not need to be inspected if: (a) the review of OE does not reveal a history of pitting or crevice corrosion; and (b) inspection results for external surfaces demonstrate that the aging effect is not applicable. Inspection results associated with the periodic introduction of moisture or halides from secondary sources may be treated as a separate population of components. In the environment of air-indoor controlled, pitting and crevice corrosion is only expected to occur as the result of secondary source of moisture or halides. Alloy susceptibility may be considered when reviewing OE and interpreting inspection results. Inspections focus on the most susceptible alloys and locations.

The GALL-SLR Report recommends the further evaluation of aluminum piping, piping components, and tanks exposed to an air environment to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion. GALL-SLR Report AMP XI.M32, “One-Time Inspection,” is an acceptable method to demonstrate that the aging effect of loss of material due to pitting and crevice corrosion is not occurring at a rate that affects the intended function of the components. If loss of material due to pitting or crevice corrosion has occurred and is sufficient to potentially affect the intended function of an aluminum SSC, the following AMPs are acceptable methods to manage loss of material due to pitting or crevice corrosion: (i) GALL-SLR Report AMP XI.M29, “Aboveground Metallic Tanks,” for tanks; (ii) GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical Components,” for external surfaces of piping and piping components; (iii) GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” for underground piping, piping components and tanks; and (iv) GALL-SLR Report Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” for internal surfaces of components that are not included in other aging management programs.

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

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

3.2.2.4 Aging Management Programs

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

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

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

If the applicant chooses to use a plant-specific program that is not a GALL-SLR AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix A.1.2.3 of this SRP-SLR Report).

3.2.2.5 Final Safety Analysis Report Supplement

The summary description of the programs and activities for managing the effects of aging for the subsequent period of extended operation in the FSAR Supplement should be sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects will be managed during the subsequent period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the subsequent period of extended operation. Table 3.0-1 of this SRP SLR Report provides examples of the type of information to be included in the FSAR Supplement. Table 3.2-2 lists the programs that are applicable for this SRP-SLR subsection.

3.2.3 Review Procedures

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

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

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

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

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

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

3.2.3.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The NRC staff reviews the evaluation of this TLAA separately, following the guidance in Section 4.3 of this SRP-SLR.

3.2.3.2.2 Loss of Material Due to Pitting and Crevice Corrosion

The GALL-SLR Report recommends further evaluation to manage loss of material due to pitting and crevice corrosion of SS piping, piping components, and tanks exposed to outdoor air or any air environment when the component is insulated where the presence of sufficient halides (e.g., chlorides) and moisture is possible. The possibility of pitting and crevice corrosion also extends to indoor components located in close proximity to sources of outdoor air (e.g., components near intake vents).

If the applicant claims that neither the environment nor composition of the insulation will result in loss of material due to pitting and crevice corrosion, the reviewer should evaluate the applicant’s data to verify that sufficient halides will not be present on the surface of the SS piping, piping components, or tanks. If the applicant elects to manage loss of material due to pitting or crevice corrosion, the reviewer should determine whether an adequate program is credited to manage the aging effect based on the applicable environmental conditions.

3.2.3.2.3 Loss of Material Due to Erosion

The GALL-SLR Report recommends further evaluation of programs to manage loss of material due to erosion of the SS high pressure safety injection pump minimum flow orifice. The reviewer reviews the applicant’s proposed program on a case-by-case basis to ensure that an adequate program will be in place to manage this aging effect.

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

The GALL-SLR Report recommends further evaluation of programs to manage loss of material due to general corrosion and flow blockage due to fouling in the spray nozzles and flow orifices of the drywell and suppression chamber spray system spray exposed to air—indoor uncontrolled. This is necessary to prevent the plugging of spray nozzles and flow orifices of the BWR drywell and suppression chamber spray system. The reviewer reviews the applicant’s proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of loss of material due to general corrosion and flow blockage due to fouling of these components.

3.2.3.2.5 Cracking Due to Stress Corrosion Cracking

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

If the applicant claims that neither the environment nor composition of insulation will result in stress corrosion cracking, the reviewer should evaluate the applicant's data to verify that sufficient halides will not be present on the surface of the SS piping, piping components, or tanks. If the applicant elects to manage stress corrosion cracking, the reviewer should determine whether an adequate program is credited to manage the aging effect based on the applicable environmental conditions.

3.2.3.2.6 Quality Assurance for Aging Management of Nonsafety-Related Components

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

3.2.3.2.7 Ongoing Review of Operating Experience

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

3.2.3.2.8 Loss of Material Due to Recurring Internal Corrosion

The GALL-SLR Report recommends further evaluation to manage recurring internal corrosion aging effects. The reviewer conducts an independent review of plant-specific operating experience to determine whether the plant is currently experiencing recurring internal corrosion. The scope of this further evaluation AMR item includes recurring aging effects in which the plant-specific operating experience review reveals repetitive occurrences (e.g., one per refueling outage that has occurred over: (a) three or more sequential or nonsequential cycles for a 10-year operating experience search, or (b) two or more sequential or nonsequential cycles for a 5-year operating experience search) of aging effects with the same aging mechanism as a result of which the component either did not meet plant-specific acceptance criteria or experienced a reduction in wall thickness greater than 50 percent (regardless of the minimum wall thickness).

The reviewer should evaluate plant specific operating experience examples to determine if the chosen AMP should be augmented. For example, during a 10-year search of plant specific operating experience, two instances of 360 degree 30 percent wall loss occurred at copper alloy to steel joints. Neither the significance of the aging effect nor the frequency of occurrence of aging effect threshold has been exceeded. Nevertheless, the operating experience should be evaluated to determine if the AMP that is proposed to manage the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of inspections) to provide reasonable assurance that the CLB intended functions of the component will be met throughout the subsequent period of extended operation. Likewise, the GALL-SLR Report AMR items associated with the new further evaluation items only cite raw water and waste water environments because operating experience indicates that these are the predominant environments associated with recurring internal corrosion; however, if the search of plant-specific operating experience reveals recurring internal corrosion in other water environments (e.g., treated water), the aging effect should be addressed in a similar manner.

The reviewer determines whether a proposed program is adequate to manage recurring internal corrosion by evaluating the proposed AMP against the criteria in SRP-SLR Section 3.2.2.2.8.

3.2.3.2.9 Cracking Due to Stress Corrosion Cracking and Intergranular Stress Corrosion Cracking

The GALL-SLR Report recommends review of plant-specific AMPs for managing cracking due to SCC and IGSCC in BWR SS and nickel alloy piping and piping components greater than or equal to 4 inches NPS; nozzle safe ends and associated welds; and control rod drive return line nozzle caps and the associated cap-to-nozzle welds or cap-to-safe end welds in BWR-3, BWR-4, BWR-5, and BWR-6 designs that are exposed to reactor coolant. Components in dead-legs and other piping locations with stagnant flow may be subject to localized environmental conditions that could exacerbate the mechanisms of SCC and IGSCC. The reviewer ensures that the applicant has identified any such locations and provided justification for the AMPs credited for managing this aging effect. The reviewer reviews the applicant's justification and proposed AMPs on a case-by-case basis to ensure that the effects of aging will be adequately managed.

3.2.3.2.10 Cracking Due to Stress Corrosion Cracking in Aluminum Alloys

The GALL-SLR Report recommends the further evaluation of aluminum components (i.e., piping, piping components, and tanks) exposed to atmospheric air or aqueous solutions that contain halides to manage cracking due to SCC. The reviewer must first determine if the aging effect of cracking due to SCC is applicable and requires aging management. The aging effect of cracking is to be considered applicable unless it is demonstrated that one of the two acceptance criteria are met by demonstrating that an aggressive environment is not present or the specific material is not susceptible, as discussed in Section 3.2.2.2.10. Additionally, guidance is also provided on the review of the third condition necessary for SCC to occur, a sustained tensile stress. Each of three conditions is evaluated based on the review procedures below.

If the material used to fabricate the component being evaluated is not susceptible to SCC then the aging effect of cracking due to SCC is not applicable and does not require aging management. When determining if an aluminum alloy is susceptible to SCC the reviewer is to verify the material's (a) alloy composition, (b) condition or temper, and (c) product form. Additionally, if the material was produced using a process specifically developed to provide a

SCC resistant microstructure then the reviewer will consider the effects of this processing in the review. Once the material information has been established the reviewer is to evaluate the technical justification used to substantiate that the material is not susceptible to SCC when exposed to an aggressive environment and sustained tensile stress. The reviewer will evaluate all documentation and references used by the applicant as part of a technical justification.

If the environment that an aluminum alloy is exposed to is not aggressive, such as dry gas, controlled indoor air, or treated water, then the aging effect of cracking due to SCC is not applicable and does not require aging management. The environments cited in the AMR items in the GALL-SLR Report that reference this further evaluation are considered to be aggressive and potentially containing halide concentrations that facilitate SCC of aluminum alloys. The reviewer is to verify that components are not also periodically exposed to nontypical environments that would be categorized as aggressive, such as outdoor air which has recently been introduced into a building and the leakage/seepage of untreated aqueous solutions into a building or underground vault. Using information provided by the applicant, the reviewer will also evaluate the chemical composition of applicable encapsulating materials (e.g., concrete, insulation) for halides.

If a barrier coating is employed to effectively isolate the aluminum alloy from an aggressive environment then the aging effect of cracking due to SCC is not applicable and does not require aging management. The reviewer is to verify that the barrier coating is impermeable to the plant-specific aqueous solutions and atmospheric air that the coating is intended to protect the alloy from being exposed to. If operating experience is cited as a technical justification for the effectiveness of a barrier coating the reviewer is to verify that the applicant has a program to manage loss of coating integrity equivalent to GALL-SLR Report AMP XI.M42.

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

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

Documentation that may assist the reviewer in determining if the aging effect of cracking due to SCC is applicable and requires aging management include (a) component drawings,

(b) applicable codes or specifications used in the design, fabrication, and installation of the component, (c) material-specific material certification data and lot release data, and (d) maintenance records and plant-specific operating experience.

If it is determined that the aging effect of cracking due to SCC is applicable the reviewer is to evaluate the applicants proposed AMP to ensure that the effects of aging on components are adequately managed so that their intended functions will be maintained consistent with the CLB for the subsequent period of extended operation. GALL-SLR Report AMP XI.M29, “Aboveground Metallic Tanks,” is an acceptable method to manage cracking of aluminum due to SCC in tanks. GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” is an acceptable method to manage cracking of aluminum due to SCC in piping and piping components. GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” is an acceptable method to manage cracking of aluminum due to SCC in piping and tanks which are buried or underground. GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” is an acceptable method to manage cracking of aluminum due to SCC in components that are not included in other AMPs.

3.2.3.2.11 Loss of Material Due to General, Crevice or Pitting Corrosion and Microbiologically-Induced Corrosion and Cracking Due to Stress Corrosion Cracking

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

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

3.2.3.2.12 Loss of Material Due to Pitting and Crevice Corrosion and Microbiologically-Induced Corrosion in Components Exposed to Treated Water, Treated Borated Water, or Sodium Pentaborate Solution

The GALL-SLR Report recommends that loss of material due to crevice corrosion can occur in steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if oxygen levels are greater than 100 ppb. In addition, loss of material due to pitting can occur if oxygen levels are greater than 100 ppb, halides or sulfates levels are greater than 150 ppb, and stagnant flow conditions exist. Loss of material due to microbiologically-induced corrosion can occur with steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if the pH is less than 10.5 and temperature is less than 99 °C [210 °F].

The reviewer verifies the applicant's chemistry control parameters to determine whether GALL-SLR Report AMP XI.M2, "Water Chemistry," and a one-time inspection program is implemented (e.g., GALL-SLR Report AMP XI.M32, "One-Time Inspection") or GALL-SLR Report AMP XI.M2, "Water Chemistry," and a periodic inspection program is implemented (e.g., GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components") to manage loss of material.

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

The GALL-SLR Report recommends a further evaluation to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion of aluminum piping, piping components, and tanks exposed to an air environment. If the applicant claims that a search of 10 years of plant-specific did not reveal any instances of loss of material due to pitting and crevice corrosion exposed to air environments, the staff conducts an independent review of plant-specific operating experience during the AMP audit.

An alternative strategy to demonstrating that pitting and crevice corrosion is not applicable is to isolate the aluminum alloy from the air environment using a barrier. Acceptable barriers include anodization and tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier coating is credited for isolating an aluminum alloy from a potentially aggressive environment then the barrier coating is evaluated to verify that it is impermeable to the plant-specific environment. GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," is an acceptable method to manage the integrity of internal and external barrier coatings.

The reviewer is to verify that the SLRA cites the use of GALL-SLR AMP XI.M32, "One-Time Inspection," for all aluminum piping, piping components, and tanks exposed to air environments. Alternatively, if the applicant states that it will utilize a strategy of isolating the aluminum components from the environment, verify that the aluminum components are coated and GALL-SLR AMP XI.M42 has been cited to manage loss of coating integrity.

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

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

3.2.3.4 Aging Management Programs

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

Table 3.2-1 of this SRP-SLR may identify a plant-specific AMP. If the applicant chooses to use a plant-specific program that is not a GALL-SLR AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix A.1.2.3 of this SRP-SLR Report).

3.2.3.5 Final Safety Analysis Report Supplement

The reviewer confirms that the applicant has provided in its FSAR supplement information equivalent to that in Table 3.0-1 of the applicable AMP for aging management of the engineered safety features. Table 3.2-2 lists the AMPs that are applicable for this SRP-SLR subsection. The reviewer also confirms that the applicant has provided information for Subsection 3.2.3.3, "AMR Results Not Consistent With or Not Addressed in the GALL-SLR Report," equivalent to that in Table 3.0-1.

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

An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should confirm that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.2.4 Evaluation Findings

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

> On the basis of its review, as discussed above, the staff concludes that the applicant has demonstrated that the aging effects associated with the engineered safety features systems components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the subsequent period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable FSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the engineered safety features systems, as required by 10 CFR 54.21(d).

3.2.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

3.2.6 References

1. NRC. NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, LWR Edition." Washington, DC: U.S. Nuclear Regulatory Commission. March 2007.

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	1	BWR/PWR	Stainless steel, steel piping, piping components exposed to treated water, treated borated water	Cumulative fatigue damage due to fatigue	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.2.2.2.1)	V.D1.E-13 V.D2.E-10
D	2						
D	3						
M	4	BWR/PWR	Stainless steel piping, piping components exposed to air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.2.2.2.2)	V.B.EP-107 V.C.EP-107 V.D1.EP-107 V.D2.EP-107
M	5	PWR	Stainless steel orifice (miniflow recirculation) exposed to treated borated water	Loss of material due to erosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.2.2.2.3)	V.D1.E-24
M	6	BWR	Steel drywell and suppression chamber spray system (internal surfaces): flow orifice; spray nozzles exposed to air – indoor uncontrolled (internal)	Loss of material due to general corrosion; flow blockage due to fouling	Plant-specific aging management program	Yes (SRP-SLR Section 3.2.2.2.4)	V.D2.EP-113
M	7	BWR/PWR	Stainless steel piping, piping components exposed to air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical	Yes (SRP-SLR Section 3.2.2.2.5)	V.B.EP-103 V.C.EP-103 V.D1.EP-103 V.D2.EP-103

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					Components"		
M	8	PWR	Aluminum, copper alloy (>15% Zn) piping, piping components exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, "Boric Acid Corrosion"	No	V.D1.EP-101 V.E.EP-38
	9	PWR	Steel external surfaces, bolting exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, "Boric Acid Corrosion"	No	V.A.E-28 V.D1.E-28 V.E.E-28 V.E.E-41
M	10	BWR/PWR	Cast austenitic stainless steel piping, piping components exposed to treated borated water >250°C (>482°F), treated water >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	AMP XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No	V.D1.E-47 V.D2.E-11
M	11	BWR	Steel piping, piping components exposed to steam, treated water	Wall thinning due to flow-accelerated corrosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	V.D2.E-07 V.D2.E-09
	12	BWR/PWR	Steel, high-strength closure bolting exposed to air with steam or water leakage	Cracking due to cyclic loading, stress corrosion cracking	AMP XI.M18, "Bolting Integrity"	No	V.E.E-03
	13	BWR/PWR	Steel; stainless steel bolting, closure bolting exposed to air – outdoor (external), air – indoor uncontrolled (external)	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M18, "Bolting Integrity"	No	V.E.EP-64 V.E.EP-70

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
	14	BWR/PWR	Steel closure bolting exposed to air with steam or water leakage	Loss of material due to general corrosion	AMP XI.M18, "Bolting Integrity"	No	V.E.E-02
M	15	BWR/PWR	Copper alloy, nickel alloy, steel; stainless steel; bolting, closure bolting exposed to any environment, air – outdoor (external), raw water, waste water, treated borated water, fuel oil, treated water, air – indoor uncontrolled (external)	Loss of preload due to thermal effects, gasket creep, or self-loosening	AMP XI.M18, "Bolting Integrity"	No	V.E.EP-116 V.E.EP-117 V.E.EP-118 V.E.EP-119 V.E.EP-120 V.E.EP-121 V.E.EP-122 V.E.EP-69
M	16	BWR/PWR	Steel Containment isolation piping and components (Internal surfaces), Piping, piping components exposed to treated water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	V.C.EP-62 V.D2.EP-60
M	17	BWR	Aluminum, stainless steel piping, piping components exposed to treated water	Loss of material due to pitting, crevice corrosion, MIC (stainless steel only)	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	V.D2.EP-71 V.D2.EP-73
M	18	BWR/PWR	Stainless steel containment isolation piping and components (internal surfaces) exposed to treated water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	V.C.EP-63

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
	19	BWR/PWR	Stainless steel heat exchanger tubes exposed to treated water, treated borated water	Reduction of heat transfer due to fouling	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	V.A.E-20 V.D2.EP-74 V.D1.E-20
M	20	PWR	Stainless steel piping, piping components, tanks exposed to treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	V.A.E-12 V.D1.E-12
	21	PWR	Steel (with stainless steel or nickel-alloy cladding) safety injection tank (accumulator) exposed to treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	V.D1.E-38
M	22	PWR	Stainless steel piping, piping components, tanks exposed to treated borated water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	V.A.EP-41 V.D1.EP-41
M	23	BWR/PWR	Steel heat exchanger components, containment isolation piping, components (internal surfaces) exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; fouling that leads to corrosion; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	V.A.EP-90 V.C.E-22 V.D1.EP-90 V.D2.EP-90
M	24	PWR	Stainless steel piping, piping components exposed to raw water	Loss of material due to pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	V.D1.EP-55

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	25	BWR/PWR	Stainless steel heat exchanger components, containment isolation piping, components (internal surfaces) exposed to raw water	Loss of material due to pitting, crevice corrosion, MIC; fouling that leads to corrosion; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	V.A.EP-91 V.C.E-34 V.D1.EP-91 V.D2.EP-91
	26	BWR	Stainless steel heat exchanger tubes exposed to raw water	Reduction of heat transfer due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	V.D2.E-21
	27	BWR/PWR	Stainless steel, steel heat exchanger tubes exposed to raw water	Reduction of heat transfer due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	V.A.E-21 V.D1.E-21 V.D2.E-23
M	28	BWR/PWR	Stainless steel piping, piping components exposed to closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	AMP XI.M21A, "Closed Treated Water Systems"	No	V.A.EP-98 V.C.EP-98 V.D1.EP-98 V.D2.EP-98
M	29	BWR/PWR	Steel piping, piping components exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	V.C.EP-99
M	30	BWR/PWR	Steel heat exchanger components exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	V.A.EP-92 V.D1.EP-92 V.D2.EP-92
M	31	BWR/PWR	Stainless steel heat exchanger components, piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	V.A.EP-93 V.A.EP-95 V.C.EP-95 V.D1.EP-93 V.D1.EP-95 V.D2.EP-93

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
							V.D2.EP-95
M	32	BWR/PWR	Copper alloy heat exchanger components, piping, piping components exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	V.A.EP-94 V.A.EP-97 V.B.EP-97 V.D1.EP-94 V.D1.EP-97 V.D2.EP-94 V.D2.EP-97
	33	BWR/PWR	Copper alloy, stainless steel heat exchanger tubes exposed to closed-cycle cooling water	Reduction of heat transfer due to fouling	AMP XI.M21A, "Closed Treated Water Systems"	No	V.A.EP-100 V.A.EP-96 V.D1.EP-96 V.D2.EP-96
M	34	BWR/PWR	Copper alloy (>15% Zn or >8% Al) piping, piping components, heat exchanger components exposed to closed-cycle cooling water, treated water	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	V.A.EP-27 V.A.EP-37 V.B.EP-27 V.B.EP-37 V.D1.EP-27 V.D1.EP-37 V.D2.EP-27 V.D2.EP-37
M	35	PWR	Gray cast iron motor cooler exposed to Treated water, closed-cycle cooling water	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	V.A.E-43 V.D1.E-43
M	36	PWR	Gray cast iron piping, piping components exposed to closed-cycle cooling water, treated water	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	V.D1.EP-52

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	37	BWR/PWR	Gray cast iron piping, piping components exposed to soil, ground water	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	V.B.EP-54 V.D1.EP-54 V.D2.EP-54
M	38	BWR	Elastomer seals, piping, piping components exposed to air – indoor uncontrolled (external)	Hardening and loss of strength due to elastomer degradation	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.B.EP-59
M	39	BWR/PWR	Steel external surfaces exposed to condensation (external)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.E-46
M	40	BWR/PWR	Steel ducting, piping, components (external surfaces), ducting, closure bolting, containment isolation piping, components (external surfaces), external surfaces exposed to air – indoor uncontrolled (external)	Loss of material due to general corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.A.E-26 V.B.E-26 V.B.E-40 V.C.E-35 V.D2.E-26 V.E.E-44
	41	BWR/PWR	Steel external surfaces exposed to air – outdoor (external)	Loss of material due to general corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.E-45
M	42	BWR/PWR	Aluminum piping, piping components exposed to air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical	No	V.E.EP-114

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					Components"		
M	43	BWR	Elastomer seals, piping, piping components exposed to air – indoor uncontrolled (internal)	Hardening and loss of strength due to elastomer degradation	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.B.EP-58
	44	BWR/PWR	Steel piping and components (internal surfaces), ducting and components (internal surfaces) exposed to air – indoor uncontrolled (internal)	Loss of material due to general corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.A.E-29 V.B.E-25 V.D2.E-29
	45	PWR	Steel encapsulation components exposed to air – indoor uncontrolled (internal)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.A.EP-42
	46	BWR	Steel piping and components (internal surfaces) exposed to condensation (internal)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.D2.E-27
	47	PWR	Steel encapsulation components exposed to air with borated water leakage (internal)	Loss of material due to general, pitting, crevice, boric acid corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping	No	V.A.EP-43

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					and Ducting Components"		
M	48	BWR/PWR	Stainless steel piping, piping components (internal surfaces), tanks exposed to condensation (internal)	Loss of material due to pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.A.EP-81 V.D1.EP-81 V.D2.EP-61
M	49	BWR/PWR	Steel piping, piping components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	V.A.EP-77 V.D1.EP-77 V.D2.EP-77
M	50	BWR/PWR	Copper alloy, stainless steel piping, piping components exposed to lubricating oil	Loss of material due to general (copper alloy only), pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	V.A.EP-76 V.D1.EP-76 V.D1.EP-80 V.D2.EP-76
	51	BWR/PWR	Steel, copper alloy, stainless steel heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	V.A.EP-75 V.A.EP-78 V.A.EP-79 V.D1.EP-75 V.D1.EP-78 V.D1.EP-79 V.D2.EP-75 V.D2.EP-78 V.D2.EP-79
M	52	BWR/PWR	Steel (with coating or wrapping) piping, piping components exposed to soil, concrete	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	V.B.EP-111

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	53	BWR/PWR	Stainless steel, nickel alloy piping, piping components exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil environment only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	V.D1.EP-72 V.D2.EP-72
M	53a	BWR/PWR	Steel, nickel alloy underground piping, piping components exposed to air-indoor uncontrolled, condensation, air-outdoor, raw water	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	V.E.EP-123
M	54	BWR	Stainless steel piping, piping components exposed to treated water >60°C (>140°F)	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	AMP XI.M7, "BWR Stress Corrosion Cracking," and AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Section 3.2.2.2.9)	V.D2.E-37
M	55	BWR/PWR	Steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.2.2.2.11)	V.F.EP-112
M	56	BWR/PWR	Aluminum piping, piping components exposed to air – indoor uncontrolled (internal)	Loss of material due to pitting, crevice corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.2.2.2.13)	V.F.EP-3
M	57	BWR/PWR	Copper alloy piping, piping components exposed to air – indoor uncontrolled (external), gas	None	None	No	V.F.EP-10 V.F.EP-9
M	58	PWR	Copper alloy piping, piping components exposed to air with borated water leakage	None	None	No	V.F.EP-12

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	59	BWR/PWR	Galvanized steel ducting, piping, and components exposed to air – indoor controlled (external)	None	None	No	V.F.EP-14
M	60	BWR/PWR	Glass piping elements exposed to air – indoor uncontrolled (external), lubricating oil, raw water, treated water, treated borated water, air with borated water leakage, condensation (internal/external), gas, closed-cycle cooling water, air – outdoor	None	None	No	V.F.EP-15 V.F.EP-16 V.F.EP-28 V.F.EP-29 V.F.EP-30 V.F.EP-65 V.F.EP-66 V.F.EP-67 V.F.EP-68 V.F.EP-87
M	61	BWR/PWR	Nickel alloy piping, piping components exposed to air – indoor uncontrolled (external)	None	None	No	V.F.EP-17
M	62	BWR/PWR	Nickel alloy piping, piping components exposed to air with borated water leakage	None	None	No	V.F.EP-115
M	63	BWR/PWR	Stainless steel piping, piping components exposed to air – indoor uncontrolled (external), air with borated water leakage, gas, air – indoor uncontrolled (internal)	None	None	No	V.F.EP-18 V.F.EP-19 V.F.EP-22 V.F.EP-82

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	64	BWR/PWR	Steel piping, piping components exposed to air – indoor controlled (external), gas	None	None	No	V.F.EP-4 V.F.EP-7
M	65	BWR/PWR	Any material piping, piping components exposed to treated water, treated borated water	Wall thinning due to erosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	V.D1.E-407 V.D2.E-408
M	66	BWR/PWR	Metallic piping, piping components, tanks exposed to raw water, waste water	Loss of material due to recurring internal corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.2.2.2.9)	V.A.E-400 V.B.E-400 V.C.E-400 V.D1.E-400 V.D2.E-400
M	67	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to soil, concrete	Cracking due to stress corrosion cracking	AMP XI.M29, "Aboveground Metallic Tanks"	No	V.D1.E-405 V.D2.E-405
M	68	BWR/PWR	Steel tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to soil, concrete, air – outdoor, air – indoor uncontrolled, moist air, condensation	Loss of material due to general, pitting, crevice corrosion, MIC (soil environment only)	AMP XI.M29, "Aboveground Metallic Tanks"	No	V.D1.E-402 V.D2.E-402
M	69	BWR/PWR	Insulated steel, copper alloy, aluminum piping, piping components, tanks exposed to condensation, air –	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.E-403

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			outdoor				
M	70	BWR/PWR	Steel, stainless steel, aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to treated water, treated borated water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC (steel and stainless steel only)	AMP XI.M29, "Aboveground Metallic Tanks"	No	V.A.E-404 V.D1.E-404 V.D2.E-404
M	71	BWR/PWR	Insulated copper alloy (> 15% Zn) piping, piping components, tanks exposed to condensation, air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.E-406
M	72	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, treated borated water, lubricating oil	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, or physical damage, and spalling for cementitious coatings/linings	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	V.A.E-401 V.B.E-401 V.C.E-401 V.D1.E-401 V.D2.E-401
M	73	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw	Loss of material due to general, pitting, crevice corrosion, MIC; fouling that leads to corrosion; cracking due to stress corrosion cracking	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	V.A.E-414 V.B.E-414 V.C.E-414 V.D1.E-414 V.D2.E-414

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			water, treated water, treated borated water, lubricating oil				
	74	BWR/PWR	Gray cast iron piping components with internal coatings/linings exposed to closed-cycle cooling water, raw water, or treated water	Loss of material due to selective leaching	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	V.A.E-415 V.B.E-415 V.C.E-415 V.D1.E-415 V.D2.E-415
N	75	BWR/PWR	Steel, stainless steel bolting exposed to condensation, fuel oil, lubricating oil	Loss of preload due to thermal effects, gasket creep, or self-loosening	AMP XI.M18, "Bolting Integrity"	No	V.E.E-416 V.E.E-417
N	76	BWR/PWR	Copper alloy bolting exposed to raw water, waste water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M18, "Bolting Integrity"	No	V.E.E-418
N	77	BWR/PWR	Steel bolting exposed to lubricating oil, fuel oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M18, "Bolting Integrity"	No	V.E.E-419
N	78	BWR/PWR	Stainless steel, aluminum piping, piping components exposed to soil, concrete	Cracking due to stress corrosion cracking	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	V.A.E-420 V.D1.E-420 V.D2.E-420
N	79	BWR/PWR	Stainless steel bolting exposed to soil, concrete	Cracking due to stress corrosion cracking	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	V.A.E-421 V.D1.E-421 V.D2.E-421
N	80	BWR/PWR	Stainless steel underground piping, piping components, tanks exposed to air –	Cracking due to stress corrosion cracking	AMP XI.M41, "Buried and Underground Piping and Tanks"	Yes (SRP-SLR Section 3.2.2.2.5)	V.B.E-423 V.C.E-423 V.D1.E-423 V.D2.E-423

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			outdoor				
N	81	BWR/PWR	Stainless steel, steel, aluminum, copper alloy, titanium heat exchanger components exposed to air, condensation (external)	Reduction of heat transfer due to fouling	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.E-424
N	83	BWR/PWR	Elastomer seals, piping, piping components exposed to air – outdoor	Hardening and loss of strength due to elastomer degradation	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.E-426
N	84	BWR/PWR	Elastomer seals, piping, piping components exposed to condensation	Hardening and loss of strength due to elastomer degradation	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.A.E-427 V.B.E-427 V.D1.E-427 V.D2.E-427
N	85	BWR/PWR	Nickel alloy piping, piping components, heat exchanger components exposed to treated water, treated borated water	Loss of material due to pitting, crevice corrosion, MIC	Plant-specific aging management program	Yes (SRP-SLR Section 3.2.2.2.12)	V.A.E-428 V.D1.E-428 V.D2.E-428
N	86	BWR/PWR	Steel, stainless steel bolting exposed to raw water, waste water, treated water, treated borated water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC	AMP XI.M18, "Bolting Integrity"	No	V.E.E-430 V.E.E-429 V.E.E-431

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	87	BWR/PWR	Jacketed thermal insulation in an air – indoor uncontrolled, air – outdoor environment, air with borated water leakage, air with reactor coolant leakage, air with steam or water leakage environment	Reduced thermal insulation resistance due to moisture intrusion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.E-422
N	89	BWR/PWR	Steel, stainless steel, nickel alloy, copper alloy, aluminum piping, piping components exposed to condensation	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.E-433
N	90	BWR/PWR	Steel components exposed to treated water, raw water	Long-term loss of material due to general corrosion	AMP XI.M32, "One-Time Inspection"	No	V.A.E-434 V.B.E-434 V.C.E-434 V.D1.E-434 V.D2.E-434
N	91	BWR/PWR	Stainless steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.2.2.2.11)	V.F.EP-20
N	92	BWR/PWR	Stainless steel, steel, aluminum, copper alloy, titanium heat exchanger components internal to components exposed to air, condensation	Reduction of heat transfer due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.A.E-435 V.B.E-435 V.D1.E-435 V.D2.E-435

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	95	PWR	Copper alloy (≤8% Al) piping, piping components exposed to air with borated water leakage	None	None	No	V.F.E-438
N	96	BWR/PWR	Stainless steel piping, piping components exposed to raw water (for components not covered by NRC GL 89-13)	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.D1.E-439
N	97	BWR	Steel piping, piping components exposed to raw water (for components not covered by NRC GL 89-13)	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.D2.E-440
N	98	BWR/PWR	Copper alloy (>15% Zn or >8% Al) piping, piping components exposed to soil ground water	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	V.D1.E-441 V.D2.E-441
N	99	BWR/PWR	Stainless steel tanks exposed to air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.2.2.2.2)	V.E.E-442
N	100	BWR/PWR	Aluminum piping, piping components exposed to air – outdoor, raw water, waste water, condensation (internal)	Cracking due to stress corrosion cracking	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Yes (SRP-SLR Section 3.2.2.2.10)	V.A.E-443 V.B.E-443 V.D1.E-443 V.D2.E-443

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	101	BWR/PWR	Aluminum piping, piping components exposed to air – outdoor, raw water, waste water, condensation (external)	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.2.2.2.10)	V.E.E-444
N	102	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to the following external environments: soil, concrete, air – outdoor, air – indoor uncontrolled, air – indoor controlled, condensation, raw water, waste water	Cracking due to stress corrosion cracking	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.2.2.2.10)	V.D1.E-445 V.D2.E-445
N	103	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to air – outdoor, air – indoor uncontrolled, air – indoor controlled, moist air, condensation	Cracking due to stress corrosion cracking	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.2.2.2.5)	V.D1.E-446 V.D2.E-446
N	104	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Aboveground Metallic Tanks"	No	V.D1.E-447 V.D2.E-447

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	105	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to air (external)	Loss of material due to pitting, crevice corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.2.2.2.13)	V.D1.E-448 V.D2.E-448
N	106	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to air – indoor uncontrolled, moist air, condensation, air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.2.2.2.2)	V.D1.E-449 V.D2.E-449
N	107	BWR/PWR	Insulated stainless steel tanks exposed to condensation, air – outdoor, air – indoor uncontrolled, air – indoor controlled	Loss of material due to pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.2.2.2.2)	V.E.E-450
N	108	BWR/PWR	Insulated stainless steel piping, piping components, tanks exposed to condensation, air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.2.2.2.5)	V.E.E-451
N	109	BWR/PWR	Insulated aluminum piping, piping components, tanks exposed to condensation, air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.2.2.2.10)	V.E.E-452

Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	110	BWR/PWR	Aluminum underground piping, piping components, tanks exposed to air – outdoor, raw water, condensation	Cracking due to stress corrosion cracking	AMP XI.M41, "Buried and Underground Piping and Tanks"	Yes (SRP-SLR Section 3.2.2.2.10)	V.B.E-453 V.C.E-453 V.D1.E-453 V.D2.E-453
N	111	BWR/PWR	Aluminum underground piping, piping components exposed to air (external)	Loss of material due to pitting, crevice corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.2.2.2.13)	V.E.E-454
N	112	BWR/PWR	Stainless steel underground piping, piping components exposed to raw water	Loss of material due to pitting, crevice corrosion	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	V.E.E-455
N	113	BWR/PWR	Stainless steel underground piping, piping components exposed to air – indoor uncontrolled, condensation, air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M41, "Buried and Underground Piping and Tanks"	Yes (SRP-SLR Section 3.2.2.2.2)	V.E.E-456

Table 3.2-2. AMPs and Additional Guidance Appendices Recommended for Aging Management of Engineered Safety Features	
GALL-SLR Report Chapter/AMP	**Program Name**
AMP XI.M2	Water Chemistry
AMP XI.M7	Boiling Water Reactor Stress Corrosion Cracking
AMP XI.M10	Boric Acid Corrosion
AMP XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)
AMP XI.M17	Flow-Accelerated Corrosion
AMP XI.M18	Bolting Integrity
AMP XI.M20	Open-Cycle Cooling Water System
AMP XI.M21A	Closed Treated Water Systems
AMP XI.M29	Aboveground Metallic Tanks
AMP XI.M32	One-Time Inspection
AMP XI.M33	Selective Leaching
AMP XI.M36	External Surfaces Monitoring of Mechanical Components
AMP XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
AMP XI.M39	Lubricating Oil Analysis
AMP XI.M41	Buried and Underground Piping and Tanks
AMP XI.M42	Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks
GALL-SLR Report Appendix A	Quality Assurance for Aging Management Programs
GALL-SLR Report Appendix B	Operating Experience for Aging Management Programs
SRP-SLR Appendix A.1	Plant-Specific AMP

3.3 Aging Management of Auxiliary Systems

Review Responsibilities

Primary—Branch assigned responsibility by Project Manager (PM) as described in Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Section 3.0 of this SRP-SLR.

3.3.1 Areas of Review

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

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

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

The responsible review organization is to review the following SLR application AMR and AMP items assigned to it, per SRP-SLR Section 3.0:

AMRs

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

AMPs

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

FSAR Supplement

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

3.3.2 Acceptance Criteria

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

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

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

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

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

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

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

"Further Evaluation Recommended" and the "GALL-SLR Item" column, for the AMR items that reference the following subsections.

3.3.2.2.1 Cumulative Fatigue Damage

Fatigue is a time-limited aging analysis (TLAA) as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). This TLAA is addressed separately in Section 4.3, "Metal Fatigue Analysis," or Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses," of this SRP-SLR.

3.3.2.2.2 Cracking Due to Stress Corrosion Cracking and Cyclic Loading

Cracking due to stress corrosion cracking (SCC) and cyclic loading could occur in stainless steel (SS) PWR nonregenerative heat exchanger components exposed to treated borated water greater than 60 °C [>140 °F] in the chemical and volume control system. The existing AMP on monitoring and control of primary water chemistry in PWRs manages the aging effects of cracking due to SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic loading. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that cracking is not occurring. The GALL-SLR Report recommends that a plant-specific AMP be evaluated to verify the absence of cracking due to SCC and cyclic loading to ensure that these aging effects are managed adequately. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.

3.3.2.2.3 Cracking Due to Stress Corrosion Cracking

Cracking due to SCC could occur for SS piping, piping components, and tanks exposed to outdoor air or any air environment when the component is insulated. The possibility of cracking also extends to indoor components located in close proximity to sources of outdoor air (e.g., components near intake vents). Cracking is known to occur in environments containing sufficient halides (e.g., chlorides) and in which moisture is possible.

Applicable outdoor air environments (and associated local indoor air environments) include, but are not limited to, those within approximately 5 miles of a saltwater coastline, within 1/2 mile of a road which is treated with salt in the wintertime, areas in which the soil contains more than trace chlorides, plants having cooling towers where the water is treated with chlorine or chlorine compounds, and areas subject to chloride contamination from other agricultural or industrial sources.

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

The applicant may demonstrate that SCC is not expected to occur by one or more of the following applicable means.

- For outdoor uninsulated components, describing the outdoor air environment present at the plant and demonstrating that SCC is not expected.

- For underground components, the applicant may demonstrate that SCC due to exposure to in-leakage to the vault as a result of external precipitation or groundwater is not expected.
- For insulated components, determining that the insulation does not contain sufficient contaminants to cause SCC. One acceptable means to demonstrate this is provided by Regulatory Guide 1.36, "Nonmetallic Thermal Insulation for Austenitic Stainless Steel."
- For indoor components, determining that there are no liquid-filled systems with threaded or bolted connections (e.g., flanges, valve packing) that could leak onto the component.
- For all components, demonstrating that the aggressive environment is not present by isolating the component from the environment using a barrier to prevent loss of material due to pitting or crevice corrosion. An acceptable barrier includes tightly-adhering coatings that have been demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier coating is credited for isolating a component from a potentially aggressive environment then the barrier coating is evaluated to verify that it is impervious to the plant-specific environment. GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," is an acceptable method to manage the integrity of a barrier coating for internal or external coatings.

The GALL-SLR Report recommends further evaluation to determine whether an AMP is needed to manage this aging effect based on the environmental conditions applicable to the plant and requirements applicable to the components. GALL-SLR AMP XI.M36, "External Surfaces Monitoring," GALL-SLR AMP XI.M29, "Aboveground Metallic Tanks," or AMP XI.M41, "Buried and Underground Piping and Tanks," (for underground components) are acceptable methods to manage cracking of SS due to SCC in piping, piping components, and tanks.

3.3.2.2.4 Loss of Material Due to Pitting and Crevice Corrosion

Loss of material due to pitting and crevice corrosion could occur in SS piping, piping components, and tanks exposed to outdoor air or any air environment when the component is insulated or where the component is in the vicinity of insulated components. The possibility of pitting and crevice corrosion also extends to indoor components located in close proximity to sources of outdoor air (e.g., components near intake vents). Pitting and crevice corrosion is known to occur in environments containing sufficient halides (e.g., chlorides) and in which the presence of moisture is possible.

Applicable outdoor air environments (and associated local indoor air environments) include, but are not limited to, those within approximately 5 miles of a saltwater coastline, within 1/2 mile of a road which is treated with salt in the wintertime, areas in which the soil contains more than trace chlorides, plants having cooling towers where the water is treated with chlorine or chlorine compounds, and areas subject to chloride contamination from other agricultural or industrial sources.

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

The applicant may demonstrate that loss of material due to pitting and crevice corrosion is not expected to occur by one or more of the following applicable means.

- For outdoor uninsulated components, describing the outdoor air environment present at the plant and demonstrating that external pitting or crevice corrosion is not expected.
- For underground components, the applicant may demonstrate that loss of material due to pitting or crevice corrosion due to exposure to in-leakage to the vault as a result of external precipitation or groundwater is not expected.
- For insulated components, determining that the insulation does not contain sufficient contaminants to cause loss of material due to pitting or crevice corrosion. One acceptable means to demonstrate this is provided by Regulatory Guide 1.36, "Nonmetallic Thermal Insulation for Austenitic Stainless Steel."
- For indoor components, determining that there are no liquid-filled systems with threaded or bolted connections (e.g., flanges, valve packing) that could leak onto the component.
- For all components, demonstrating that the aggressive environment is not present by isolating the component from the environment using a barrier to prevent loss of material due to pitting or crevice corrosion. An acceptable barrier includes coatings that have been demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier coating is credited for isolating a component from a potentially aggressive environment, then the barrier coating is evaluated to verify that it is impervious to the plant-specific environment. GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," is an acceptable method to manage the integrity of a barrier coating for internal or external coatings.

The GALL-SLR Report recommends further evaluation to determine whether an AMP is needed to manage this aging effect based on the environmental conditions applicable to the plant and requirements applicable to the components. GALL-SLR AMP XI.M36, "External Surfaces Monitoring," GALL-SLR AMP XI.M29, "Aboveground Metallic Tanks," or AMP XI.M41, "Buried and Underground Piping and Tanks," (for underground components) are acceptable methods to manage loss of material due to pitting and crevice corrosion in SS piping, piping components, and tanks.

3.3.2.2.5 Quality Assurance for Aging Management of Nonsafety-Related Components

Acceptance criteria are described in Branch Technical Position (BTP) IQMB-1 (Appendix A.2, of this SRP-SLR Report.)

3.3.2.2.6 Ongoing Review of Operating Experience

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

3.3.2.2.7 Loss of Material Due to Recurring Internal Corrosion

Recurring internal corrosion can result in the need to augment AMPs beyond the recommendations in the GALL-SLR Report. During the search of plant-specific operating experience (OE) conducted during the SLRA development, recurring internal corrosion can be identified by the number of occurrences of aging effects and the extent of degradation at each localized corrosion site. This further evaluation item is applicable if the search of plant-specific

OE reveals repetitive occurrences (e.g., one per refueling outage cycle that has occurred over: (a) in any three or more—cycles for a 10-year OE search, or (b) in any two or more—cycles for a 5-year OE search) of aging effects with the same aging mechanism in which the aging effect resulted in the component either not meeting plant-specific acceptance criteria or experiencing a reduction in wall thickness greater than 50 percent (regardless of the minimum wall thickness).

The GALL-SLR Report recommends that a plant-specific AMP, or a new or existing AMP, be evaluated for inclusion of augmented requirements to ensure the adequate management of any recurring aging effect(s). Potential augmented requirements include: alternative examination methods (e.g., volumetric versus external visual), augmented inspections (e.g., a greater number of locations, additional locations based on risk insights based on susceptibility to aging effect and consequences of failure, a greater frequency of inspections), and additional trending parameters and decision points where increased inspections would be implemented. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1of this SRP-SLR Report)."

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

Plant-specific operating experience examples should be evaluated to determine if the chosen AMP should be augmented even if the thresholds for significance of aging effect or frequency of occurrence of aging effect have not been exceeded. For example, during a 10-year search of plant specific operating experience, two instances of 360 degree 30 percent wall loss occurred at copper alloy to steel joints. Neither the significance of the aging effect nor the frequency of occurrence of aging effect threshold has been exceeded. Nevertheless, the operating experience should be evaluated to determine if the AMP that is proposed to manage the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of inspections) to provide reasonable assurance that the current licensing basis (CLB) intended functions of the component will be met throughout the subsequent period of extended operation. Likewise, the GALL-SLR Report AMR items associated with the new further evaluation—items only cite raw water and waste water environments because OE indicates that these are the predominant environments associated with recurring internal corrosion; however, if the search of plant-specific OE reveals recurring internal corrosion in other water environments (e.g., treated water), the aging effect should be addressed in a similar manner.

3.3.2.2.8 Reduction in Impact Strength

Reduction in impact strength can occur in polyvinyl chloride (PVC) piping and piping components that have been exposed to sunlight 2 years or longer. If the piping had been wrapped with an opaque material or painted during installation, an AMP should include inspections of the condition of the wrap or paint. If the piping had not been wrapped or painted, a plant-specific program to address reduction in impact strength is recommended.

3.3.2.2.9 Cracking Due to Stress Corrosion Cracking and Intergranular Stress Corrosion Cracking

Cracking due to SCC and intergranular stress corrosion cracking (IGSCC) could occur in BWR SS and nickel alloy piping, piping components greater than or equal to 4 inches nominal pipe size; nozzle safe ends and associated welds; and control rod drive return line nozzle caps and the associated cap-to-nozzle welds or cap-to-safe end welds in BWR-3, BWR-4, BWR-5, and BWR-6 designs that are exposed to reactor coolant. The GALL-SLR Report recommends GALL-SLR Report AMP XI.M2, "Water Chemistry," to mitigate SCC and IGSCC and augmented inspection activities in accordance with GALL-SLR Report AMP XI.M7, "BWR Stress Corrosion Cracking," for condition monitoring. However, these programs may need to be augmented to manage the effects of cracking in dead-legs and other piping locations with stagnant flow where localized environmental conditions could exacerbate the mechanisms of SCC and IGSCC. The GALL-SLR Report recommends further evaluation to identify any such locations and to evaluate the adequacy of the applicant's proposed AMPs on a case-by-case basis to ensure that the intended functions of components in these locations will be maintained during the subsequent period of extended operation. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.3.2.2.10 Cracking Due to Stress Corrosion Cracking in Aluminum Alloys

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

<u>Susceptible Material</u>: If the material of a component is not susceptible to SCC then the aging effect is not applicable. The microstructure of an aluminum alloy, of which alloy composition is only one factor, is what determines if the alloy is susceptible to SCC. Therefore, providing guidance based on alloy composition will not always successfully protect against SCC in aluminum alloys. The temper, condition, and product form of the alloy is considered when assessing if a material is susceptible to SCC. Aluminum alloys that are susceptible to SCC include:

- 2xxx series alloys in the F, W, Ox, T3x, T4x, or T6x temper
- 5xxx series alloys with a magnesium content of 3.5 weight percent or greater
- 6xxx series alloys in the F temper
- 7xxx series alloys in the F, T5x, or T6x temper
- 2xx.x and 7xx.x series alloys
- 3xx.x series alloys that contain copper
- 5xx.x series alloys with a magnesium content of greater than 8 weight percent

The material is evaluated to verify that it is not susceptible to SCC and that the basis used to make the determination is technically substantiated. Tempers have been specifically developed to improve the SCC resistance for some aluminum alloys. Aluminum alloy and temper combination which are not susceptible to SCC when used in piping, piping component, and tank applications include 1xxx series, 3xxx series, 6061-T6x, and 5454-x.

GALL-SLR Report AMP XI.M29, “Aboveground Metallic Tanks,” is an acceptable method to manage cracking of aluminum due to SCC in tanks. GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” is an acceptable method to manage cracking of aluminum due to SCC in piping and piping components. GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” is an acceptable method to manage cracking of aluminum due to SCC in piping and tanks which are buried or underground. GALL-SLR Report AMP XI.M27, “Fire Water System,” is an acceptable method to manage cracking of aluminum due to SCC in fire water storage tanks. GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” is an acceptable method to manage cracking of aluminum due to SCC in components that are not included in other AMPs. Additional acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

Aggressive Environment: If the environment that an aluminum alloy is exposed to is not aggressive, such as dry gas, controlled indoor air, or treated water, then cracking due to SCC will not occur and the aging effect is not applicable. Aggressive environments that are known to result in cracking of susceptible aluminum alloys due to SCC are aqueous solutions and atmospheric air that contain halides (e.g., chloride). Halide concentrations should generally be considered high enough to facilitate SCC of aluminum alloys in uncontrolled or untreated aqueous solutions and atmospheric air, such as outdoor air, raw water, waste water, and condensation, unless demonstrated otherwise. If an aluminum component is encapsulated in a secondary material, such as insulation or concrete, the composition of the encapsulating material is evaluated for halides. The environment that the aluminum alloy is exposed to is evaluated to verify that it is either controlled or treated and free of halides.

An alternative strategy to demonstrating that an aggressive environment is not present is to isolate the aluminum alloy from the environment using a barrier to prevent SCC. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier coating is credited for isolating an aluminum alloy from a potentially aggressive environment then the barrier coating is evaluated to verify that it is impervious to the plant-specific environment. GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” or equivalent program is an acceptable method to manage the integrity of a barrier coating.

3.3.2.2.11 Loss of Material Due to General, Crevice or Pitting Corrosion and Microbiologically-Induced Corrosion and Cracking Due to Stress Corrosion Cracking

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

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

3.3.2.2.12 Loss of Material Due to Pitting and Crevice Corrosion and Microbiologically-Induced Corrosion in Components Exposed to Treated Water, Treated Borated Water, or Sodium Pentaborate Solution

Loss of material due to crevice corrosion can occur in steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if oxygen levels are greater than 100 parts per billion (ppb). In addition, loss of material due to pitting can occur if oxygen levels are greater than 100 ppb, halides or sulfates levels are greater than 150 ppb, and stagnant flow conditions exist. Loss of material due to microbiologically-induced corrosion can occur with steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if the pH is less than 10.5 and temperature is less than 99 °C [210 °F].

Where oxygen levels are less than or equal to 100 ppb, GALL-SLR Report AMP XI.M2, “Water Chemistry,” and GALL-SLR Report AMP XI.M32, “One-Time Inspection,” are acceptable methods to manage loss of material due to pitting and crevice corrosion. Where oxygen levels are greater than 100 ppb, GALL-SLR Report AMP XI.M2, “Water Chemistry,” and GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” are acceptable methods to manage loss of material due to crevice corrosion. Where stagnant flow conditions exist, and oxygen levels are greater than 100 ppb and halides or sulfates levels are greater than 150 ppb, GALL-SLR Report AMP XI.M2, “Water Chemistry,” and GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” are acceptable methods to manage loss of material due to pitting and crevice corrosion.

Where the pH is greater than or equal to 10.5 and the temperature is greater than or equal to 99 °C [210 °F], GALL-SLR Report AMP XI.M2, “Water Chemistry,” and GALL-SLR Report AMP XI.M32, “One-Time Inspection,” are acceptable methods to manage loss of material due to microbiologically-induced corrosion. Where the pH is less than 10.5 and temperature is less than 99 °C [210 °F], GALL-SLR Report AMP XI.M2, "Water Chemistry," and GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," are acceptable methods to manage loss of material due to MIC.

For tanks and spent fuel storage racks, due to the restricted accessibility for inspections, GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," is an acceptable method to manage loss of material due to pitting and crevice corrosion even though the surface exposed to the environment may not be an interior surface.

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

Loss of material due to pitting and crevice corrosion could occur in aluminum piping, piping components, and tanks exposed to an air environment for a sufficient duration of time. Air environments known to result in pitting and/or crevice corrosion of aluminum alloys are those that contain halides (e.g., chloride) and periodic moisture. The moisture level and halide concentration in atmospheric and uncontrolled air are greatly dependent on geographical location and site-specific conditions. Moisture level and halide concentration should generally be considered high enough to facilitate pitting and/or crevice corrosion of aluminum alloys in atmospheric and uncontrolled air, unless demonstrated otherwise. The periodic introduction of moisture or halides into an air environment from secondary sources should also be considered. Leakage of fluids from mechanical connections, such as bolted flanges and valve packing, through insulation onto a component in indoor controlled air is an example of a secondary source that should be considered. The operating experience (OE) and condition of aluminum alloy components are evaluated to determine if the plant-specific air environment is aggressive enough to result in pitting and crevice corrosion after prolonged exposure. The aging effect of loss of material due to pitting and crevice corrosion in aluminum alloys is not applicable and does not require management if: (a) the plant-specific OE does not reveal a history of pitting or crevice corrosion and (b) a one-time inspection demonstrates that the aging effect is not occurring or that loss of material due to pitting or crevice corrosion is occurring so slowly that it will not affect the intended function of the components.

The internal surfaces of aluminum components do not need to be inspected if: (a) the review of OE does not reveal a history of pitting or crevice corrosion; and (b) inspection results for external surfaces demonstrate that the aging effect is not applicable. Inspection results associated with the periodic introduction of moisture or halides from secondary sources may be treated as a separate population of components. In the environment of air-indoor controlled, pitting and crevice corrosion is only expected to occur as the result of secondary source of moisture or halides. Alloy susceptibility may be considered when reviewing OE and interpreting inspection results. Inspections focus on the most susceptible alloys and locations.

The GALL-SLR Report recommends the further evaluation of aluminum piping, piping components, and tanks exposed to an air environment to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion. GALL-SLR Report AMP XI.M32, "One-Time Inspection," is an acceptable method to demonstrate that the aging effect of loss of material due to pitting and crevice corrosion is not occurring at a rate that affects the intended function of the components. If loss of material due to pitting or crevice corrosion has occurred and is sufficient to potentially affect the intended function of an aluminum SSC, the following AMPs are acceptable methods to manage loss of material due to pitting or crevice corrosion: (i) GALL-SLR Report AMP XI.M29, "Aboveground Metallic Tanks," for tanks; (ii) GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," for external surfaces of piping and piping components; (iii) GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," for underground piping, piping components and tanks; and (iv) GALL-SLR Report Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components" for internal surfaces of components that are not included in other aging management programs.

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

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

3.3.2.4 Aging Management Programs

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

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

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

If the applicant chooses to use a plant-specific program that is not a GALL-SLR AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix A.1.2.3 of this SRP-SLR).

3.3.2.5 Final Safety Analysis Report Supplement

The summary description of the programs and activities for managing the effects of aging for the subsequent period of extended operation in the FSAR Supplement should be sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects will be managed during the subsequent period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the period of extended operation. Table 3.3-2 lists the programs that are applicable for this SRP-SLR subsection.

3.3.3 Review Procedures

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

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

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

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

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

The basic review procedures defined in Subsection 3.3.3.1 need to be applied first for all of the AMRs and AMPs provided in this section. In addition, if the GALL-SLR Report AMR item to which the SLRA AMR item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL-SLR Report for each of the following aging effect/aging mechanism combinations. Refer to Table 3.3-1 for the items that reference the following subsections.

3.3.3.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.3 of this SRP-SLR.

3.3.3.2.2 Cracking Due to Stress Corrosion Cracking and Cyclic Loading

The GALL-SLR Report also recommends further evaluation of programs to manage cracking due to SCC and cyclic loading in the SS nonregenerative heat exchangers in the chemical and volume control system (PWR) exposed to treated borated water >60 °C [>140 °F]. The water chemistry program relies on monitoring and control of water chemistry to manage the aging effects of cracking due to SCC and cyclic loading. The GALL-SLR Report recommends the effectiveness of the chemistry control program be verified to ensure that cracking is not occurring. The absence of cracking due to SCC and cyclic loading is to be verified. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.3.3.2.3 Cracking Due to Stress Corrosion Cracking

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

If the applicant claims that neither the environment nor composition of insulation will result in stress corrosion cracking, the reviewer should evaluate the applicant's data to verify that sufficient halides will not be present on the surface of the SS piping, piping components, or tanks. If the applicant elects to manage stress corrosion cracking, the reviewer should determine whether an adequate program is credited to manage the aging effect based on the applicable environmental conditions.

3.3.3.2.4 Loss of Material Due to Pitting and Crevice Corrosion

The GALL-SLR Report recommends further evaluation to manage loss of material due to pitting and crevice corrosion of SS piping, piping components, and tanks exposed to outdoor air or any air environment when the component is insulated where the presence of sufficient halides (e.g., chlorides) and moisture is possible. The possibility of pitting and crevice corrosion also extends to indoor components located in close proximity to sources of outdoor air (e.g., components near intake vents).

If the applicant claims that neither the environment nor composition of the insulation will result in loss of material due to pitting and crevice corrosion, the reviewer should evaluate the applicant's data to verify that sufficient halides will not be present on the surface of the SS piping, piping components, or tanks. If the applicant elects to manage loss of material due to pitting or crevice corrosion, the reviewer should determine whether an adequate program is credited to manage the aging effect based on the applicable environmental conditions.

3.3.3.2.5 Quality Assurance for Aging Management of Nonsafety-Related Components

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

3.3.3.2.6 Ongoing Review of Operating Experience

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

3.3.3.2.7 Loss of Material Due to Recurring Internal Corrosion

The GALL-SLR Report recommends further evaluation to manage recurring internal corrosion aging effects. The reviewer conducts an independent review of plant-specific OE to determine whether the plant is currently experiencing recurring internal corrosion. The scope of this further evaluation AMR item includes recurring aging effects in which the plant-specific OE review reveals repetitive occurrences (e.g., one per refueling outage that has occurred over: (a) in any three or more cycles for a 10-year OE search, or (b) in any two or more cycles for a 5-year OE search) of aging effects with the same aging mechanism as a result of which the component either did not meet plant-specific acceptance criteria or experienced a reduction in wall thickness greater than 50 percent (regardless of the minimum wall thickness).

The reviewer should evaluate plant-specific operating experience examples to determine if the chosen AMP should be augmented. For example, during a 10-year search of plant specific OE, two instances of 360 degree 30 percent wall loss occurred at copper alloy to steel joints. Neither the significance of the aging effect nor the frequency of occurrence of aging effect threshold has been exceeded. Nevertheless, the OE should be evaluated to determine if the AMP that is proposed to manage the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of inspections) to provide reasonable assurance that the CLB intended functions of the component will be met throughout the subsequent period of extended operation. Likewise, the GALL-SLR Report AMR items associated with the new further evaluation (FE) items only cite raw water and waste water environments because OE indicates that these are the predominant environments associated with recurring internal corrosion; however, if the search of plant-specific OE reveals recurring internal corrosion in other water environments (e.g., treated water), the aging effect should be addressed in a similar manner.

The reviewer determines whether a proposed program is adequate to manage recurring internal corrosion by evaluating the proposed AMP against the criteria in SRP-SLR Section 3.3.2.2.7.

3.3.3.2.8 Reduction in Impact Strength

The reviewer should confirm that PVC piping and piping components, exposed to sunlight had been wrapped with an opaque material or painted during installation or determine whether an adequate program is used to manage reduction in impact strength for PVC piping exposed to sunlight. If the PVC piping and piping components exposed to sunlight had been wrapped with an opaque material or painted, the reviewer should confirm the adequacy of the program used to conduct inspections of the wrap or paint.

3.3.3.2.9 Cracking Due to Stress Corrosion Cracking and Intergranular Stress Corrosion Cracking

The GALL-SLR Report recommends review of plant-specific AMPs for managing cracking due to SCC and IGSCC in BWR SS and nickel alloy piping and piping components greater than or equal to 4 inches nominal pipe size; nozzle safe ends and associated welds; and control rod drive return line nozzle caps and the associated cap-to-nozzle welds or cap-to-safe end welds in BWR-3, BWR-4, BWR-5, and BWR-6 designs that are exposed to reactor coolant. Components in dead-legs and other piping locations with stagnant flow may be subject to localized environmental conditions that could exacerbate the mechanisms of SCC and IGSCC. The reviewer ensures that the applicant has identified any such locations and provided justification for the AMPs credited for managing this aging effect. The reviewer reviews the applicant's justification and proposed AMPs on a case-by-case basis to ensure that the effects of aging will be adequately managed.

3.3.3.2.10 Cracking Due to Stress Corrosion Cracking in Aluminum Alloys

The GALL-SLR Report recommends the further evaluation of aluminum components (i.e., piping, piping components, and tanks) exposed to atmospheric air or aqueous solutions that contain halides to manage cracking due to SCC. The reviewer first determines if the aging effect of cracking due to SCC is applicable and requires aging management. The aging effect of cracking is to be considered applicable unless it is demonstrated that one of the two acceptance criteria are met by demonstrating that an aggressive environment is not present or the specific material is not susceptible, as discussed in Section 3.3.2.2.10. Additionally, guidance is also provided on the review of the third condition necessary for SCC to occur, a sustained tensile stress. Each of three conditions is evaluated based on the review procedures below.

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

<u>Aggressive Environment</u>: If the environment that an aluminum alloy is exposed to is not aggressive, such as dry gas, controlled indoor air, or treated water, then the aging effect of cracking due to SCC is not applicable and does not require aging management. The environments cited in the AMR line items in the GALL-SLR Report that reference this further evaluation are considered to be aggressive and potentially containing halide concentrations that facilitate SCC of aluminum alloys. The reviewer is to verify that components are not also periodically exposed to nontypical environments that would be categorized as aggressive, such as outdoor air which has recently been introduced into a building and the leakage/seepage of untreated aqueous solutions into a building or underground vault. Using information provided by the applicant, the reviewer will also evaluate the chemical composition of applicable encapsulating materials (e.g., concrete, insulation) for halides.

If a barrier coating is employed to effectively isolate the aluminum alloy from an aggressive environment then the aging effect of cracking due to SCC is not applicable and does not require aging management. The reviewer is to verify that the barrier coating is impermeable to the plant-specific aqueous solutions and atmospheric air that the coating is intended to protect the alloy from being exposed to. If operating experience is cited as a technical justification for the effectiveness of a barrier coating the reviewer is to verify that the applicant has a program to manage loss of coating integrity equivalent to GALL-SLR Report AMP XI.M42.

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

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

Documentation that may assist the reviewer in determining if the aging effect of cracking due to SCC is applicable and requires aging management include (a) component drawings, (b) applicable Codes or specifications used in the design, fabrication, and installation of the component, (c) material-specific material certification data and lot release data, and (d) maintenance records and plant-specific operating experience.

If it is determined that the aging effect of cracking due to SCC is applicable the reviewer is to evaluate the applicants proposed AMP to ensure that the effects of aging on components are adequately managed so that their intended functions will be maintained consistent with the CLB for the subsequent period of extended operation. GALL-SLR Report AMP XI.M29, “Aboveground Metallic Tanks,” is an acceptable method to manage cracking of aluminum due to SCC in tanks. GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” is an acceptable method to manage cracking of aluminum due to SCC in piping and piping components. GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” is an acceptable method to manage cracking of aluminum due to SCC in piping and tanks which are buried or underground. GALL-SLR Report AMP XI.M27, “Fire Water System,” is an acceptable method to manage cracking of aluminum due to SCC in fire water storage tanks. GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” is an acceptable method to manage cracking of aluminum due to SCC in components that are not included in other AMPs.

3.3.3.2.11 Loss of Material Due to General, Crevice or Pitting Corrosion and Microbiologically-Induced Corrosion and Cracking Due to Stress Corrosion Cracking

The GALL-SLR Report recommends that for steel piping and piping components exposed to concrete, if the following conditions are met, loss of material is not considered to be an applicable aging effect for steel: (a) attributes of the concrete are consistent with ACI 318 or ACI 349 (low water-to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG–1557; (b) plant-specific operating experience indicates no degradation of the concrete that could lead to penetration of water to the metal surface; and (c) the piping is not potentially exposed to groundwater. For SS piping and piping components, loss of material and cracking due to SCC are not considered to be applicable aging effects as long as the piping is not potentially exposed to groundwater. Where these conditions are not met, loss of material due to general (steel only), crevice, or pitting corrosion and microbiologically-induced corrosion and cracking due to SCC (SS only) are identified as applicable aging effects. GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," is an acceptable method to manage these aging effects.

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

3.3.3.2.12 Loss of Material Due to Pitting and Crevice Corrosion and Microbiologically-Induced Corrosion in Components Exposed to Treated Water, Treated Borated Water, or Sodium Pentaborate Solution

The GALL-SLR Report recommends that loss of material due to crevice corrosion can occur in steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if oxygen levels are greater than 100 ppb. In addition, loss of material due to pitting can occur if oxygen levels are greater than 100 ppb, halides or sulfates levels are greater than 150 ppb, and stagnant flow conditions exist. Loss of material due to microbiologically-induced corrosion can occur with steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if the pH is less than 10.5 and temperature is less than 99 °C [210 °F].

The reviewer verifies the applicant's chemistry control parameters to determine whether GALL-SLR Report AMP XI.M2, "Water Chemistry," and a one-time inspection program is implemented (e.g., GALL-SLR Report AMP XI.M32, "One-Time Inspection") or GALL-SLR Report AMP XI.M2, "Water Chemistry," and a periodic inspection program is implemented (e.g., GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components") to manage loss of material.

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

The GALL-SLR Report recommends a further evaluation to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion of aluminum piping, piping components, and tanks exposed to an air environment. If the applicant claims that a search of 10 years of plant-specific did not reveal any instances of loss of material due to pitting and crevice corrosion exposed to air environments, the staff conducts an independent review of plant-specific operating experience during the AMP audit.

An alternative strategy to demonstrating that pitting and crevice corrosion is not applicable is to isolate the aluminum alloy from the air environment using a barrier. Acceptable barriers include anodization and tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier coating is credited for isolating an aluminum alloy from a potentially aggressive environment then the barrier coating is evaluated to verify that it is impermeable to the plant-specific environment. GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," is an acceptable method to manage the integrity of internal and external barrier coatings.

The reviewer is to verify that the SLRA cites the use of GALL-SLR AMP XI.M32, "One-Time Inspection," for all aluminum piping, piping components, and tanks exposed to air environments. Alternatively, if the applicant states that it will utilize a strategy of isolating the aluminum components from the environment, verify that the aluminum components are coated and GALL-SLR AMP XI.M42 has been cited to manage loss of coating integrity.

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

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

3.3.3.4 Aging Management Programs

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR Report AMP. If the applicant identifies, in the SLRA AMP, an exception to any of the program elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not identified by the SLRA, between the SLRA AMP and the GALL-SLR Report AMP with which the SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions or differences. The AMPs evaluated in the GALL-SLR Report pertinent to the auxiliary systems components are summarized in Table 3.3-1 of this SRP-SLR. The "GALL-SLR Item" column identifies the AMR item numbers in the GALL-SLR Report, Chapter VII, presenting detailed information summarized by this row.

3.3.4 Evaluation Findings

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

On the basis of its review, as discussed above, the NRC staff concludes that the applicant has demonstrated that the aging effects associated with the auxiliary systems components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the subsequent period of extended operation, as required by 10 CFR 54.21(a)(3).

The NRC staff also reviewed the applicable FSAR Supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the auxiliary systems, as required by 10 CFR 54.21(d).

3.3.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

3.3.6 References

1. NRC. NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. March 2007.

2. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of 1 0 CFR Part 54–The License Renewal Rule." Revision 6. Washington, DC: Nuclear Energy Institute.

3. ASME. Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components." ASME Boiler and Pressure Vessel Code, 2004 Edition. New York City, New York: The American Society of Mechanical Engineers.

4. ASTM International. "Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation." D95-83. West Conshohocken, Pennsylvania, American Society for Testing and Materials. 1990.

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	1	BWR/PWR	Steel cranes: structural girders exposed to air – indoor uncontrolled (external), air – outdoor	Cumulative fatigue damage due to fatigue	TLAA, SRP-SLR Section 4.7 "Other Plant-Specific TLAAs"	Yes (SRP-SLR Section 3.3.2.2.1)	VII.B.A-06
M	2	BWR/PWR	Stainless steel, steel heat exchanger components and tubes, piping, piping components exposed to treated borated water, air - indoor, uncontrolled, treated water	Cumulative fatigue damage due to fatigue	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.3.2.2.1)	VII.E1.A-100 VII.E1.A-34 VII.E1.A-57 VII.E3.A-34 VII.E3.A-62 VII.E4.A-62
M	3	PWR	Stainless steel heat exchanger components, non-regenerative exposed to treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking; cyclic loading	AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Section 3.3.2.2.2)	VII.E1.A-69
M	4	BWR/PWR	Stainless steel piping, piping components exposed to air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.3.2.2.3)	VII.C1.AP-209 VII.C2.AP-209 VII.C3.AP-209 VII.D.AP-209 VII.E1.AP-209 VII.E4.AP-209 VII.F1.AP-209 VII.F2.AP-209 VII.F4.AP-209 VII.G.AP-209 VII.H1.AP-209 VII.H2.AP-209
D	5						
M	6	BWR/PWR	Stainless steel piping, piping components exposed to air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of	Yes (SRP-SLR Section 3.3.2.2.4)	VII.C1.AP-221 VII.C2.AP-221 VII.C3.AP-221 VII.D.AP-221

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					Mechanical Components"		VII.E1.AP-221 VII.E4.AP-221 VII.F1.AP-221 VII.F2.AP-221 VII.F4.AP-221 VII.G.AP-221 VII.H1.AP-221 VII.H2.AP-221
	7	PWR	Stainless steel high-pressure pump, casing exposed to treated borated water	Cracking due to cyclic loading	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	VII.E1.AP-115
	8	PWR	Stainless steel heat exchanger components and tubes exposed to treated borated water >60°C (>140°F)	Cracking due to cyclic loading	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	VII.E1.AP-119
M	9	PWR	Steel, aluminum, copper alloy (>15% Zn) external surfaces, piping, piping components, bolting exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, "Boric Acid Corrosion"	No	VII.A3.A-79 VII.A3.AP-1 VII.E1.A-79 VII.E1.AP-1 VII.I.A-102 VII.I.A-79 VII.I.AP-66
	10	BWR/PWR	Steel, high-strength closure bolting exposed to air with steam or water leakage	Cracking due to stress corrosion cracking; cyclic loading	AMP XI.M18, "Bolting Integrity"	No	VII.I.A-04

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
	11	BWR/PWR	Steel, high-strength high-pressure pump, closure bolting exposed to air with steam or water leakage	Cracking due to stress corrosion cracking; cyclic loading	AMP XI.M18, "Bolting Integrity"	No	VII.E1.AP-122
	12	BWR/PWR	Steel; stainless steel closure bolting, bolting exposed to condensation, air – indoor uncontrolled (external), air – outdoor (external)	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M18, "Bolting Integrity"	No	VII.D.AP-121 VII.I.AP-125 VII.I.AP-126
	13	BWR/PWR	Steel closure bolting exposed to air with steam or water leakage	Loss of material due to general corrosion	AMP XI.M18, "Bolting Integrity"	No	VII.I.A-03
M	14	BWR/PWR	Steel, stainless steel bolting exposed to soil	Loss of preload due to thermal effects, gasket creep, or self-loosening	AMP XI.M18, "Bolting Integrity"	No	VII.I.AP-242 VII.I.AP-244
M	15	BWR/PWR	Steel; stainless steel, copper alloy, nickel alloy, stainless steel closure bolting, bolting exposed to air – indoor uncontrolled (external), any environment, air – outdoor (external), raw water, waste water, treated borated water, fuel oil, treated water	Loss of preload due to thermal effects, gasket creep, or self-loosening	AMP XI.M18, "Bolting Integrity"	No	VII.I.AP-124 VII.I.AP-261 VII.I.AP-262 VII.I.AP-263 VII.I.AP-264 VII.I.AP-265 VII.I.AP-266 VII.I.AP-267
M	16	BWR	Stainless steel piping, piping components, outboard the second containment isolation valves with a diameter ≥4 inches nominal pipe size exposed to treated water > 93°C (> 200°F)	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	AMP XI.M2, "Water Chemistry," and AMP XI.M25, "BWR Reactor Water Cleanup System"	No	VII.E3.AP-283

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
	17	BWR/PWR	Stainless steel heat exchanger tubes exposed to treated water, treated borated water	Reduction of heat transfer due to fouling	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.A4.AP-139 VII.A3.A-101 VII.E1.A-101
M	18	BWR/PWR	Stainless steel high-pressure pump, casing, piping, piping components, exposed to treated borated water >60°C (>140°F), sodium pentaborate solution >60°C (>140°F)	Cracking due to stress corrosion cracking	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.E1.AP-114 VII.E2.AP-181
	19	BWR/PWR	Stainless steel regenerative heat exchanger components exposed to treated water >60°C (>140°F)	Cracking due to stress corrosion cracking	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.E3.AP-120
M	20	BWR/PWR	Stainless steel, steel with stainless steel cladding heat exchanger components exposed to treated borated water >60°C (>140°F), treated water >60°C (>140°F)	Cracking due to stress corrosion cracking	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.E1.AP-118 VII.E3.AP-112
M	21	BWR	Steel piping, piping components, exposed to treated water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.E3.AP-106 VII.E4.AP-106
M	22	BWR	Copper alloy piping, piping components, exposed to treated water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time	No	VII.A4.AP-140 VII.E3.AP-140 VII.E4.AP-140

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					Inspection"		
D	23						
D	24						
M	25	BWR	Aluminum piping exposed to treated water	Loss of material due to pitting, crevice corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.A4.AP-130 VII.E3.AP-130 VII.E4.AP-130
	26	BWR/PWR	Steel with stainless steel cladding piping, piping components exposed to treated water	Loss of material due to pitting, crevice corrosion (only after cladding degradation)	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.A4.AP-108
	27	BWR	Stainless steel heat exchanger tubes exposed to treated water	Reduction of heat transfer due to fouling	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.E3.AP-139
M	28	PWR	Stainless steel piping, piping components, tanks exposed to treated borated water	Cracking due to stress corrosion cracking, MIC	Plant-specific aging management program	Yes (SRP-SLR Section 3.3.2.2.12)	VII.E1.AP-82

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	29	PWR	Steel (with stainless steel cladding); stainless steel piping, piping components exposed to treated borated water	Loss of material due to pitting, crevice corrosion, MIC	Plant-specific aging management program	Yes (SRP-SLR Section 3.3.2.2.12)	VII.E1.A-88
M	30	BWR/PWR	Concrete, cementitious material piping, piping components exposed to raw water	Changes in material properties due to aggressive chemical attack	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.AP-250
M	30.2	BWR/PWR	Fiberglass, HDPE piping, piping components exposed to raw water (internal)	Cracking, blistering, change in color due to water absorption	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.AP-238 VII.C1.AP-239
M	31	BWR/PWR	Concrete, cementitious material piping, piping components exposed to raw water	Cracking due to settling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.AP-248
M	32	BWR/PWR	Reinforced concrete, asbestos cement piping, piping components exposed to raw water	Cracking due to aggressive chemical attack and leaching; changes in material properties due to aggressive chemical attack	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.AP-155
M	32.5	BWR/PWR	Elastomer seals, piping, piping components exposed to raw water	Hardening and loss of strength due to elastomer degradation; loss of material due to wear	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.AP-75 VII.C1.AP-76 VII.G.AP-75 VII.G.AP-76

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	33	BWR/PWR	Concrete, cementitious material piping, piping components exposed to raw water	Loss of material due to abrasion, cavitation, aggressive chemical attack, leaching	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.AP-249
M	34	BWR/PWR	Nickel alloy, copper alloy piping, piping components exposed to raw water	Loss of material due to general (copper alloy only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.AP-206 VII.C3.AP-195 VII.C3.AP-206
M	35	BWR/PWR	Copper alloy piping, piping components exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.H2.AP-193
M	36	BWR/PWR	Copper alloy piping, piping components exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; fouling that leads to corrosion; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.AP-196
M	37	BWR/PWR	Steel piping, piping components exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; fouling that leads to corrosion; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.AP-194 VII.C3.AP-194 VII.H2.AP-194

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	38	BWR/PWR	Copper alloy, steel heat exchanger components exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; fouling that leads to corrosion; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.AP-179 VII.C1.AP-183
M	39	BWR/PWR	Stainless steel piping, piping components, exposed to raw water	Loss of material due to pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C3.A-53
M	40	BWR/PWR	Stainless steel piping, piping components exposed to raw water	Loss of material due to pitting, crevice corrosion, MIC; fouling that leads to corrosion; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.A-54
M	41	BWR/PWR	Stainless steel piping, piping components, exposed to raw water	Loss of material due to pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.H2.AP-55
	42	BWR/PWR	Copper alloy, titanium, stainless steel heat exchanger tubes exposed to raw water	Reduction of heat transfer due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.A-72 VII.C1.AP-153 VII.C1.AP-187 VII.C3.AP-187 VII.G.AP-187 VII.H2.AP-187
M	43	BWR/PWR	Stainless steel piping, piping components, exposed to closed- cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.C2.AP-186 VII.E3.AP-186 VII.E4.AP-186

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
	44	BWR/PWR	Stainless steel; steel with stainless steel cladding heat exchanger components exposed to closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.E3.AP-192
M	45	BWR/PWR	Steel piping, piping components, tanks exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.C2.AP-202 VII.F1.AP-202 VII.F2.AP-202 VII.F3.AP-202 VII.F4.AP-202 VII.H2.AP-202
M	46	BWR/PWR	Steel, copper alloy heat exchanger components, piping, piping components exposed to closed- cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.A3.AP-189 VII.A3.AP-199 VII.A4.AP-189 VII.A4.AP-199 VII.C2.AP-189 VII.C2.AP-199 VII.E1.AP-189 VII.E1.AP-199 VII.E1.AP-203 VII.E3.AP-189 VII.E3.AP-199 VII.E4.AP-189 VII.E4.AP-199 VII.F1.AP-189 VII.F1.AP-199 VII.F1.AP-203 VII.F2.AP-189 VII.F2.AP-199 VII.F3.AP-189 VII.F3.AP-199 VII.F3.AP-203 VII.F4.AP-189 VII.F4.AP-199 VII.H1.AP-199

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
							VII.H2.AP-199
M	47	BWR	Stainless steel; steel with stainless steel cladding heat exchanger components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.E3.AP-191 VII.E4.AP-191
M	48	BWR/PWR	Aluminum piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.C2.AP-254 VII.H2.AP-255
M	49	BWR/PWR	Stainless steel piping, piping components, exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.C2.A-52
	50	BWR/PWR	Stainless steel, copper alloy, steel heat exchanger tubes exposed to closed-cycle cooling water	Reduction of heat transfer due to fouling	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.C2.AP-188 VII.C2.AP-205 VII.E3.AP-188 VII.E4.AP-188 VII.F1.AP-204 VII.F1.AP-205 VII.F2.AP-204 VII.F2.AP-205 VII.F3.AP-204 VII.F3.AP-205 VII.F4.AP-204
	51	BWR/PWR	Boraflex spent fuel storage racks: neutron-absorbing sheets (PWR), spent fuel storage racks: neutron-absorbing sheets (BWR) exposed to treated borated water, treated water	Reduction of neutron-absorbing capacity due to boraflex degradation	AMP XI.M22, "Boraflex Monitoring"	No	VII.A2.A-86 VII.A2.A-87

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	52	BWR/PWR	Steel cranes: rails and structural girders exposed to air – indoor uncontrolled, air – outdoor	Loss of material due to general corrosion	AMP XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems"	No	VII.B.A-07
M	53	BWR/PWR	Steel cranes - rails exposed to air – indoor uncontrolled, air – outdoor	Loss of material due to wear	AMP XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems"	No	VII.B.A-05
M	54	BWR/PWR	Copper alloy piping, piping components, exposed to condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M24, "Compressed Air Monitoring"	No	VII.D.AP-240
M	55	BWR/PWR	Steel piping, piping components exposed to condensation (internal)	Loss of material due to general, pitting corrosion	AMP XI.M24, "Compressed Air Monitoring"	No	VII.D.A-26
M	56	BWR/PWR	Stainless steel piping, piping components, exposed to condensation (internal)	Loss of material due to pitting, crevice corrosion	AMP XI.M24, "Compressed Air Monitoring"	No	VII.D.AP-81
	57	BWR/PWR	Elastomer fire barrier penetration seals exposed to air – indoor uncontrolled, air – outdoor	Increased hardness; shrinkage; loss of strength due to weathering	AMP XI.M26, "Fire Protection"	No	VII.G.A-19 VII.G.A-20

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	58	BWR/PWR	Steel halon/carbon dioxide fire suppression system piping, piping components exposed to air – indoor uncontrolled (external)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M26, "Fire Protection"	No	VII.G.AP-150
	59	BWR/PWR	Steel fire rated doors exposed to air – indoor uncontrolled, air – outdoor	Loss of material due to wear	AMP XI.M26, "Fire Protection"	No	VII.G.A-21 VII.G.A-22
	60	BWR/PWR	Reinforced concrete structural fire barriers: walls, ceilings and floors exposed to air – indoor uncontrolled	Concrete cracking and spalling due to aggressive chemical attack, and reaction with aggregates	AMP XI.M26, "Fire Protection," and AMP XI.S6, "Structures Monitoring"	No	VII.G.A-90
	61	BWR/PWR	Reinforced concrete structural fire barriers: walls, ceilings and floors exposed to air – outdoor	Cracking, loss of material due to freeze- thaw, aggressive chemical attack, and reaction with aggregates	AMP XI.M26, "Fire Protection," and AMP XI.S6, "Structures Monitoring"	No	VII.G.A-92
	62	BWR/PWR	Reinforced concrete structural fire barriers: walls, ceilings and floors exposed to air - indoor, uncontrolled, air – outdoor	Loss of material due to corrosion of embedded steel	AMP XI.M26, "Fire Protection," and AMP XI.S6, "Structures Monitoring"	No	VII.G.A-91 VII.G.A-93
	63	BWR/PWR	Steel fire hydrants exposed to air – outdoor	Loss of material due to general, pitting, crevice corrosion	AMP XI.M27, "Fire Water System"	No	VII.G.AP-149

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	64	BWR/PWR	Steel, copper alloy piping, piping components exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; fouling that leads to corrosion; flow blockage due to fouling	AMP XI.M27, "Fire Water System"	No	VII.G.A-33 VII.G.AP-197
M	65	BWR/PWR	Aluminum piping, piping components exposed to raw water	Loss of material due to pitting, crevice corrosion, MIC; fouling that leads to corrosion; flow blockage due to fouling	AMP XI.M27, "Fire Water System"	No	VII.G.AP-180
M	66	BWR/PWR	Stainless steel piping, piping components exposed to raw water	Loss of material due to pitting, crevice corrosion, MIC; fouling that leads to corrosion; flow blockage due to fouling	AMP XI.M27, "Fire Water System"	No	VII.G.A-55
M	67	BWR/PWR	Steel tanks exposed to air – outdoor (external)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M29, "Aboveground Metallic Tanks"	No	VII.H1.A-95
M	68	BWR/PWR	Steel piping, piping components exposed to fuel oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M30, "Fuel Oil Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.G.AP-234

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	69	BWR/PWR	Copper alloy piping, piping components exposed to fuel oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M30, "Fuel Oil Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.G.AP-132 VII.H1.AP-132 VII.H2.AP-132
M	70	BWR/PWR	Steel piping, piping components, tanks exposed to fuel oil	Loss of material due to general, pitting, crevice corrosion, MIC; fouling that leads to corrosion	AMP XI.M30, "Fuel Oil Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.H1.AP-105 VII.H2.AP-105
M	71	BWR/PWR	Stainless steel, aluminum piping, piping components exposed to fuel oil	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M30, "Fuel Oil Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.G.AP-136 VII.H1.AP-129 VII.H1.AP-136 VII.H2.AP-129 VII.H2.AP-136
M	72	BWR/PWR	Gray cast iron, copper alloy (>15% Zn or >8% Al) piping, piping components, heat exchanger components exposed to treated water, closed-cycle cooling water, soil, raw water, waste water, ground water	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	VII.A3.AP-31 VII.A3.AP-43 VII.A4.AP-31 VII.A4.AP-32 VII.A4.AP-43 VII.C1.A-02 VII.C1.A-47 VII.C1.A-51 VII.C1.A-66 VII.C2.A-50 VII.C2.AP-31 VII.C2.AP-32 VII.C2.AP-43 VII.C3.A-02 VII.C3.A-47 VII.C3.A-51 VII.E1.AP-31

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
							VII.E1.AP-43 VII.E1.AP-65 VII.E3.AP-31 VII.E3.AP-32 VII.E3.AP-43 VII.E4.AP-31 VII.E4.AP-32 VII.E4.AP-43 VII.E5.A-547 VII.E5.A-724 VII.F1.AP-31 VII.F1.AP-43 VII.F1.AP-65 VII.F2.AP-31 VII.F2.AP-43 VII.F3.A-50 VII.F3.AP-43 VII.F3.AP-65 VII.F4.AP-31 VII.F4.AP-43 VII.G.A-02 VII.G.A-47 VII.G.A-51 VII.G.AP-31 VII.H1.A-02 VII.H1.AP-43 VII.H2.A-02 VII.H2.A-47 VII.H2.A-51 VII.H2.AP-43
M	73	BWR/PWR	Concrete, cementitious material piping, piping components exposed to air – outdoor	Changes in material properties due to aggressive chemical attack	AMP XI.M36, "External Surfaces Monitoring of Mechanical	No	VII.C1.AP-253

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					Components"		
M	74	BWR/PWR	Concrete, cementitious material piping, piping components exposed to air – outdoor	Cracking due to settling	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.C1.AP-251
M	75	BWR/PWR	Reinforced concrete, asbestos cement piping, piping components exposed to air – outdoor	Cracking due to aggressive chemical attack and leaching; changes in material properties due to aggressive chemical attack	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.C1.AP-156
M	76	BWR/PWR	Elastomer seals, piping, piping components exposed to air – indoor uncontrolled (internal/external), air – indoor controlled, outdoor air, dry air, condensation, air with borated water leakage	Hardening and loss of strength due to elastomer degradation	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.F1.AP-102 VII.F2.AP-102 VII.F3.AP-102 VII.F4.AP-102
M	77	BWR/PWR	Concrete, cementitious material piping, piping components exposed to air – outdoor	Loss of material due to abrasion, cavitation, aggressive chemical attack, leaching	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.C1.AP-252
M	78	BWR/PWR	Steel piping and components, ducting, closure bolting exposed to air – indoor uncontrolled, air – outdoor,	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of	No	VII.D.A-80 VII.F1.A-10 VII.F1.A-105 VII.F2.A-10

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			condensation		Mechanical Components"		VII.F2.A-105 VII.F3.A-10 VII.F3.A-105 VII.F4.A-10 VII.F4.A-105 VII.I.A-105 VII.I.A-77 VII.I.A-78 VII.I.A-81
M	79	BWR/PWR	Copper alloy piping, piping components, exposed to condensation (external)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.AP-109
M	80	BWR/PWR	Steel heat exchanger components, piping, piping components, exposed to air – indoor uncontrolled (external), air – outdoor (external)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.F1.AP-41 VII.F2.AP-41 VII.F3.AP-41 VII.F4.AP-41 VII.G.AP-40 VII.G.AP-41 VII.H1.A-24 VII.H2.AP-40 VII.H2.AP-41
M	81	BWR/PWR	Copper alloy, aluminum piping, piping components, exposed to air – outdoor (external), air – outdoor	Loss of material due to general (copper alloy only) pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.AP-159 VII.I.AP-256
M	82	BWR/PWR	Elastomer seals and components exposed to air – indoor uncontrolled (external), air – indoor controlled, outdoor air, dry air, air with borated	Loss of material due to wear	AMP XI.M36, "External Surfaces Monitoring of Mechanical	No	VII.I.AP-113

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			water leakage		Components"		
M	83	BWR/PWR	Stainless steel diesel engine exhaust piping, piping components exposed to diesel exhaust	Cracking due to stress corrosion cracking	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.H2.AP-128
M	85	BWR/PWR	Elastomer seals, piping, piping components exposed to closed-cycle cooling water	Hardening and loss of strength due to elastomer degradation	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C2.AP-259
M	86	BWR/PWR	Elastomer seals piping and piping components exposed to treated borated water, treated water	Hardening and loss of strength due to elastomer degradation	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.A3.AP-100 VII.A4.AP-101
M	88	BWR/PWR	Steel; stainless steel piping and piping components, diesel engine exhaust exposed to raw water (potable), diesel exhaust	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting	No	VII.E5.AP-270 VII.H2.AP-104

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					Components"		
M	89	BWR/PWR	Steel, copper alloy piping, piping components exposed to moist air, condensation (internal)	Loss of material due to general, pitting, crevice corrosion	For fire water system components: AMP XI.M27, "Fire Water System"	No	VII.G.AP-143
	90	BWR/PWR	Steel ducting and components (internal surfaces) exposed to condensation (internal)	Loss of material due to general, pitting, crevice corrosion, (for drip pans and drain lines) MIC	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.F1.A-08 VII.F2.A-08 VII.F3.A-08 VII.F4.A-08
M	91	BWR/PWR	Steel piping, piping components, tanks exposed to waste water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.E5.AP-281
M	92	BWR/PWR	Aluminum piping, piping components, exposed to condensation (internal)	Loss of material due to pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.F1.AP-142 VII.F2.AP-142 VII.F3.AP-142 VII.F4.AP-142

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	93	BWR/PWR	Copper alloy piping, piping components, exposed to raw water (potable)	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.E5.AP-271
	94	BWR/PWR	Stainless steel ducting and components exposed to condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.F1.AP-99 VII.F2.AP-99 VII.F3.AP-99
M	95	BWR/PWR	Copper alloy, stainless steel, aluminum, nickel alloy, steel piping, piping components, heat exchanger components, piping, piping components, tanks exposed to waste water, condensation (internal)	Loss of material due to general (steel and copper alloy only), pitting, crevice corrosion, MIC (steel, stainless steel, nickel alloy, and copper alloy in waste water environments only)	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.E5.AP-272 VII.E5.AP-273 VII.E5.AP-274 VII.E5.AP-275 VII.E5.AP-276 VII.E5.AP-278 VII.E5.AP-279 VII.E5.AP-280
M	96	BWR/PWR	Elastomer seals, piping, piping components exposed to air – indoor uncontrolled (internal)	Loss of material due to wear	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.F1.AP-103 VII.F2.AP-103 VII.F3.AP-103 VII.F4.AP-103

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	96.2	BWR/PWR	Steel, aluminum, copper alloy, stainless steel heat exchanger tubes exposed to condensation (for components not covered by NRC GL 89-13)	Reduction of heat transfer due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-419 VII.F1.A-419 VII.F2.A-419 VII.F3.A-419 VII.F4.A-419
N	96.4	BWR/PWR	Steel, aluminum, copper alloy, stainless steel heat exchanger components exposed to condensation (for components not covered by NRC GL 89-13)	Loss of material due to general (steel and copper alloy only), pitting, crevice corrosion; fouling that leads to corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-417 VII.C1.A-418 VII.F1.A-417 VII.F1.A-418 VII.F2.A-417 VII.F2.A-418 VII.F3.A-417 VII.F3.A-418 VII.F4.A-417 VII.F4.A-418
M	97	BWR/PWR	Steel piping, piping components, reactor coolant pump oil collection system: tanks, reactor coolant pump oil collection system: piping, tubing, valve bodies exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VII.C1.AP-127 VII.C2.AP-127 VII.E1.AP-127 VII.E4.AP-127 VII.F1.AP-127 VII.F2.AP-127 VII.F3.AP-127 VII.F4.AP-127 VII.G.AP-116 VII.G.AP-117 VII.G.AP-127 VII.H2.AP-127
	98	BWR/PWR	Steel heat exchanger components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC; fouling that leads	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time	No	VII.H2.AP-131

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
				to corrosion	Inspection"		
M	99	BWR/PWR	Copper alloy, aluminum piping, piping components exposed to lubricating oil	Loss of material due to general (copper alloy only), pitting, crevice corrosion, MIC (copper alloy only)	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VII.C1.AP-133 VII.C2.AP-133 VII.E1.AP-133 VII.E4.AP-133 VII.G.AP-133 VII.H2.AP-133 VII.H2.AP-162
M	100	BWR/PWR	Stainless steel piping, piping components exposed to lubricating oil	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VII.C1.AP-138 VII.C2.AP-138 VII.E1.AP-138 VII.E4.AP-138 VII.G.AP-138 VII.H2.AP-138
	101	BWR/PWR	Aluminum heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VII.H2.AP-154
	102	BWR/PWR	Boral®; boron steel, and other materials (excluding Boraflex) spent fuel storage racks: neutron-absorbing sheets (PWR), spent fuel storage racks: neutron-absorbing sheets (BWR) exposed to treated borated water, treated water	Reduction of neutron-absorbing capacity; change in dimensions and loss of material due to effects of SFP environment	AMP XI.M40, "Monitoring of Neutron-Absorbing Materials other than Boraflex"	No	VII.A2.AP-235 VII.A2.AP-236

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	103	BWR/PWR	Reinforced concrete, asbestos cement piping, piping components exposed to soil, concrete	Cracking due to aggressive chemical attack and leaching; Changes in material properties due to aggressive chemical attack	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.C1.AP-157
M	104	BWR/PWR	HDPE, fiberglass piping, piping components exposed to soil, concrete	Cracking, blistering, change in color due to water absorption	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.C1.AP-175 VII.C1.AP-176
M	105	BWR/PWR	Concrete, concrete cylinder piping, asbestos cement pipe piping, piping components exposed to soil, concrete	Cracking, spalling, corrosion of rebar due to exposure of rebar	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.C1.AP-177 VII.C1.AP-178 VII.C1.AP-237
M	106	BWR/PWR	Steel (with coating or wrapping) piping, piping components exposed to soil, concrete	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.C1.AP-198 VII.C3.AP-198 VII.G.AP-198 VII.H1.AP-198
M	107	BWR/PWR	Stainless steel, nickel alloy piping, piping components exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil environment only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.C1.AP-137 VII.C3.AP-137 VII.G.AP-137 VII.H1.AP-137 VII.H2.AP-137
M	108	BWR/PWR	Titanium, super austenitic, aluminum, copper alloy, stainless steel, nickel alloy piping, piping components, bolting exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil environment only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.C1.AP-171 VII.C1.AP-172 VII.C1.AP-173 VII.C1.AP-174 VII.I.AP-243

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	109	BWR/PWR	Steel bolting exposed to soil, concrete	Loss of material due to general, pitting, crevice corrosion, MIC (soil environment only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.I.AP-241
M	109a	BWR/PWR	Copper alloy, stainless steel, nickel alloy, steel underground piping, piping components exposed to air – indoor uncontrolled, condensation, air – outdoor (external)	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.I.AP-284
M	110	BWR	Stainless steel piping, piping components exposed to treated water >60°C (>140°F)	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	AMP XI.M7, "BWR Stress Corrosion Cracking," and AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Section 3.3.2.2.9)	VII.E4.A-61
	111	BWR/PWR	Steel structural steel exposed to air – indoor uncontrolled (external)	Loss of material due to general, pitting, crevice corrosion	AMP XI.S6, "Structures Monitoring"	No	VII.A1.A-94
M	112	BWR/PWR	Steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.3.2.2.11)	VII.J.AP-282
M	113	BWR/PWR	Aluminum piping, piping components exposed to gas	None	None	No	VII.J.AP-37
M	114	BWR/PWR	Copper alloy piping, piping components exposed to air – indoor uncontrolled (internal/external), air – dry,	None	None	No	VII.J.AP-144 VII.J.AP-8 VII.J.AP-9

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			gas				
M	115	PWR	Copper alloy piping, piping components exposed to air with borated water leakage	None	None	No	VII.J.AP-11
M	116	BWR/PWR	Galvanized steel piping, piping components exposed to air – indoor uncontrolled	None	None	No	VII.J.AP-13
M	117	BWR/PWR	Glass piping elements exposed to air, air – indoor uncontrolled (external), lubricating oil, closed-cycle cooling water, air – outdoor, fuel oil, raw water, treated water, treated borated water, air with borated water leakage, condensation (internal/external), gas	None	None	No	VII.J.AP-14 VII.J.AP-15 VII.J.AP-166 VII.J.AP-167 VII.J.AP-48 VII.J.AP-49 VII.J.AP-50 VII.J.AP-51 VII.J.AP-52 VII.J.AP-96 VII.J.AP-97 VII.J.AP-98
M	118	BWR/PWR	Nickel alloy piping, piping components exposed to air – indoor uncontrolled (external)	None	None	No	VII.J.AP-16
M	119	BWR/PWR	Nickel alloy, PVC, glass piping, piping components exposed to air with borated water leakage, air – indoor uncontrolled, condensation (internal), waste water, potable water, raw water	None	None	No	VII.J.AP-260 VII.J.AP-268 VII.J.AP-269 VII.J.AP-277

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	120	BWR/PWR	Stainless steel piping, piping components exposed to air – indoor uncontrolled (internal/external), air – indoor uncontrolled (external), air with borated water leakage, air – dry, gas	None	None	No	VII.J.AP-123 VII.J.AP-17 VII.J.AP-18 VII.J.AP-20 VII.J.AP-22
M	121	BWR/PWR	Steel piping, piping components, exposed to air – indoor controlled (external), air – dry, gas	None	None	No	VII.J.AP-2 VII.J.AP-4 VII.J.AP-6
M	122	BWR/PWR	Titanium heat exchanger components, piping and piping components exposed to air – indoor uncontrolled, air – outdoor	None	None	No	VII.J.AP-151 VII.J.AP-160
M	123	BWR/PWR	Titanium (ASTM Grades 1,2, 7, 11, or 12) heat exchanger components other than tubes, piping and piping components exposed to raw water	None	None	No	VII.C1.AP-152 VII.C1.AP-161
M	124	BWR/PWR	Stainless steel, steel (with stainless steel or nickel-alloy cladding) spent fuel storage racks (BWR), spent fuel storage racks (PWR), piping, piping components exposed to treated water >60°C (>140°F), treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.A2.A-96 VII.A2.A-97 VII.A3.A-56 VII.E1.A-103
M	125	BWR/PWR	Steel (with stainless steel cladding); stainless steel spent fuel storage racks (BWR), spent fuel storage racks (PWR), piping, piping	Loss of material due to pitting, crevice corrosion, MIC	Plant-specific aging management program	Yes (SRP-SLR Section 3.3.2.2.12)	VII.A2.AP-79 VII.A3.AP-79 VII.E1.AP-79 VII.A2.A-98 VII.A2.A-99

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			components exposed to treated water, treated borated water				
M	126	BWR/PWR	Any material piping, piping components exposed to treated water, treated borated water, raw water	Wall thinning due to erosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	VII.C1.A-409 VII.E1.A-407 VII.E3.A-408
M	127	BWR/PWR	Metallic piping, piping components, tanks exposed to raw water, waste water	Loss of material due to recurring internal corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.3.2.2.7)	VII.A2.A-400 VII.A3.A-400 VII.A4.A-400 VII.C1.A-400 VII.C2.A-400 VII.C3.A-400 VII.D.A-400 VII.E1.A-400 VII.E2.A-400 VII.E3.A-400 VII.E4.A-400 VII.E5.A-400 VII.F1.A-400 VII.F2.A-400 VII.F3.A-400 VII.F4.A-400 VII.G.A-400 VII.H1.A-400 VII.H2.A-400
M	128	BWR/PWR	Steel tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to soil, concrete, air – outdoor, air – indoor uncontrolled, moist air, raw water, condensation	Loss of material due to general, pitting, crevice corrosion, MIC (soil, raw water environments only)	AMP XI.M29, "Aboveground Metallic Tanks"	No	VII.C3.A-401 VII.E5.A-401 VII.H1.A-401

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	129	BWR/PWR	Steel tanks exposed to soil, concrete; air – indoor uncontrolled, raw water, treated water, waste water, condensation	Loss of material due to general, pitting, crevice corrosion, MIC (soil, raw water, treated water, waste water environments only)	AMP XI.M29, "Aboveground Metallic Tanks"	No	VII.H1.A-402
M	130	BWR/PWR	Metallic sprinklers exposed to air – indoor controlled, air – indoor uncontrolled, air – outdoor, moist air, condensation, raw water, treated water	Loss of material due to general, pitting, crevice corrosion, MIC (raw water and treated water environments only and all metals except for aluminum only), fouling that leads to corrosion; flow blockage due to fouling	AMP XI.M27, "Fire Water System"	No	VII.G.A-403
M	131	BWR/PWR	Steel, stainless steel, copper alloy, aluminum piping, piping components exposed to air – indoor uncontrolled (internal), air – outdoor (internal), condensation (internal)	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion, fouling that leads to corrosion; flow blockage due to fouling	AMP XI.M27, "Fire Water System"	No	VII.G.A-404
M	132	BWR/PWR	Insulated steel, copper alloy, copper alloy (> 15% Zn), aluminum piping, piping components, tanks exposed to	Loss of material due to general (steel, copper alloy only), pitting,	AMP XI.M36, "External Surfaces Monitoring of	No	VII.I.A-405

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			condensation, air – outdoor	crevice corrosion; cracking due to stress corrosion cracking (copper alloy (>15% Zn) only)	Mechanical Components"		
M	133	BWR/PWR	HDPE underground piping, piping components exposed to air – indoor uncontrolled, condensation, air – outdoor (external)	Cracking, blistering, change in color due to water absorption	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.I.A-406
M	134	BWR/PWR	Steel, stainless steel, copper alloy piping, piping components, and heat exchanger components exposed to a raw water environment (for components not covered by NRC GL 89-13)	Loss of material due to general (steel and copper alloy only), pitting, crevice corrosion, MIC, fouling that leads to corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-727
	135	BWR/PWR	Steel, stainless steel pump casings submerged in a waste water (internal and external) environment	Loss of material due to general (steel only), pitting, crevice corrosion, MIC	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.E5.A-410 VII.E5.A-411
M	136	BWR/PWR	Steel fire water storage tanks exposed to air – indoor uncontrolled, air – outdoor, condensation, moist air, raw water, treated water, soil, concrete	Loss of material due to general, pitting, crevice corrosion, MIC (raw water, treated water, soil only), fouling that leads to corrosion	AMP XI.M27, "Fire Water System"	No	VII.G.A-412

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	137	BWR/PWR	Steel, stainless steel, aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to treated water, treated borated water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC	AMP XI.M29, "Aboveground Metallic Tanks"	No	VII.C3.A-413 VII.E5.A-413 VII.H1.A-413
M	138	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, treated borated water, waste water, lubricating oil, fuel oil	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, or physical damage, and spalling for cementitious coatings/linings	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	VII.A2.A-416 VII.A3.A-416 VII.A4.A-416 VII.C1.A-416 VII.C2.A-416 VII.C3.A-416 VII.D.A-416 VII.E1.A-416 VII.E2.A-416 VII.E3.A-416 VII.E4.A-416 VII.E5.A-416 VII.F1.A-416 VII.F2.A-416 VII.F3.A-416 VII.F4.A-416 VII.G.A-416 VII.H1.A-416 VII.H2.A-416
M	139	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, treated borated water, lubricating oil, waste water	Loss of material due to general, pitting, crevice corrosion, MIC; fouling that leads to corrosion; cracking due to stress corrosion cracking	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	VII.A2.A-414 VII.A3.A-414 VII.A4.A-414 VII.C1.A-414 VII.C2.A-414 VII.C3.A-414 VII.D.A-414 VII.E1.A-414 VII.E2.A-414 VII.E3.A-414

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
							VII.E4.A-414 VII.E5.A-414 VII.F1.A-414 VII.F2.A-414 VII.F3.A-414 VII.F4.A-414 VII.G.A-414 VII.H1.A-414 VII.H2.A-414
M	140	BWR/PWR	Gray cast iron piping components with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, waste water	Loss of material due to selective leaching	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	VII.C1.A-415 VII.C2.A-415 VII.C3.A-415 VII.D.A-415 VII.E1.A-415 VII.E2.A-415 VII.E3.A-415 VII.E4.A-415 VII.E5.A-415 VII.F1.A-415 VII.F2.A-415 VII.F3.A-415 VII.F4.A-415 VII.G.A-415 VII.H1.A-415 VII.H2.A-415
N	141	BWR/PWR	Steel, stainless steel bolting exposed to condensation, fuel oil, lubricating oil	Loss of preload due to thermal effects, gasket creep, or self-loosening	AMP XI.M18, "Bolting Integrity"	No	VII.I.A-421 VII.I.A-422
N	142	BWR/PWR	Copper alloy bolting exposed to raw water, waste water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M18, "Bolting Integrity"	No	VII.I.A-423

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	143	BWR/PWR	Steel bolting exposed to lubricating oil, fuel oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M18, "Bolting Integrity"	No	VII.I.A-424
N	144	BWR/PWR	Stainless steel, aluminum piping, piping components exposed to soil, concrete	Cracking due to stress corrosion cracking	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.C1.A-425 VII.C3.A-425 VII.E5.A-425 VII.G.A-425 VII.H1.A-425 VII.H2.A-425
N	145	BWR/PWR	Stainless steel bolting exposed to soil, concrete	Cracking due to stress corrosion cracking	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.C1.A-426 VII.C3.A-426 VII.E5.A-426 VII.G.A-426 VII.H1.A-426 VII.H2.A-426
N	146	BWR/PWR	Stainless steel underground piping, piping components, tanks exposed to air – outdoor, raw water, condensation	Cracking due to stress corrosion cracking	AMP XI.M41, "Buried and Underground Piping and Tanks"	Yes (SRP-SLR Section 3.3.2.2.3)	VII.C1.A-714 VII.C2.A-714 VII.C3.A-714 VII.D.A-714 VII.E1.A-714 VII.E4.A-714 VII.F1.A-714 VII.F2.A-714 VII.F4.A-714 VII.G.A-714 VII.H1.A-714 VII.H2.A-714
N	147	BWR/PWR	Nickel alloy and nickel alloy cladding piping, piping components exposed to closed cycle cooling water, closed cycle cooling water >60°C (>140°F)	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.C2.A-471

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	148	BWR/PWR	Elastomer piping, ducting components exposed to air – outdoor	Hardening and loss of strength due to elastomer degradation	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.A-427
N	149	BWR/PWR	Fiberglass piping and ducting, piping and ducting components exposed to air – outdoor	Cracking, blistering, change in color due to water absorption	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.A-428
N	150	BWR/PWR	Fiberglass piping and ducting, piping and ducting components exposed to air – indoor	Change in material properties due to exposure to ultraviolet light, ozone, radiation, temperature	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.A-720
N	151	BWR/PWR	Stainless steel, steel, aluminum, copper alloy, titanium heat exchanger components exposed to air, condensation (external)	Reduction of heat transfer due to fouling	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.A-716
N	153	BWR/PWR	Elastomer seals, piping, piping components exposed to air – outdoor	Hardening and loss of strength due to elastomer degradation	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.A-708
N	154	BWR/PWR	Elastomer, fiberglass piping, piping components, ducting, ducting components exposed to air-outdoor, air-indoor	Loss of material due to wear	AMP XI.M36, "External Surfaces Monitoring of Mechanical	No	VII.I.A-719

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					Components"		
N	155	BWR/PWR	Stainless steel piping, piping components, and tanks exposed to waste water greater than 140° F	Cracking due to stress corrosion cracking	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.E5.A-721
N	156	BWR/PWR	Elastomer seals, piping, piping components exposed to condensation, waste water, gas, fuel oil, lubricating oil	Hardening and loss of strength due to elastomer degradation	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.E1.A-504 VII.E2.A-504 VII.E3.A-504 VII.E4.A-504 VII.E5.A-504 VII.F1.A-504 VII.F2.A-504 VII.F3.A-504 VII.F4.A-504 VII.G.A-504 VII.H1.A-660 VII.H2.A-677 VII.E5.A-728 VII.D.A-729
N	157	BWR/PWR	Steel piping, piping components, heat exchanger components exposed to air-outdoor (internal)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.E1.A-722 VII.E2.A-722 VII.E3.A-722 VII.E4.A-722 VII.E5.A-722 VII.F1.A-722 VII.F2.A-722 VII.F3.A-722 VII.F4.A-722

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
							VII.G.A-722 VII.H1.A-722 VII.H2.A-722
N	158	BWR/PWR	Nickel alloy piping, piping components heat exchanger components (for components not covered by NRC GL 89-13) exposed to raw water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-454 VII.C2.A-454
N	159	BWR/PWR	Fiberglass piping, piping components, ducting and components exposed to air – indoor (internal)	Loss of material due to wear	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.D.A-495 VII.E5.A-495 VII.F1.A-495 VII.F2.A-495 VII.F3.A-495 VII.F4.A-495 VII.G.A-495 VII.H1.A-495 VII.H2.A-495
N	160	BWR/PWR	Copper alloy (>15% Zn or >8% Al) piping, piping components, heat exchanger components exposed to closed-cycle cooling water	Cracking due to stress corrosion cracking	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.C2.A-473
N	161	BWR/PWR	Copper alloy heat exchanger components exposed to condensation	Reduction of heat transfer due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.F1.A-565 VII.F2.A-565 VII.F3.A-565 VII.F4.A-565 VII.G.A-565 VII.H1.A-565 VII.H2.A-565

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	162	BWR/PWR	Steel, stainless steel, copper alloy piping, piping components exposed to air-outdoor	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M27, "Fire Water System"	No	VII.G.A-637
N	164	BWR/PWR	Gray cast iron piping, piping components exposed to air – indoor uncontrolled, air – outdoor, moist air, condensation, raw water, treated water, waste water (external)	Loss of material due to general, pitting, crevice corrosion, MIC (raw water, waste water, and treated water environments only)	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.A-455
N	165	BWR/PWR	Gray cast iron piping, piping components exposed to air – indoor uncontrolled, air – outdoor, moist air, condensation, raw water, treated water, waste water (internal)	Loss of material due to general, pitting, crevice corrosion, MIC (raw water, waste water, and treated water environments only)	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-456 VII.C2.A-456 VII.C3.A-456 VII.D.A-456 VII.E5.A-456 VII.G.A-456 VII.H1.A-456 VII.H2.A-456
N	166	BWR/PWR	Copper alloy piping, piping components exposed to concrete	None	None	No	VII.J.A-711
N	167	BWR/PWR	Zinc piping components exposed to air-indoor	None	None	No	VII.J.A-712
N	169	BWR/PWR	Steel, copper alloy piping, piping components exposed to steam	Loss of material due to general, pitting, crevice corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.F1.A-566 VII.F2.A-566 VII.F3.A-566 VII.F4.A-566

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	170	BWR/PWR	Stainless steel piping, piping components exposed to steam	Loss of material due to pitting, crevice corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.F1.A-567 VII.F2.A-567 VII.F3.A-567 VII.F4.A-567
N	171	BWR/PWR	Steel, stainless steel bolting exposed to raw water, waste water, treated water, treated borated water	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M18, "Bolting Integrity"	No	VII.I.A-725 VII.I.A-723 VII.I.A-726
N	172	BWR/PWR	PVC piping, piping components exposed to sunlight	Reduction in impact strength due to photolysis	Plant-specific aging management program	Yes (SRP-SLR Section 3.3.2.2.8)	VII.C1.A-458 VII.E5.A-458 VII.G.A-458
N	173	BWR/PWR	Elastomer seals, piping, piping components exposed to raw water, raw water (for components not covered by NRC GL 89-13), waste water, treated water, fuel oil, lubricating oil, condensation	Hardening and loss of strength due to elastomer degradation	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-457 VII.C2.A-477 VII.D.A-498 VII.E5.A-548 VII.G.A-641 VII.H1.A-667 VII.H2.A-667 VII.A2.A-749 VII.A3.A-749 VII.A4.A-749 VII.C1.A-749 VII.C2.A-749 VII.C3.A-749 VII.D.A-749 VII.E1.A-749 VII.E2.A-749 VII.E3.A-749 VII.E4.A-749 VII.E5.A-749 VII.F1.A-749 VII.F2.A-749

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
							VII.F3.A-749 VII.F4.A-749 VII.G.A-749 VII.H1.A-749 VII.H2.A-749
N	174	BWR/PWR	Elastomer seals, piping, piping components exposed to raw water, raw water (for components not covered by NRC GL 89-13), waste water	Loss of material due to wear	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-459 VII.E5.A-550
N	175	BWR/PWR	Fiberglass piping, piping components, tanks exposed to raw water, raw water (for components not covered by NRC GL 89-13), waste water	Cracking, blistering, change in color due to water absorption	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-460 VII.E5.A-551 VII.G.A-644
N	176	BWR/PWR	Fiberglass piping, piping components, tanks exposed to raw water, raw water environment (for components not covered by NRC GL 89-13), waste water	Loss of material due to wear	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-461 VII.E5.A-552 VII.G.A-645
N	177	BWR/PWR	Fiberglass piping, piping components exposed to soil	Loss of material due to wear	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.C1.A-462 VII.E5.A-462 VII.G.A-462

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	178	BWR/PWR	Fiberglass piping and piping components exposed to concrete	None	None	No	VII.J.A-710
N	179	BWR/PWR	Masonry walls: structural fire barriers exposed to air – indoor uncontrolled, air – outdoor	Cracking due to restraint shrinkage, creep, aggressive environment	AMP XI.M26, "Fire Protection," and AMP XI.S5, "Masonry Walls"	No	VII.G.A-626
N	180	BWR/PWR	Masonry walls: structural fire barriers exposed to air – outdoor	Loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.M26, "Fire Protection," and AMP XI.S5, "Masonry Walls"	No	VII.G.A-627
N	181	BWR/PWR	Stainless steel, nickel alloy, aluminum, titanium piping, piping components, exposed to condensation (External)	Loss of material due to pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.A-700 VII.I.A-701 VII.I.A-702 VII.I.A-703
N	182	BWR/PWR	Jacketed thermal insulation in an air – indoor uncontrolled, air – outdoor environment, air with borated water leakage, air with reactor coolant leakage, air with steam or water leakage	Reduced thermal insulation resistance due to moisture intrusion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.A-704
N	184	BWR/PWR	PVC piping, piping components, tanks exposed to concrete	None	None	No	VII.J.A-709
N	185	BWR/PWR	Aluminum fire water storage tanks exposed to air – outdoor, raw water, condensation, soil, concrete	Cracking due to stress corrosion cracking	AMP XI.M27, "Fire Water System"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.G.A-623

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	186	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to air – outdoor, air – indoor controlled, air – indoor uncontrolled, raw water, waste water, condensation, soil, concrete	Cracking due to stress corrosion cracking	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.C3.A-482 VII.E5.A-482 VII.H1.A-482
N	187	BWR/PWR	Insulated aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to air – outdoor, air – indoor controlled, air – indoor uncontrolled, condensation	Cracking due to stress corrosion cracking	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.G.A-654 VII.H1.A-654
N	189	BWR/PWR	Aluminum tanks, piping, piping components exposed to air – outdoor, raw water, waste water, condensation (internal)	Cracking due to stress corrosion cracking	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.A2.A-429 VII.A3.A-429 VII.A4.A-429 VII.C1.A-451 VII.C2.A-451 VII.C3.A-451 VII.D.A-451 VII.E1.A-451 VII.E2.A-451 VII.E3.A-451 VII.E4.A-451 VII.E5.A-451 VII.F1.A-451 VII.F2.A-451 VII.F3.A-451 VII.F4.A-451 VII.G.A-451 VII.H1.A-451 VII.H2.A-451

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	190	BWR/PWR	Aluminum piping, piping components, tanks exposed to raw water, waste water, condensation (external)	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.I.A-452
N	191	BWR/PWR	Aluminum piping, piping components, tanks exposed to soil, concrete	Cracking due to stress corrosion cracking	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.I.A-707
N	192	BWR/PWR	Aluminum underground piping, piping components, tanks exposed to air – outdoor, raw water, condensation	Cracking due to stress corrosion cracking	AMP XI.M41, "Buried and Underground Piping and Tanks"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.I.A-706
N	193	BWR/PWR	Steel components exposed to treated water, raw water, waste water	Long-term loss of material due to general corrosion	AMP XI.M32, "One-Time Inspection"	No	VII.A4.A-439 VII.C1.A-469 VII.E1.A-439 VII.E3.A-439 VII.E4.A-532 VII.E5.A-469 VII.G.A-651 VII.H2.A-651
N	194	BWR/PWR	PVC piping, piping components, and tanks exposed to soil, concrete	Loss of material due to wear	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.E5.A-537 VII.G.A-537
N	195	BWR/PWR	Concrete, cementitious material piping, piping components exposed to raw water	Changes in material properties due to aggressive chemical attack	AMP XI.M27, "Fire Water System"	No	VII.G.A-647

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	196	BWR/PWR	HDPE piping, piping components exposed to raw water	Cracking, blistering, change in color due to water absorption	AMP XI.M27, "Fire Water System"	No	VII.G.A-648
N	197	BWR/PWR	Fire water system piping, piping components, heat exchanger, heat exchanger components (any material) with only a leakage boundary (spatial) or structural integrity (attached) intended function	Loss of material due to general (steel and copper alloy only), pitting, crevice corrosion, MIC	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.G.A-649
N	198	BWR/PWR	Fire water system piping, piping components, heat exchanger, heat exchanger components (any material) with only a leakage boundary (spatial) or structural integrity (attached) intended function	Loss of material due to general (steel and copper alloy only), pitting, crevice corrosion, MIC, fouling that leads to corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.G.A-650
N	199	BWR/PWR	Steel structural bolting exposed to air – indoor uncontrolled, air – outdoor	Loss of preload due to self-loosening	AMP XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems"	No	VII.B.A-730
N	200	BWR/PWR	High-strength steel structural bolting exposed to air – indoor uncontrolled, air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling)	No	VII.B.A-731

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					Handling Systems"		
N	202	BWR/PWR	Stainless steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.3.2.2.11)	VII.J.AP-19
N	203	BWR	Stainless steel; steel with stainless steel cladding, piping, piping components, heat exchanger components exposed to treated water, sodium pentaborate solution	Loss of material due to pitting, crevice corrosion, MIC	Plant-specific aging management program	Yes (SRP-SLR Section 3.3.2.2.12)	VII.A4.AP-110 VII.E3.AP-110 VII.E4.AP-110 VII.A4.AP-111 VII.E2.AP-141
N	204	BWR/PWR	Stainless steel, steel, aluminum, copper alloy, titanium heat exchanger components internal to components exposed to air (external), condensation	Reduction of heat transfer due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-733 VII.C2.A-733 VII.D.A-733 VII.F1.A-733 VII.F2.A-733 VII.F3.A-733 VII.F4.A-733 VII.H2.A-733
N	205	BWR/PWR	Insulated stainless steel piping, piping components, tanks exposed to air – indoor uncontrolled, air – indoor controlled, condensation, air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.3.2.2.3)	VII.I.A-734
N	206	PWR	Copper alloy (≤8% Al) piping, piping components exposed to air with borated water leakage	None	None	No	VII.J.A-735
N	207	BWR/PWR	Stainless steel, copper alloy, titanium heat exchanger tubes exposed to raw water (for	Reduction of heat transfer due to fouling	AMP XI.M38, "Inspection of Internal	No	VII.C1.A-736

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			components not covered by NRC GL 89-13)		Surfaces in Miscellaneous Piping and Ducting Components"		
N	208	BWR/PWR	Reinforced concrete, asbestos cement piping, piping components exposed to raw water (for components not covered by NRC GL 89-13)	Cracking due to aggressive chemical attack and leaching; changes in material properties due to aggressive chemical attack	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-737
N	209	BWR/PWR	Fiberglass piping, piping components exposed to raw water (internal) (for components not covered by NRC GL 89-13)	Cracking, blistering, change in color due to water absorption	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-738
N	210	BWR/PWR	HDPE piping, piping components exposed to raw water (internal) (for components not covered by NRC GL 89-13)	Cracking, blistering, change in color due to water absorption	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-739
N	211	BWR/PWR	Concrete, cementitious material piping, piping components exposed to raw water (for components not covered by NRC GL 89-13)	Cracking due to settling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and	No	VII.C1.A-740

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					Ducting Components"		
N	212	BWR/PWR	Concrete, cementitious material piping, piping components exposed to raw water (for components not covered by NRC GL 89-13)	Loss of material due to abrasion, cavitation, aggressive chemical attack, leaching	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-741
N	213	BWR/PWR	Concrete, cementitious material piping, piping components exposed to raw water (for components not covered by NRC GL 89-13)	Changes in material properties due to aggressive chemical attack	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-742
N	214	BWR/PWR	Copper alloy (>15% Zn or >8% Al) piping, piping components exposed to soil ground water	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	VII.C1.A-743 VII.C2.A-743 VII.C3.A-743 VII.D.A-743 VII.E4.A-743 VII.E5.A-743 VII.G.A-743 VII.H1.A-743 VII.H2.A-743
N	215	BWR/PWR	Aluminum fire water storage tanks exposed to air – indoor uncontrolled, air – outdoor, condensation, moist air, raw water, treated water, soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M27, "Fire Water System"	No	VII.G.A-744

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	216	BWR/PWR	Stainless steel fire water storage tanks exposed to air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M27, "Fire Water System"	Yes (SRP-SLR Section 3.3.2.2.3)	VII.G.A-745
N	217	BWR/PWR	Stainless steel fire water storage tanks exposed to air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M27, "Fire Water System"	Yes (SRP-SLR Section 3.3.2.2.4)	VII.G.A-746
N	218	BWR/PWR	Stainless steel fire water storage tanks exposed to air – indoor uncontrolled, condensation, moist air, raw water, treated water, soil, concrete	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M27, "Fire Water System"	No	VII.G.A-747
N	219	BWR/PWR	Stainless steel piping, piping components exposed to steam	Cracking due to stress corrosion cracking	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.F1.A-748 VII.F2.A-748 VII.F3.A-748 VII.F4.A-748
M	220	BWR/PWR	Steel, copper alloy piping, piping components exposed to moist air, condensation (internal)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.H2.A-23
N	221	BWR/PWR	Aluminum piping, piping components exposed to air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.C1.A-750 VII.C2.A-750 VII.C3.A-750 VII.D.A-750 VII.E1.A-750 VII.E4.A-750 VII.F1.A-750

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
							VII.F2.A-750 VII.F4.A-750 VII.G.A-750 VII.H1.A-750 VII.H2.A-750
N	222	BWR/PWR	Stainless steel tanks exposed to air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.3.2.2.4)	VII.I.A-751
N	223	BWR/PWR	Aluminum underground piping, piping components exposed to air (external)	Loss of material due to pitting, crevice corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.3.2.2.13)	VII.I.A-752
N	224	BWR/PWR	Aluminum piping, piping components exposed to air – outdoor (external)	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.I.A-753
N	225	BWR/PWR	Aluminum tanks exposed to air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.I.A-754
N	226	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Aboveground Metallic Tanks"	No	VII.C3.A-755 VII.E5.A-755 VII.H1.A-755
N	227	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to air (external)	Loss of material due to pitting, crevice corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.3.2.2.13)	VII.C3.A-756 VII.E5.A-756 VII.H1.A-756
N	228	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to air – outdoor, air –	Loss of material due to pitting, crevice corrosion, MIC (raw water	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.3.2.2.4)	VII.C3.A-757 VII.E5.A-757 VII.H1.A-757

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			indoor uncontrolled, moist air, raw water, condensation	environment only)			
N	229	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to soil, ground water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M29, "Aboveground Metallic Tanks"	No	VII.C3.A-758 VII.E5.A-758 VII.H1.A-758
N	230	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to soil, concrete	Cracking due to stress corrosion cracking	AMP XI.M29, "Aboveground Metallic Tanks"	No	VII.C3.A-759 VII.E5.A-759 VII.H1.A-759
N	231	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to air – outdoor, air – indoor uncontrolled, air – indoor controlled, condensation	Cracking due to stress corrosion cracking	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.3.2.2.3)	VII.C3.A-760 VII.E5.A-760 VII.H1.A-760
N	232	BWR/PWR	Insulated stainless steel piping, piping components, tanks exposed to condensation, air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.3.2.2.4)	VII.I.A-761
N	233	BWR/PWR	Insulated aluminum piping, piping components, tanks exposed to condensation, air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.I.A-762
N	234	BWR/PWR	Aluminum piping, piping components exposed to air – dry, air– indoor uncontrolled, air– indoor controlled	Loss of material due to pitting, crevice corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.3.2.2.13	VII.J.A-763

Table 3.3-2. AMPs and Additional Guidance Appendices Recommended for Aging Management of Auxiliary Systems	
GALL-SLR Report Chapter/AMP	**Program Name**
AMP XI.M1	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD
AMP XI.M2	Water Chemistry
AMP XI.M7	Boiling Water Reactor Stress Corrosion Cracking
AMP XI.M10	Boric Acid Corrosion
AMP XI.M17	Flow-Accelerated Corrosion
AMP XI.M18	Bolting Integrity
AMP XI.M20	Open-Cycle Cooling Water System
AMP XI.M21A	Closed Treated Water Systems
AMP XI.M22	Boraflex Monitoring
AMP XI.M23	Inspection of Overhead Heavy and Light Loads (Related to Refueling) Handling Systems
AMP XI.M24	Compressed Air Monitoring
AMP XI.M25	Boiling Water Reactor Cleanup System
AMP XI.M26	Fire Protection
AMP XI.M27	Fire Water System
AMP XI.M29	Aboveground Metallic Tanks
AMP XI.M30	Fuel Oil Chemistry
AMP XI.M32	One-Time Inspection
AMP XI.M33	Selective Leaching
AMP XI.M36	External Surfaces Monitoring of Mechanical Components
AMP XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
AMP XI.M39	Lubricating Oil Analysis
AMP XI.M40	Monitoring of Neutron-Absorbing Materials Other than Boraflex
AMP XI.M41	Buried and Underground Piping and Tanks
AMP XI.M42	Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks
AMP XI.S6	Structures Monitoring
Appendix for GALL-SLR	Quality Assurance for Aging Management Programs
GALL-SLR Report Appendix B	Operating Experience for Aging Management Programs
SRP-SLR Appendix A	Aging Management Review—Generic (Branch Technical Position RLSB-1)

3.4 Aging Management of Steam and Power Conversion System

Review Responsibilities

Primary—Branch assigned responsibility by Project Manager (PM) as described in Section 3.0 of this Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR).

3.4.1 Areas of Review

This section addresses the aging management review (AMR) and the associated aging management programs (AMPs) of the steam and power conversion system. For a recent vintage plant, the information related to the steam and power conversion system is contained in Chapter 10, "Steam and Power Conversion System," of the plant's Final Safety Analysis Report (FSAR), consistent with the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG–0800). The steam and power conversion systems contained in this review plan section are generally consistent with those contained in NUREG–0800 except for the condenser circulating water and the condensate storage systems. For older plants, the location of applicable information is plant-specific because an older plant's FSAR may have predated NUREG–0800.

Typical steam and power conversion systems that are subject to an AMR for subsequent license renewal (SLR) are steam turbine, main steam, extraction steam, feedwater, condensate, steam generator blowdown, and auxiliary feedwater (AFW). This review plan section also includes structures and components (SCs) in nonsafety-related systems that are not connected to safety-related systems, structures, and components (SSCs) but have a spatial relationship such that their failure could adversely impact the performance of a safety-related SSC-intended function. Examples of such nonsafety-related systems may be extraction steam, plant heating steam/auxiliary boilers and hot water heating systems.

The aging management for the steam generator is reviewed following the guidance in Section 3.1 of this SRP-SLR. The aging management for portions of the boiling water reactor (BWR) main steam and main feedwater systems, extending from the reactor vessel to the outermost containment isolation valve, is reviewed separately following the guidance in Section 3.1 of this SRP-SLR.

The responsible review organization is to review the following subsequent license renewal application (SLRA) AMR and AMP items assigned to it, per SRP-SLR Section 3.0:

AMRs

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

AMPs

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

FSAR Supplement

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

3.4.2 Acceptance Criteria

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

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

The AMR and the AMPs applicable to the steam and power conversion system are described and evaluated in Chapter VIII of the GALL-SLR Report.

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

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

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

The basic acceptance criteria, defined in Subsection 3.4.2.1, need to be applied first for all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL-SLR Report AMR item to which the SLRA AMR item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL-SLR Report for each of the following aging effect/aging mechanism combinations. Refer to Table 3.4-1, comparing the "Further Evaluation Recommended" and the "GALL-SLR Item" column, for the AMR items that reference the following subsections.

3.4.2.2.1 Cumulative Fatigue Damage

Fatigue is a time-limited aging analysis (TLAA) as defined in Title 10 of the *Code of Federal Regulations* (10 CFR) 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). This TLAA is addressed separately in Section 4.3, "Metal Fatigue Analysis," of this SRP-SLR. The related GALL-SLR Report items invoked by Table 3.4-1 item 1 are VIII.D1.S-11, VIII.D2.S-11, VIII.G.S-11, VIII.B1.S-08, VIII.B2.S-08.

3.4.2.2.2 Cracking Due to Stress Corrosion Cracking

Cracking due to SCC could occur for SS piping, piping components, and tanks exposed to outdoor air or any air environment when the component is insulated. The possibility of cracking also extends to indoor components located in close proximity to sources of outdoor air (e.g., components near intake vents). Cracking is known to occur in environments containing sufficient halides (e.g., chlorides) and in which moisture is possible.

Applicable outdoor air environments (and associated local indoor air environments) include, but are not limited to, those within approximately 5 miles of a saltwater coastline, within 1/2 mile of a road which is treated with salt in the wintertime, areas in which the soil contains more than trace chlorides, plants having cooling towers where the water is treated with chlorine or chlorine compounds, and areas subject to chloride contamination from other agricultural or industrial sources.

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

The applicant may demonstrate that SCC is not expected to occur by one or more of the following applicable means.

- For outdoor uninsulated components, describing the outdoor air environment present at the plant and demonstrating that SCC is not expected.
- For underground components, the applicant may demonstrate that SCC due to exposure to in-leakage to the vault as a result of external precipitation or groundwater is not expected.
- For insulated components, determining that the insulation does not contain sufficient contaminants to cause SCC. One acceptable means to demonstrate this is provided by Regulatory Guide 1.36, “Nonmetallic Thermal Insulation for Austenitic Stainless Steel.”
- For indoor components, determining that there are no liquid-filled systems with threaded or bolted connections (e.g., flanges, valve packing) that could leak onto the component.
- For all components, demonstrating that the aggressive environment is not present by isolating the component from the environment using a barrier to prevent loss of material due to pitting or crevice corrosion. An acceptable barrier includes tightly-adhering coatings that have been demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier coating is credited for isolating a component from a potentially aggressive environment then the barrier coating is evaluated to verify that it is impervious to the plant-specific environment. GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” is an acceptable method to manage the integrity of a barrier coating for internal or external coatings.

The GALL-SLR Report recommends further evaluation to determine whether an AMP is needed to manage this aging effect based on the environmental conditions applicable to the plant and requirements applicable to the components. GALL-SLR AMP XI.M36, “External Surfaces Monitoring,” GALL-SLR AMP XI.M29, “Aboveground Metallic Tanks,” or AMP XI.M41, “Buried and Underground Piping and Tanks," (for underground components) are acceptable methods to manage cracking of SS due to SCC in piping, piping components, and tanks.

3.4.2.2.3 Loss of Material Due to Pitting and Crevice Corrosion

Loss of material due to pitting and crevice corrosion could occur in SS piping, piping components, and tanks exposed to outdoor air or any air environment when the component is insulated or where the component is in the vicinity of insulated components. The possibility of pitting and crevice corrosion also extends to indoor components located in close proximity to sources of outdoor air (e.g., components near intake vents). Pitting and crevice corrosion is known to occur in environments containing sufficient halides (e.g., chlorides) and in which the presence of moisture is possible.

Applicable outdoor air environments (and associated local indoor air environments) include, but are not limited to, those within approximately 5 miles of a saltwater coastline, within 1/2 mile of a road which is treated with salt in the wintertime, areas in which the soil contains more than trace chlorides, plants having cooling towers where the water is treated with chlorine or chlorine compounds, and areas subject to chloride contamination from other agricultural or industrial sources.

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

The applicant may demonstrate that loss of material due to pitting and crevice corrosion is not expected to occur by one or more of the following applicable means.

- For outdoor uninsulated components, describing the outdoor air environment present at the plant and demonstrating that external pitting or crevice corrosion is not expected.
- For underground components, the applicant may demonstrate that loss of material due to pitting or crevice corrosion due to exposure to in-leakage to the vault as a result of external precipitation or groundwater is not expected.
- For insulated components, determining that the insulation does not contain sufficient contaminants to cause loss of material due to pitting or crevice corrosion. One acceptable means to demonstrate this is provided by Regulatory Guide 1.36, "Nonmetallic Thermal Insulation for Austenitic Stainless Steel."
- For indoor components, determining that there are no liquid-filled systems with threaded or bolted connections (e.g., flanges, valve packing) that could leak onto the component.
- For all components, demonstrating that the aggressive environment is not present by isolating the component from the environment using a barrier to prevent loss of material due to pitting or crevice corrosion. An acceptable barrier includes coatings that have been demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier coating is credited for isolating a component from a potentially aggressive environment, then the barrier coating is evaluated to verify that it is impervious to the plant-specific environment. GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers,

and Tanks," is an acceptable method to manage the integrity of a barrier coating for internal or external coatings.

The GALL-SLR Report recommends further evaluation to determine whether an AMP is needed to manage this aging effect based on the environmental conditions applicable to the plant and requirements applicable to the components. GALL-SLR AMP XI.M36, "External Surfaces Monitoring," GALL-SLR AMP XI.M29, "Aboveground Metallic Tanks," or AMP XI.M41, "Buried and Underground Piping and Tanks," (for underground components) are acceptable methods to manage loss of material due to pitting and crevice corrosion in SS piping, piping components, and tanks.

3.4.2.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

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

Acceptance criteria are described in Branch Technical Position (BTP) IQMB-1 (Appendix A.2, of this SRP-SLR Report).

3.4.2.2.5 Ongoing Review of Operating Experience

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

3.4.2.2.6 Loss of Material Due to Recurring Internal Corrosion

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

The GALL-SLR Report recommends that a plant-specific AMP, or a new or existing AMP, be evaluated for inclusion of augmented requirements to ensure the adequate management of any recurring aging effect(s). Potential augmented requirements include: (i) alternative examination methods (e.g., volumetric versus external visual); (ii) augmented inspections (e.g., a greater number of locations, additional locations based on risk insights based on susceptibility to aging effect and consequences of failure, a greater frequency of inspections), and (iii) additional trending parameters and decision points where increased inspections would be implemented. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report)."

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

Plant-specific operating experience examples should be evaluated to determine if the chosen AMP should be augmented even if the thresholds for significance of aging effect or frequency of occurrence of aging effect have not been exceeded. For example, during a 10-year search of plant specific operating experience, two instances of 360 degree 30 percent wall loss occurred at copper alloy to steel joints. Neither the significance of the aging effect nor the frequency of occurrence of aging effect threshold has been exceeded. Nevertheless, the operating experience should be evaluated to determine if the AMP that is proposed to manage the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of inspections) to provide reasonable assurance that the current licensing basis (CLB) intended functions of the component will be met throughout the subsequent period of extended operation. Likewise, the GALL-SLR Report AMR items associated with the new further evaluation items only cite raw water and waste water environments because operating experience indicates that these are the predominant environments associated with recurring internal corrosion; however, if the search of plant-specific operating experience reveals recurring internal corrosion in other water environments (e.g., treated water), the aging effect should be addressed in a similar manner.

3.4.2.2.7 Cracking Due to Stress Corrosion Cracking in Aluminum Alloys

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

<u>Susceptible Material</u>: If the material that a component is constructed of is not susceptible to SCC then the aging effect is not applicable. The microstructure of an aluminum alloy, of which alloy composition is only one factor, is what determines if the alloy is susceptible to SCC. Therefore, providing guidance based on alloy composition will not always successfully protect against SCC in aluminum alloys. The temper, condition, and product form of the alloy is considered when assessing if a material is susceptible to SCC. Aluminum alloys that are susceptible to SCC include:

- 2xxx series alloys in the F, W, Ox, T3x, T4x, or T6x temper
- 5xxx series alloys with a magnesium content of 3.5 weight percent or greater

- 6xxx series alloys in the F temper
- 7xxx series alloys in the F, T5x, or T6x temper
- 2xx.x and 7xx.x series alloys
- 3xx.x series alloys that contain copper
- 5xx.x series alloys with a magnesium content of greater than 8 weight percent

The material is evaluated to verify that it is not susceptible to SCC and that the basis used to make the determination is technically substantiated. Tempers have been specifically developed to improve the SCC resistance for some aluminum alloys. Aluminum alloy and temper combination which are not susceptible to SCC when used in piping, piping component, and tank applications include 1xxx series, 3xxx series, 6061-T6x, and 5454-x.

GALL-SLR Report AMP XI.M29, “Aboveground Metallic Tanks,” is an acceptable method to manage cracking of aluminum due to SCC in tanks. GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” is an acceptable method to manage cracking of aluminum due to SCC in piping and piping components. GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” is an acceptable method to manage cracking of aluminum due to SCC in piping and tanks which are buried or underground. GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” is an acceptable method to manage cracking of aluminum due to SCC in components that are not included in other AMPs. Additional acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

<u>Aggressive Environment</u>: If the environment that an aluminum alloy is exposed to is not aggressive, such as dry gas, controlled indoor air, or treated water, then cracking due to SCC will not occur and the aging effect is not applicable. Aggressive environments that are known to result in cracking of susceptible aluminum alloys due to SCC are aqueous solutions and atmospheric air that contain halides (e.g., chloride). Halide concentrations should generally be considered high enough to facilitate SCC of aluminum alloys in uncontrolled or untreated aqueous solutions and atmospheric air, such as outdoor air, raw water, waste water, and condensation, unless demonstrated otherwise. If an aluminum component is encapsulated in a secondary material, such as insulation or concrete, the composition of the encapsulating material is evaluated for halides. The environment that the aluminum alloy is exposed to is evaluated to verify that it is either controlled or treated and free of halides.

An alternative strategy to demonstrating that an aggressive environment is not present is to isolate the aluminum alloy from the environment using a barrier to prevent SCC. Acceptable barriers include tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier coating is credited for isolating an aluminum alloy from a potentially aggressive environment then the barrier coating is evaluated to verify that it is imperially to the plant-specific environment. GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” or equivalent program is an acceptable method to manage the integrity of a barrier coating.

3.4.2.2.8 Loss of Material Due to General, Crevice or Pitting Corrosion and Microbiologically-Induced Corrosion and Cracking Due to Stress Corrosion Cracking

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

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

3.4.2.2.9 Loss of Material Due to Pitting and Crevice Corrosion and Microbiologically-Induced Corrosion in Components Exposed to Treated Water, Treated Borated Water, or Sodium Pentaborate Solution

Loss of material due to crevice corrosion can occur in steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if oxygen levels are greater than 100 parts per billion (ppb). In addition, loss of material due to pitting can occur if oxygen levels are greater than 100 ppb, halides or sulfates levels are greater than 150 ppb, and stagnant flow conditions exist. Loss of material due to microbiologically-induced corrosion can occur with steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if the pH is less than 10.5 and temperature is less than 99 °C [210 °F].

Where oxygen levels are less than or equal to 100 ppb, GALL-SLR Report AMP XI.M2, "Water Chemistry," and GALL-SLR Report AMP XI.M32, "One-Time Inspection," are acceptable methods to manage loss of material due to pitting and crevice corrosion. Where oxygen levels are greater than 100 ppb, GALL-SLR Report AMP XI.M2, "Water Chemistry," and GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," are acceptable methods to manage loss of material due to crevice corrosion. Where stagnant flow conditions exist, and oxygen levels are greater than 100 ppb and halides or sulfates levels are greater than 150 ppb, GALL-SLR Report AMP XI.M2, "Water Chemistry," and GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," are acceptable methods to manage loss of material due to pitting and crevice corrosion.

Where the pH is greater than or equal to 10.5 and the temperature is greater than or equal to 99 °C [210 °F], GALL-SLR Report AMP XI.M2, "Water Chemistry," and GALL-SLR Report AMP XI.M32, "One-Time Inspection," are acceptable methods to manage loss of material due to loss of material due to microbiologically-induced corrosion. Where the pH is less than 10.5 and temperature is less than 99 °C [210 °F], GALL-SLR Report AMP XI.M2, "Water Chemistry," and GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," are acceptable methods to manage loss of material due to microbiologically-induced corrosion.

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

Loss of material due to pitting and crevice corrosion could occur in aluminum piping, piping components, and tanks exposed to an air environment for a sufficient duration of time. Air environments known to result in pitting and/or crevice corrosion of aluminum alloys are those that contain halides (e.g., chloride) and periodic moisture. The moisture level and halide concentration in atmospheric and uncontrolled air are greatly dependent on geographical location and site-specific conditions. Moisture level and halide concentration should generally be considered high enough to facilitate pitting and/or crevice corrosion of aluminum alloys in atmospheric and uncontrolled air, unless demonstrated otherwise. The periodic introduction of moisture or halides into an air environment from secondary sources should also be considered. Leakage of fluids from mechanical connections, such as bolted flanges and valve packing, through insulation onto a component in indoor controlled air is an example of a secondary source that should be considered. The operating experience (OE) and condition of aluminum alloy components are evaluated to determine if the plant-specific air environment is aggressive enough to result in pitting and crevice corrosion after prolonged exposure. The aging effect of loss of material due to pitting and crevice corrosion in aluminum alloys is not applicable and does not require management if: (a) the plant-specific OE does not reveal a history of pitting or crevice corrosion and (b) a one-time inspection demonstrates that the aging effect is not occurring or that loss of material due to pitting or crevice corrosion is occurring so slowly that it will not affect the intended function of the components.

The internal surfaces of aluminum components do not need to be inspected if: (a) the review of OE does not reveal a history of pitting or crevice corrosion; and (b) inspection results for external surfaces demonstrate that the aging effect is not applicable. Inspection results associated with the periodic introduction of moisture or halides from secondary sources may be treated as a separate population of components. In the environment of air-indoor controlled, pitting and crevice corrosion is only expected to occur as the result of secondary source of moisture or halides. Alloy susceptibility may be considered when reviewing OE and interpreting inspection results. Inspections focus on the most susceptible alloys and locations.

The GALL-SLR Report recommends the further evaluation of aluminum piping, piping components, and tanks exposed to an air environment to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion. GALL-SLR Report AMP XI.M32, "One-Time Inspection," is an acceptable method to demonstrate that the aging effect of loss of material due to pitting and crevice corrosion is not occurring at a rate that affects the intended function of the components. If loss of material due to pitting or crevice corrosion has occurred and is sufficient to potentially affect the intended function of an aluminum SSC, the following AMPs are acceptable methods to manage loss of material due to pitting or crevice corrosion: (i) GALL-SLR Report AMP XI.M29, “Aboveground Metallic Tanks,” for tanks; (ii) GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical Components,” for external surfaces of piping and piping components; (iii) GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” for underground piping, piping components and tanks; and (iv) GALL-SLR Report Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” for internal surfaces of components that are not included in other aging management programs.

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

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

3.4.2.4 Aging Management Programs

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

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

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

If the applicant chooses to use a plant-specific program that is not a GALL-SLR AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix A.1.2.3 of this SRP-SLR Report).

3.4.2.5 Final Safety Analysis Report Supplement

The summary description of the programs and activities for managing the effects of aging for the subsequent period of extended operation in the FSAR Supplement should be sufficiently comprehensive that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects will be managed during the subsequent period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the subsequent period of extended operation. Table 3.0-1 of this SRP-SLR provides examples of the type of information to be included in the FSAR Supplement. Table 3.4-2 lists the programs that are applicable for this SRP-SLR subsection.

3.4.3 Review Procedures

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

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

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

Furthermore, the reviewer should confirm that the applicant has addressed operating experience identified after the issuance of the GALL-SLR Report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the steam and power conversion system components that are contained in the GALL-SLR Report as applicable to its plant.

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

The basic review procedures defined in Subsection 3.4.3.1 need to be applied first for all of the AMRs and AMPs provided in this section. In addition, if the GALL-SLR Report AMR item to which the SLRA AMR item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL-SLR Report for each of the following aging effect/aging mechanism combinations. Refer to Table 3.4-1 for the item references for the following subsections.

3.4.3.2.1 Cumulative Fatigue Damage

Fatigue is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The reviewer reviews the evaluation of this TLAA separately following the guidance in Section 4.3 of this SRP-SLR.

3.4.3.2.2 Cracking Due to Stress Corrosion Cracking

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

If the applicant claims that neither the environment nor composition of insulation will result in stress corrosion cracking, the reviewer should evaluate the applicant's data to verify that sufficient halides will not be present on the surface of the SS piping, piping components, or tanks. If the applicant elects to manage stress corrosion cracking, the reviewer should determine whether an adequate program is credited to manage the aging effect based on the applicable environmental conditions.

3.4.3.2.3 Loss of Material Due to Pitting and Crevice Corrosion

The GALL-SLR Report recommends further evaluation to manage loss of material due to pitting and crevice corrosion of SS piping, piping components, and tanks exposed to outdoor air or any air environment when the component is insulated where the presence of sufficient halides (e.g., chlorides) and moisture is possible. The possibility of pitting and crevice corrosion also extends to indoor components located in close proximity to sources of outdoor air (e.g., components near intake vents).

If the applicant claims that neither the environment nor composition of the insulation will result in loss of material due to pitting and crevice corrosion, the reviewer should evaluate the applicant's data to verify that sufficient halides will not be present on the surface of the SS piping, piping components, or tanks. If the applicant elects to manage loss of material due to pitting or crevice corrosion, the reviewer should determine whether an adequate program is credited to manage the aging effect based on the applicable environmental conditions.

3.4.3.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

The applicant's AMPs for SLR should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related components are covered by 10 CFR Part 50, Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to nonsafety-related components that are subject to an AMP for SLR. Nevertheless, the applicant has the option to expand the scope of its 10 CFR Part 50, Appendix B program to include these components and address these program elements. If the applicant chooses this option, the reviewer confirms that the applicant has documented such a commitment in the FSAR Supplement. An example description is under "Quality Assurance" in Table 3.0-1, "FSAR Supplement for Aging Management of Applicable Systems." If the applicant chooses alternative means, the branch responsible for QA should be requested to review the applicant's proposal on a case-by-case basis.

3.4.3.2.5 Ongoing Review of Operating Experience

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

In addition, the reviewer confirms that the applicant has provided an appropriate summary description of these activities in the FSAR supplement. The GALL-SLR Report provides examples of the type of information to be included in the FSAR Supplement

3.4.3.2.6 Loss of Material Due to Recurring Internal Corrosion

The GALL-SLR Report recommends further evaluation to manage recurring internal corrosion aging effects. The reviewer conducts an independent review of plant-specific operating experience to determine whether the plant is currently experiencing recurring internal corrosion. The scope of this further evaluation AMR item includes recurring aging effects in which the plant-specific operating experience review reveals repetitive occurrences (e.g., one per refueling outage that has occurred: (a) in any three or more cycles for a 10-year operating experience search, or (b) in any two or more cycles for a 5-year operating experience search) of aging effects with the same aging mechanism as a result of which the component either did not meet plant-specific acceptance criteria or experienced a reduction in wall thickness greater than 50 percent (regardless of the minimum wall thickness).

The reviewer should evaluate plant-specific operating experience examples to determine if the chosen AMP should be augmented. For example, during a 10-year search of plant specific operating experience, two instances of 360 degree 30 percent wall loss occurred at copper alloy to steel joints. Neither the significance of the aging effect nor the frequency of occurrence of aging effect threshold has been exceeded. Nevertheless, the operating experience should be evaluated to determine if the AMP that is proposed to manage the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of inspections) to provide reasonable assurance that the CLB intended functions of the component will be met throughout the subsequent period of extended operation. Likewise, the GALL-SLR Report AMR items associated with the new further evaluation items only cite raw water and waste water environments because operating experience indicates that these are the predominant environments associated with recurring internal corrosion; however, if the search of plant-specific operating experience reveals recurring internal corrosion in other water environments (e.g., treated water), the aging effect should be addressed in a similar manner.

3.4.3.2.7 Cracking Due to Stress Corrosion Cracking in Aluminum Alloys

The GALL-SLR Report recommends the further evaluation of aluminum components (i.e., piping, piping components, and tanks) exposed to atmospheric air or aqueous solutions that contain halides to manage cracking due to SCC. The reviewer must first determine if the aging effect of cracking due to SCC is applicable and requires aging management. The aging effect of cracking is to be considered applicable unless it is demonstrated that one of the two acceptance criteria are met by demonstrating that an aggressive environment is not present or the specific material is not susceptible, as discussed in Section 3.4.2.2.7. Additionally, guidance is also provided on the review of the third condition necessary for SCC to occur, a sustained tensile stress. Each of three conditions is evaluated based on the review procedures below.

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

Aggressive Environment: If the environment that an aluminum alloy is exposed to is not aggressive, such as dry gas, controlled indoor air, or treated water, then the aging effect of cracking due to SCC is not applicable and does not require aging management. The environments cited in the AMR line items in the GALL-SLR Report that reference this further evaluation are considered to be aggressive and potentially containing halide concentrations that facilitate SCC of aluminum alloys. The reviewer is to verify that components are not also periodically exposed to nontypical environments that would be categorized as aggressive, such as outdoor air which has recently been introduced into a building and the leakage/seepage of untreated aqueous solutions into a building or underground vault. Using information provided by the applicant, the reviewer will also evaluate the chemical composition of applicable encapsulating materials (e.g., concrete, insulation) for halides.

If a barrier coating is employed to effectively isolate the aluminum alloy from an aggressive environment then the aging effect of cracking due to SCC is not applicable and does not require aging management. The reviewer is to verify that the barrier coating is impermeable to the plant-specific aqueous solutions and atmospheric air that the coating is intended to protect the alloy from being exposed to. If operating experience is cited as a technical justification for the effectiveness of a barrier coating the reviewer is to verify that the applicant has a program to manage loss of coating integrity equivalent to the GALL-SLR Report AMP XI.M42.

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

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

Documentation that may assist the reviewer in determining if the aging effect of cracking due to SCC is applicable and requires aging management include (a) component drawings, (b) applicable Codes or specifications used in the design, fabrication, and installation of the component, (c) material-specific material certification data and lot release data, and (d) maintenance records and plant-specific operating experience.

If it is determined that the aging effect of cracking due to SCC is applicable the reviewer is to evaluate the applicants proposed AMP to ensure that the effects of aging on components are adequately managed so that their intended functions will be maintained consistent with the CLB for the subsequent period of extended operation. The GALL-SLR Report AMP XI.M29, “Aboveground Metallic Tanks,” is an acceptable method to manage cracking of aluminum due to SCC in tanks. The GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” is an acceptable method to manage cracking of aluminum due to SCC in piping, and piping components. The GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” is an acceptable method to manage cracking of aluminum due to SCC in piping and tanks which are buried or underground. The GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” is an acceptable method to manage cracking of aluminum due to SCC in components that are not included in other AMPs.

3.4.3.2.8 Loss of Material Due to General, Crevice or Pitting Corrosion and Microbiologically-Induced Corrosion and Cracking Due to Stress Corrosion Cracking

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

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

3.4.3.2.9 Loss of Material Due to Pitting and Crevice Corrosion and Microbiologically-Induced Corrosion in Components Exposed to Treated Water, Treated Borated Water, or Sodium Pentaborate Solution

The GALL-SLR Report recommends that loss of material due to crevice corrosion can occur in steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if oxygen levels are greater than 100 ppb. In addition, loss of material due to pitting can occur if oxygen levels are greater than 100 ppb, halides or sulfates levels are greater than 150 ppb, and stagnant flow conditions exist. Loss of material due to microbiologically-induced corrosion can occur with steel with SS cladding, SS, and nickel alloy piping, piping components, heat exchanger components, spent fuel storage racks, tanks, and PWR heat exchanger components exposed to treated water, treated borated water, or sodium pentaborate solution if the pH is less than 10.5 and temperature is less than 99 °C [210 °F].

The reviewer verifies the applicant's chemistry control parameters to determine whether GALL-SLR Report AMP XI.M2, "Water Chemistry," and a one-time inspection program is implemented (e.g., GALL-SLR Report AMP XI.M32, "One-Time Inspection") or GALL-SLR Report AMP XI.M2, "Water Chemistry," and a periodic inspection program is implemented (e.g., GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components") to manage loss of material.

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

The GALL-SLR Report recommends a further evaluation to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion of aluminum piping, piping components, and tanks exposed to an air environment. If the applicant claims that a search of 10 years of plant-specific did not reveal any instances of loss of material due to pitting and crevice corrosion exposed to air environments, the staff conducts an independent review of plant-specific operating experience during the AMP audit.

An alternative strategy to demonstrating that pitting and crevice corrosion is not applicable is to isolate the aluminum alloy from the air environment using a barrier. Acceptable barriers include anodization and tightly adhering coatings that have been demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier coating is credited for isolating an aluminum alloy from a potentially aggressive environment then the barrier coating is evaluated to verify that it is impermeable to the plant-specific environment. GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," is an acceptable method to manage the integrity of internal and external barrier coatings.

The reviewer is to verify that the SLRA cites the use of GALL-SLR AMP XI.M32, "One-Time Inspection," for all aluminum piping, piping components, and tanks exposed to air environments. Alternatively, if the applicant states that it will utilize a strategy of isolating the aluminum components from the environment, verify that the aluminum components are coated and GALL-SLR AMP XI.M42 has been cited to manage loss of coating integrity.

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

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

3.4.3.4 Aging Management Programs

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR Report AMP. If the applicant identifies, in the SLRA AMP, an exception to any of the program elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not identified by the SLRA, between the SLRA AMP and the GALL-SLR Report AMP with which the SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions, or differences. The AMPs evaluated in the GALL-SLR Report pertinent to the steam and power conversion system are summarized in Table 3.4-1 of this SRP-SLR. The "GALL-SLR Item" column identifies the AMR item numbers in the GALL-SLR Report, Chapter VIII, presenting detailed information summarized by this row.

Table 3.4-1 of this SRP-SLR may identify a plant-specific AMP. If the applicant chooses to use a plant-specific program that is not a GALL-SLR AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix A.1.2.3 of this SRP-SLR Report).

3.4.3.5 Final Safety Analysis Report Supplement

The reviewer confirms that the applicant has provided in the FSAR supplement information equivalent to that in GALL-SLR for aging management of the steam and power conversion systems. Table 3.4-2 lists the AMPs that are applicable for this SRP-SLR subsection. The reviewer also confirms that the applicant has provided information for Subsection 3.4.3.3, "AMR Results Not Consistent with or Not Addressed in the GALL-SLR Report," equivalent to that in Table 3.0-1.

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

As noted in Table 3.0-1, the applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should confirm that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.4.4 Evaluation Findings

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

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

managing aging of the steam and power conversion system, as required by 10 CFR 54.21(d).

3.4.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

3.4.6 References

1. NRC. NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. March 2007.

2. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54 The License Renewal Rule." Revision 6. Washington, DC: Nuclear Energy Institute. 1995.

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	1	BWR/PWR	Steel piping, piping components exposed to steam, treated water	Cumulative fatigue damage due to fatigue	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.4.2.2.1)	VIII.B1.S-08 VIII.B2.S-08 VIII.D1.S-11 VIII.D2.S-11 VIII.G.S-11
M	2	BWR/PWR	Stainless steel piping, piping components exposed to air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.4.2.2.2)	VIII.A.SP-118 VIII.B1.SP-118 VIII.B2.SP-118 VIII.C.SP-118 VIII.D1.SP-118 VIII.D2.SP-118 VIII.E.SP-118 VIII.F.SP-118 VIII.G.SP-118
M	3	BWR/PWR	Stainless steel piping, piping components exposed to air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.4.2.2.3)	VIII.A.SP-127 VIII.B1.SP-127 VIII.B2.SP-127 VIII.C.SP-127 VIII.D1.SP-127 VIII.D2.SP-127 VIII.E.SP-127 VIII.F.SP-127 VIII.G.SP-127
	4	PWR	Steel external surfaces, bolting exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, "Boric Acid Corrosion"	No	VIII.H.S-30 VIII.H.S-40
M	5	BWR/PWR	Steel piping, piping components exposed to steam, treated water	Wall thinning due to flow-accelerated corrosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	VIII.A.S-15 VIII.B1.S-15 VIII.B2.S-15 VIII.C.S-15 VIII.D1.S-16 VIII.D2.S-16

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
							VIII.E.S-16 VIII.F.S-16 VIII.G.S-16
M	6	BWR/PWR	Steel, stainless steel bolting exposed to soil	Loss of preload due to thermal effects, gasket creep, or self-loosening	AMP XI.M18, "Bolting Integrity"	No	VIII.H.SP-142 VIII.H.SP-144
	7	BWR/PWR	High-strength steel closure bolting exposed to air with steam or water leakage	Cracking due to cyclic loading, stress corrosion cracking	AMP XI.M18, "Bolting Integrity"	No	VIII.H.S-03
	8	BWR/PWR	Steel; stainless steel bolting, closure bolting exposed to air – outdoor (external), air – indoor uncontrolled (external)	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M18, "Bolting Integrity"	No	VIII.H.SP-82 VIII.H.SP-84
	9	BWR/PWR	Steel closure bolting exposed to air with steam or water leakage	Loss of material due to general corrosion	AMP XI.M18, "Bolting Integrity"	No	VIII.H.S-02
M	10	BWR/PWR	Copper alloy, nickel alloy, steel; stainless steel bolting, closure bolting exposed to any environment, air – outdoor (external), air – indoor uncontrolled (external)	Loss of preload due to thermal effects, gasket creep, or self-loosening	AMP XI.M18, "Bolting Integrity"	No	VIII.H.SP-149 VIII.H.SP-150 VIII.H.SP-151 VIII.H.SP-83

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	11	BWR/PWR	Stainless steel piping, piping components, tanks, heat exchanger components exposed to steam, treated water >60°C (>140°F)	Cracking due to stress corrosion cracking	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.A.SP-98 VIII.B1.SP-88 VIII.B1.SP-98 VIII.B2.SP-98 VIII.C.SP-88 VIII.D1.SP-88 VIII.E.SP-88 VIII.E.SP-97 VIII.F.SP-85 VIII.F.SP-88 VIII.G.SP-88
M	12	BWR/PWR	Steel tanks exposed to treated water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.E.SP-75 VIII.G.SP-75
M	13	PWR	Steel piping, piping components exposed to treated water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.B1.SP-74 VIII.D1.SP-74 VIII.F.SP-74 VIII.G.SP-74
M	14	BWR/PWR	Steel piping, piping components, PWR heat exchanger components exposed to steam, treated water	Loss of material due to general, pitting, crevice corrosion, MIC (treated water only)	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.A.SP-71 VIII.B1.SP-71 VIII.B2.SP-160 VIII.B2.SP-73 VIII.C.SP-71 VIII.C.SP-73 VIII.D2.SP-73 VIII.E.SP-73 VIII.E.SP-78 VIII.F.SP-78
M	15	BWR/PWR	Steel heat exchanger components exposed to treated water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.E.SP-77

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	16	BWR/PWR	Copper alloy, aluminum piping, piping components exposed to treated water	Loss of material due to general (copper alloy only), pitting, crevice corrosion, MIC (copper alloy only)	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.A.SP-101 VIII.D1.SP-90 VIII.D2.SP-90 VIII.E.SP-90 VIII.F.SP-101 VIII.F.SP-90 VIII.G.SP-90
	17	PWR	Copper alloy heat exchanger tubes exposed to treated water	Reduction of heat transfer due to fouling	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.F.SP-100
	18	BWR/PWR	Copper alloy, stainless steel heat exchanger tubes exposed to treated water	Reduction of heat transfer due to fouling	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.E.SP-100 VIII.E.SP-96 VIII.F.SP-96 VIII.G.SP-100
M	19	BWR/PWR	Stainless steel, steel heat exchanger components exposed to raw water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC; fouling that leads to corrosion; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VIII.E.SP-117 VIII.E.SP-146 VIII.F.SP-146 VIII.F.SP-117 VIII.G.SP-117 VIII.G.SP-146
M	20	BWR/PWR	Copper alloy, stainless steel piping, piping components exposed to raw water	Loss of material due to general (copper alloy only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VIII.A.SP-31 VIII.E.SP-31 VIII.E.SP-36 VIII.F.SP-31 VIII.F.SP-36

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
							VIII.G.SP-31 VIII.G.SP-36
D	21						
	22	BWR/PWR	Stainless steel, copper alloy, steel heat exchanger tubes, heat exchanger components exposed to raw water	Reduction of heat transfer due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VIII.E.S-28 VIII.E.SP-56 VIII.F.S-28 VIII.F.SP-56 VIII.G.S-27 VIII.G.S-28 VIII.G.SP-56
M	23	BWR/PWR	Stainless steel piping, piping components exposed to closed-cycle cooling water >60°C (>140°F)	Cracking due to stress corrosion cracking	AMP XI.M21A, "Closed Treated Water Systems"	No	VIII.E.SP-54 VIII.F.SP-54 VIII.G.SP-54
D	24						
M	25	BWR/PWR	Steel heat exchanger components exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	VIII.A.S-23 VIII.E.S-23 VIII.F.S-23 VIII.G.S-23
M	26	BWR/PWR	Stainless steel heat exchanger components, piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	VIII.E.S-25 VIII.E.SP-39 VIII.F.S-25 VIII.F.SP-39 VIII.G.S-25 VIII.G.SP-39

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	27	BWR/PWR	Copper alloy piping, piping components exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	VIII.E.SP-8 VIII.F.SP-8 VIII.G.SP-8
M	28	BWR/PWR	Steel, stainless steel, copper alloy heat exchanger components and tubes exposed to closed-cycle cooling water	Reduction of heat transfer due to fouling	AMP XI.M21A, "Closed Treated Water Systems"	No	VIII.A.SP-64 VIII.E.SP-41 VIII.E.SP-57 VIII.E.SP-64 VIII.F.SP-41 VIII.F.SP-64 VIII.G.SP-41 VIII.G.SP-64
	29	BWR/PWR	Steel tanks exposed to air – outdoor (external)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M29, "Aboveground Metallic Tanks"	No	VIII.E.S-31 VIII.G.S-31
M	30	BWR/PWR	Steel tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to soil, concrete, air – outdoor, air – indoor uncontrolled, moist air, condensation (external)	Loss of material due to general, pitting, crevice corrosion, MIC (soil environment only)	AMP XI.M29, "Aboveground Metallic Tanks"	No	VIII.E.SP-115 VIII.G.SP-116
D	31						
M	32	BWR/PWR	Gray cast iron piping, piping components exposed to soil, ground water	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	VIII.E.SP-26 VIII.G.SP-26

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	33	BWR/PWR	Gray cast iron, copper alloy (>15% Zn or >8% Al) piping, piping components exposed to treated water, raw water, closed-cycle cooling water, soil, ground water	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	VIII.A.SP-27 VIII.A.SP-28 VIII.A.SP-30 VIII.E.S-440 VIII.E.SP-27 VIII.E.SP-29 VIII.E.SP-30 VIII.E.SP-55 VIII.F.S-440 VIII.F.SP-27 VIII.F.SP-29 VIII.F.SP-30 VIII.F.SP-55 VIII.G.S-440 VIII.G.SP-27 VIII.G.SP-28 VIII.G.SP-29 VIII.G.SP-30 VIII.G.SP-55
M	34	BWR/PWR	Steel external surfaces exposed to air – indoor uncontrolled (external), air – outdoor (external), condensation (external)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-29 VIII.H.S-41 VIII.H.S-42
M	35	BWR/PWR	Aluminum piping, piping components exposed to air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.SP-147

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	36	PWR	Steel piping, piping components exposed to air – outdoor (internal)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.B1.SP-59
M	37	PWR	Steel piping, piping components exposed to condensation (internal)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.B1.SP-60 VIII.G.SP-60
M	38	PWR	Steel piping, piping components exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; fouling that leads to corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.G.SP-136
M	39	BWR/PWR	Stainless steel piping, piping components exposed to condensation (internal)	Loss of material due to pitting and crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.B1.SP-110 VIII.B2.SP-110
M	40	BWR/PWR	Steel piping, piping components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VIII.A.SP-91 VIII.D1.SP-91 VIII.D2.SP-91 VIII.E.SP-91 VIII.G.SP-91
	41	PWR	Steel heat exchanger components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time	No	VIII.G.SP-76

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					Inspection"		
M	42	PWR	Aluminum piping, piping components exposed to lubricating oil	Loss of material due to pitting, crevice corrosion	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VIII.G.SP-114
M	43	BWR/PWR	Copper alloy piping, piping components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VIII.A.SP-92 VIII.D1.SP-92 VIII.D2.SP-92 VIII.E.SP-92 VIII.G.SP-92
M	44	BWR/PWR	Stainless steel piping, piping components, heat exchanger components exposed to lubricating oil	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VIII.A.SP-95 VIII.D1.SP-95 VIII.D2.SP-95 VIII.E.SP-95 VIII.G.SP-79 VIII.G.SP-95
	45	PWR	Aluminum heat exchanger components and tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VIII.G.SP-113
	46	PWR	Stainless steel, steel, copper alloy heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VIII.G.SP-102 VIII.G.SP-103 VIII.G.SP-99

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	47	BWR/PWR	Steel (with coating or wrapping), stainless steel, nickel-alloy piping, piping components, tanks exposed to soil, concrete	Loss of material due to general (steel only), pitting, crevice corrosion, MIC	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.E.SP-145 VIII.G.SP-145
M	48	BWR/PWR	Stainless steel, nickel alloy bolting exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil environment only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.H.SP-143
M	49	BWR/PWR	Stainless steel, nickel alloy piping, piping components exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil environment only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.E.SP-94 VIII.G.SP-94
M	50	BWR/PWR	Steel bolting exposed to soil, concrete	Loss of material due to general, pitting, crevice corrosion, MIC (soil environment only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.H.SP-141
M	50x	BWR/PWR	Underground steel, nickel alloy,, copper alloy piping, piping components exposed to air-indoor uncontrolled, condensation, air-outdoor (external)	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.H.SP-161
M	51	BWR/PWR	Steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.4.2.2.8)	VIII.I.SP-154

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	52	BWR/PWR	Aluminum piping, piping components exposed to gas	None	None	No	VIII.I.SP-23
M	53	PWR	Copper alloy piping, piping components exposed to air with borated water leakage	None	None	No	VIII.I.SP-104
M	54	BWR/PWR	Copper alloy piping, piping components exposed to gas, air – indoor uncontrolled (external)	None	None	No	VIII.I.SP-5 VIII.I.SP-6
M	55	BWR/PWR	Glass piping elements exposed to lubricating oil, air, air – outdoor, condensation, raw water, treated water, air with borated water leakage, gas, closed-cycle cooling water, air – indoor uncontrolled (external)	None	None	No	VIII.I.SP-10 VIII.I.SP-108 VIII.I.SP-33 VIII.I.SP-34 VIII.I.SP-35 VIII.I.SP-67 VIII.I.SP-68 VIII.I.SP-69 VIII.I.SP-70 VIII.I.SP-9
M	56	BWR/PWR	Nickel alloy piping, piping components exposed to air – indoor uncontrolled (external)	None	None	No	VIII.I.SP-11
M	57	BWR/PWR	Nickel alloy, PVC Piping, piping components exposed to air with borated water leakage, air –	None	None	No	VIII.I.SP-148 VIII.I.SP-152 VIII.I.SP-153

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			indoor uncontrolled, condensation (internal)				
M	58	BWR/PWR	Stainless steel piping, piping components exposed to air – indoor uncontrolled (external), gas, air – indoor uncontrolled (internal)	None	None	No	VIII.I.SP-12 VIII.I.SP-15 VIII.I.SP-86
M	59	BWR/PWR	Steel piping, piping components exposed to air – indoor controlled (external), gas	None	None	No	VIII.I.SP-1 VIII.I.SP-4
M	60	BWR/PWR	Any material piping, piping components exposed to treated water	Wall thinning due to erosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	VIII.D1.S-408 VIII.D2.S-408 VIII.G.S-408
M	61	BWR/PWR	Metallic piping, piping components, tanks exposed to raw water, waste water	Loss of material due to recurring internal corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.4.2.2.6)	VIII.A.S-400 VIII.B1.S-400 VIII.B2.S-400 VIII.C.S-400 VIII.D1.S-400 VIII.D2.S-400 VIII.E.S-400 VIII.F.S-400 VIII.G.S-400
M	62	BWR/PWR	Steel, stainless steel or aluminum tanks (within the scope of AMP XI.M29,	Loss of material due to general (steel only), pitting, crevice corrosion, MIC	AMP XI.M29, "Aboveground Metallic Tanks"	No	VIII.E.S-405 VIII.G.S-405

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			"Aboveground Metallic Tanks") exposed to treated water				
M	63	BWR/PWR	Insulated steel, copper alloy, copper alloy (> 15% Zn), aluminum piping, piping components, tanks exposed to condensation, air – outdoor	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion; cracking due to stress corrosion cracking (copper alloy (>15% Zn) only)	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-402
M	64	BWR/PWR	Jacketed thermal insulation in an air – indoor uncontrolled, air – outdoor environment, air with borated water leakage, air with reactor coolant leakage, or air with steam or water leakage	Reduced thermal insulation resistance due to moisture intrusion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-403
D	65						
M	66	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, physical damage,	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	VIII.A.S-401 VIII.B1.S-401 VIII.B2.S-401 VIII.C.S-401 VIII.D1.S-401 VIII.D2.S-401

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			closed-cycle cooling water, raw water, treated water, treated borated water, lubricating oil	spalling for cementitious coatings/linings			VIII.E.S-401 VIII.F.S-401 VIII.G.S-401
M	67	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, treated borated water, lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC; fouling that leads to corrosion; cracking due to stress corrosion cracking	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	VIII.A.S-414 VIII.B1.S-414 VIII.B2.S-414 VIII.C.S-414 VIII.D1.S-414 VIII.D2.S-414 VIII.E.S-414 VIII.F.S-414 VIII.G.S-414
M	68	BWR/PWR	Gray cast iron piping components with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, waste water	Loss of material due to selective leaching	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	VIII.A.S-415 VIII.B1.S-415 VIII.B2.S-415 VIII.C.S-415 VIII.D1.S-415 VIII.D2.S-415 VIII.E.S-415 VIII.F.S-415 VIII.G.S-415
N	69	BWR/PWR	Steel, stainless steel bolting exposed to condensation, lubricating oil	Loss of preload due to thermal effects, gasket creep, or self-loosening	AMP XI.M18, "Bolting Integrity"	No	VIII.H.S-416 VIII.H.S-417
N	70	BWR/PWR	Copper alloy bolting exposed to raw water, waste water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M18, "Bolting Integrity"	No	VIII.H.S-418

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	71	BWR/PWR	Steel bolting exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M18, "Bolting Integrity"	No	VIII.H.S-419
N	72	BWR/PWR	Stainless steel, aluminum piping, piping components exposed to soil, concrete	Cracking due to stress corrosion cracking	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.E.S-420 VIII.G.S-420
N	73	BWR/PWR	Stainless steel bolting exposed to soil, concrete	Cracking due to stress corrosion cracking	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.E.S-421 VIII.G.S-421
N	74	BWR/PWR	Underground stainless steel piping, piping components, tanks exposed to air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M41, "Buried and Underground Piping and Tanks"	Yes (SRP-SLR Section 3.4.2.2.2)	VIII.H.S-425
N	75	BWR/PWR	Stainless steel, steel, aluminum, copper alloy, titanium heat exchanger components exposed to air (external)	Reduction of heat transfer due to fouling	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-426
N	77	BWR/PWR	Elastomer seals, piping, piping components exposed to air – outdoor	Hardening and loss of strength due to elastomer degradation	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-428
N	78	BWR/PWR	Elastomer seals, piping, piping components exposed to condensation	Hardening and loss of strength due to elastomer degradation	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping	No	VIII.D1.S-429 VIII.D2.S-429 VIII.E.S-429 VIII.G.S-429

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					and Ducting Components"		
N	80	BWR/PWR	Stainless steel, steel, nickel alloy, copper alloy, aluminum piping, piping components exposed to condensation	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-431
N	81	BWR/PWR	Steel components exposed to treated water, raw water	Long-term loss of material due to general corrosion	AMP XI.M32, "One-Time Inspection"	No	VIII.A.S-432 VIII.B1.S-432 VIII.B2.S-432 VIII.C.S-432 VIII.D1.S-432 VIII.D2.S-432 VIII.E.S-432 VIII.F.S-432 VIII.G.S-432
N	82	BWR/PWR	Stainless steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.4.2.2.8)	VIII.I.SP-13
N	83	BWR/PWR	Stainless steel tanks exposed to treated water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC	Plant-specific aging management program	Yes (SRP-SLR Section 3.4.2.2.9)	VIII.E.SP-162 VIII.G.SP-162
N	84	BWR/PWR	Stainless steel, nickel alloy piping, piping components exposed to steam	Loss of material due to pitting, crevice corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.A.SP-155 VIII.B1.SP-155 VIII.B2.SP-155 VIII.B1.SP-157

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	85	BWR/PWR	Stainless steel piping, piping components, PWR heat exchanger components exposed to treated water	Loss of material due to pitting, crevice corrosion, MIC	Plant-specific aging management program	Yes (SRP-LR Section 3.4.2.2.9)	VIII.E.SP-80 VIII.E.SP-81 VIII.F.SP-81 VIII.B1.SP-87 VIII.C.SP-87 VIII.D1.SP-87 VIII.D2.SP-87 VIII.E.SP-87 VIII.F.SP-87 VIII.G.SP-87
N	86	BWR/PWR	Stainless steel, steel, aluminum, copper alloy, titanium heat exchanger components internal to components exposed to air (external)	Reduction of heat transfer due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.E.S-433 VIII.G.S-433
N	88	PWR	Copper alloy (≤8% Al) piping, piping components exposed to air with borated water leakage	None	None	No	VIII.I.S-435
N	89	BWR/PWR	Steel, stainless steel, copper alloy piping, piping components exposed to raw water (for components not covered by NRC GL 89-13)	Loss of material due to general (steel and copper alloy only), pitting, crevice corrosion, MIC	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.A.S-436 VIII.E.S-436 VIII.F.S-436 VIII.G.S-436

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	90	BWR/PWR	Steel, stainless steel, copper alloy heat exchanger components exposed to raw water (for components not covered by NRC GL 89-13)	Reduction of heat transfer due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.E.S-437 VIII.F.S-437 VIII.G.S-437
N	91	BWR/PWR	Steel, stainless steel, copper alloy heat exchanger components exposed to raw water (for components not covered by NRC GL 89-13)	Loss of material due to general (steel and copper alloy only), pitting, crevice corrosion, MIC	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.E.S-438 VIII.F.S-438 VIII.G.S-438
N	92	BWR/PWR	Copper alloy (>15% Zn or >8% Al) piping, piping components exposed to soil ground water	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	VIII.D1.S-439 VIII.D2.S-439 VIII.E.S-439 VIII.F.S-439 VIII.G.S-439
N	93	BWR/PWR	Stainless steel tanks exposed to air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.4.2.2.2)	VIII.A.S-441 VIII.B1.S-441 VIII.B2.S-441 VIII.C.S-441 VIII.D1.S-441 VIII.D2.S-441 VIII.E.S-441 VIII.F.S-441 VIII.G.S-441

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	94	BWR/PWR	Underground aluminum piping, piping components exposed to air (external)	Loss of material due to pitting, crevice corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.4.2.2.10)	VIII.H.S-442
N	95	BWR/PWR	Underground stainless steel piping, piping components exposed to air-indoor uncontrolled, condensation, air-outdoor (external)	Loss of material due to pitting, crevice corrosion	AMP XI.M41, "Buried and Underground Piping and Tanks"	Yes (SRP-SLR Section 3.4.2.2.3)	VIII.H.S-443
N	96	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Aboveground Metallic Tanks"	No	VIII.E.S-444 VIII.G.S-444
N	97	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to air (external)	Loss of material due to pitting, crevice corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.4.2.2.10)	VIII.E.S-445 VIII.G.S-445
N	98	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to air, air – outdoor, air – indoor uncontrolled, moist air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.4.2.2.3)	VIII.E.S-446 VIII.G.S-446

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			(external)				
N	99	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil environment only)	AMP XI.M29, "Aboveground Metallic Tanks"	No	VIII.E.S-447 VIII.G.S-447
N	100	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to air – outdoor, air – indoor uncontrolled, air – indoor controlled, condensation (external)	Cracking due to stress corrosion cracking	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.4.2.2.2)	VIII.E.S-448 VIII.G.S-448
N	101	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to soil, concrete	Cracking due to stress corrosion cracking	AMP XI.M29, "Aboveground Metallic Tanks"	No	VIII.E.S-449 VIII.G.S-449
N	102	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to soil, concrete, air – outdoor, air – indoor	Cracking due to stress corrosion cracking	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.4.2.2.7)	VIII.E.S-450 VIII.G.S-450

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			uncontrolled, air – indoor controlled, raw water, waste water, condensation				
N	103	BWR/PWR	Insulated stainless steel piping, piping components, tanks exposed to condensation, air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.4.2.2.3)	VIII.H.S-451
N	104	BWR/PWR	Insulated stainless steel tanks exposed to condensation, air – outdoor, air – indoor uncontrolled, air – indoor controlled	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.4.2.2.2)	VIII.H.S-452
N	105	BWR/PWR	Insulated aluminum tanks exposed to condensation, air – outdoor, air – indoor uncontrolled, air – indoor controlled	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.4.2.2.7)	VIII.H.S-453
N	106	BWR/PWR	Steel, stainless steel, copper alloy, copper alloy (> 15% Zn), nickel alloy piping, piping components exposed to air – outdoor	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion; cracking due to stress corrosion cracking (copper alloy (>15% Zn) only)	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-454

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	107	BWR/PWR	Steel, stainless steel, copper alloy, copper alloy (> 15% Zn), nickel alloy tanks exposed to condensation	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion; cracking due to stress corrosion cracking (copper alloy (>15% Zn) only)	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-455
N	108	BWR/PWR	Stainless steel piping, piping components, tanks exposed to condensation	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.4.2.2.2)	VIII.H.S-456
N	109	BWR/PWR	Aluminum piping, piping components, tanks exposed to condensation, raw water, waste water	Cracking due to stress corrosion cracking	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.4.2.2.7)	VIII.H.S-457
N	110	BWR/PWR	Aluminum piping, piping components exposed to air – outdoor, raw water, waste water, condensation (internal)	Cracking due to stress corrosion cracking	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Yes (SRP-SLR Section 3.4.2.2.7)	VIII.D1.S-458 VIII.D2.S-458 VIII.E.S-458 VIII.F.S-458 VIII.G.S-458
N	111	BWR/PWR	Aluminum tanks exposed to raw water, waste water, condensation (internal)	Cracking due to stress corrosion cracking	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Yes (SRP-SLR Section 3.4.2.2.7)	VIII.D1.S-459 VIII.D2.S-459 VIII.E.S-459 VIII.F.S-459 VIII.G.S-459

Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	112	BWR/PWR	Underground aluminum piping, piping components, tanks exposed to air – outdoor	Cracking due to stress corrosion cracking	AMP XI.M41, "Buried and Underground Piping and Tanks"	Yes (SRP-SLR Section 3.4.2.2.7)	VIII.H.S-460
N	113	BWR/PWR	Aluminum piping, piping components exposed to air – indoor uncontrolled	Loss of material due to pitting, crevice corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.4.2.2.10)	VIII.I.S-461

Table 3.4-2. AMPs and Additional Guidance Appendices Recommended for Aging Management of Steam and Power Conversion System	
GALL-SLR Report Chapter/AMP	**Program Name**
AMP XI.M2	Water Chemistry
AMP XI.M10	Boric Acid Corrosion
AMP XI.M17	Flow-Accelerated Corrosion
AMP XI.M18	Bolting Integrity
AMP XI.M20	Open-Cycle Cooling Water System
AMP XI.M21A	Closed Treated Water Systems
AMP XI.M29	Aboveground Metallic Tanks
AMP XI.M32	One-Time Inspection
AMP XI.M33	Selective Leaching
AMP XI.M36	External Surfaces Monitoring of Mechanical Components
AMP XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
AMP XI.M39	Lubricating Oil Analysis
AMP XI.M41	Buried and Underground Piping and Tanks
AMP XI.M42	Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks
GALL-SLR Report Appendix A	Quality Assurance for Aging Management Programs
GALL-SLR Report Appendix B	Operating Experience for Aging Management Programs
SRP-SLR Appendix A.1	Aging Management Review—Generic (Branch Technical Position RLSB-1)

3.5 Aging Management of Containments, Structures, and Component Supports

Review Responsibilities

Primary— Branch assigned responsibility by Project Manager (PM) as described in Section 3.0 of this Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR).

3.5.1 Areas of Review

This section addresses the aging management review (AMR) and the associated aging management programs (AMPs) for containments, structures and components (SC) supports. For a recent vintage plant, the information related to containments, supports is contained in Chapter 3, “Design of Structures, Components, Equipment, and Systems,” of the plant’s final safety analysis report (FSAR), consistent with the “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants” (NUREG–0800). For older vintage plants, the location of applicable information is plant-specific because an older plant’s FSAR may have predated NUREG–0800. The scope of this section is containment structures, and safety-related and other SC supports.

The pressurized water reactor (PWR) containment structures consist of concrete (reinforced or prestressed) and steel containments. The boiling water reactor (BWR) containment structures consist of Mark I, Mark II, and Mark III steel and concrete (reinforced or prestressed) containments.

The safety-related structures (other than containments) are organized into nine groups: Group 1: BWR reactor building, PWR shield building, control room/building; Group 2: BWR reactor building with steel superstructure; Group 3: auxiliary building, diesel generator building, radwaste building, turbine building, switchgear room, yard structures [auxiliary feedwater (AFW) pump house, utility/piping tunnels, security lighting poles, manholes, duct banks], station blackout (SBO) structures (transmission towers, startup transformer circuit breaker foundation, electrical enclosure); Group 4: containment internal structures, excluding refueling canal; Group 5: fuel storage facility, refueling canal; Group 6: water-control structures (e.g., intake structure, cooling tower, and spray pond); Group 7: concrete tanks and missile barriers; Group 8: steel tank foundations and missile barriers; and Group 9: BWR unit vent stack.

The component supports are organized into seven groups: Group B1.1: supports for American Society of Mechanical Engineers (ASME) Class 1 piping and components; Group B1.2: supports for ASME Class 2 and 3 piping and components; Group B1.3: supports for ASME Class MC components; Group B2: supports for cable tray, conduit, heating, ventilation, and air conditioning (HVAC) ducts, TubeTrack®, instrument tubing, non-ASME piping and components; Group B3: anchorage of racks, panels, cabinets, and enclosures for electrical equipment and instrumentation; Group B4: supports for miscellaneous equipment [e.g., emergency diesel generator (EDG), HVAC components]; and Group B5: supports for miscellaneous structures (e.g., platforms, pipe whip restraints, jet impingement shields, masonry walls).

The responsible review organization is to review the following subsequent license renewal application (SLRA) AMR and AMP items assigned to it, per SRP-SLR Section 3.0, for review:

AMRs

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

AMPs

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

FSAR Supplement

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

3.5.2 Acceptance Criteria

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

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

The AMRs and the AMPs applicable to structures and component supports are described and evaluated in Chapters II and III of the GALL-SLR Report.

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

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

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

The basic acceptance criteria defined in Section 3.5.2.1 need to be applied first for all of the AMRs and AMPs as part of this section. In addition, if the GALL-SLR Report AMR item to which the SLRA AMR item is compared identifies that "further evaluation is recommended," then additional criteria apply for each of the following aging effect/aging mechanism combinations. Refer to Table 3.5-1, comparing the "Further Evaluation Recommended" column and the "GALL-SLR Item" column, for the AMR items that reference the following subsections.

3.5.2.2.1 Pressurized Water Reactor and Boiling Water Reactor Containments

3.5.2.2.1.1 Cracking and Distortion Due to Increased Stress Levels from Settlement; Reduction of Foundation Strength, and Cracking Due to Differential Settlement and Erosion of Porous Concrete Subfoundations

Cracking and distortion due to increased stress levels from settlement could occur in PWR and BWR concrete and steel containments. The existing program relies on ASME Section XI, Subsection IWL to manage these aging effects. Also, reduction of foundation strength and cracking, due to differential settlement and erosion of porous concrete subfoundations could occur in all types of PWR and BWR containments. The existing program relies on the structures monitoring program to manage these aging effects. However, some plants may rely on a dewatering system to lower the site groundwater level. If the plant's current licensing basis (CLB) credits a dewatering system to control settlement, further evaluation is recommended to verify the continued functionality of the dewatering system during the subsequent period of extended operation.

3.5.2.2.1.2 Reduction of Strength and Modulus Due to Elevated Temperature

Reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR and BWR concrete and steel containments. The implementation of 10 CFR 50.55a and ASME Section XI, Subsection IWL would not be able to identify the reduction of strength and modulus of concrete due to elevated temperature. Subsection CC-3440 of ASME Section III, Division 2, specifies the concrete temperature limits for normal operation or any other long-term period. Further evaluation is recommended of a plant-specific AMP if any portion of the concrete containment components exceeds specified temperature limits {i.e., general area temperature greater than 66 °C [150 °F] and local area temperature greater than 93 °C [200 °F]}. Higher temperatures may be allowed if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations. Acceptance criteria are described in Branch Technical Position (BTP) RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.5.2.2.1.3 Loss of Material Due to General, Pitting and Crevice Corrosion

1. Loss of material due to general, pitting, and crevice corrosion could occur in steel elements of inaccessible areas for all types of PWR and BWR containments. The existing program relies on ASME Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J, to manage this aging effect. Further evaluation is recommended of plant-specific programs to manage this aging effect if corrosion is indicated from the IWE examinations. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

2. Loss of material due to general, pitting, and crevice corrosion could occur in steel torus shell of Mark I containments. The existing program relies on ASME Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J, to manage this aging effect. If corrosion is significant, recoating of the torus is recommended. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3. Loss of material due to general, pitting, and crevice corrosion could occur in steel torus ring girders and downcomers of Mark I containments, downcomers of Mark II containments, and interior surface of suppression chamber shell of Mark III

containments. The existing program relies on ASME Section XI, Subsection IWE to manage this aging effect. Further evaluation is recommended of plant-specific programs to manage this aging effect if corrosion is significant. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.5.2.2.1.4 Loss of Prestress Due to Relaxation, Shrinkage, Creep, and Elevated Temperature

Loss of prestress forces due to relaxation, shrinkage, creep, and elevated temperature for PWR prestressed concrete containments and BWR Mark II prestressed concrete containments is a time-limited aging analysis (TLAA) as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.5, “Concrete Containment Unbonded Tendon Pre-stress Analysis,” of this SRP-SLR Report.

3.5.2.2.1.5 Cumulative Fatigue Damage

If included in the CLB, fatigue analyses of metal liner, metal plates, suppression pool steel shells (including welded joints) and penetrations (including personnel airlock, equipment hatch, control rod drive (CRD) hatch, penetration sleeves, dissimilar metal welds, and penetration bellows) for all types of PWR and BWR containments and BWR vent header, vent line bellows, and downcomers are TLAAs as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.6, “Containment Liner Plates, Metal Containments, and Penetrations Fatigue Analysis,” of this SRP-SLR Report.

3.5.2.2.1.6 Cracking Due to Stress Corrosion Cracking

Stress corrosion cracking (SCC) of stainless steel (SS) penetration bellows and dissimilar metal welds could occur in all types of PWR and BWR containments. The existing program relies on ASME Section XI, Subsection IWE and10 CFR Part 50, Appendix J, to manage this aging effect. Further evaluation is recommended of additional appropriate examinations/evaluations implemented to detect these aging effects for SS penetration bellows and dissimilar metal welds.

3.5.2.2.1.7 Loss of Material (Scaling, Spalling) and Cracking Due to Freeze-Thaw

Loss of material (scaling, spalling) and cracking due to freeze-thaw could occur in inaccessible areas of PWR and BWR concrete containments. Further evaluation is recommended of this aging effect for plants located in moderate to severe weathering conditions.

3.5.2.2.1.8 Cracking Due to Expansion From Reaction With Aggregates

Cracking due to expansion from reaction with aggregates could occur in inaccessible areas of concrete elements of PWR and BWR concrete and steel containments. Further evaluation is recommended to determine if a plant-specific AMP is required to manage this aging effect. A plant-specific aging management program is not required if (1) as described in NUREG–1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with American Society for Testing and Materials (ASTM) C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) for potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.5.2.2.1.9 Increase in Porosity and Permeability Due to Leaching of Calcium Hydroxide and Carbonation

Increase in porosity and permeability due to leaching of calcium hydroxide and carbonation could occur in inaccessible areas of concrete elements of PWR and BWR concrete and steel containments. Further evaluation is recommended if leaching is observed in accessible areas that impact intended functions. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.5.2.2.2 Safety-Related and Other Structures and Component Supports

3.5.2.2.2.1 Aging Management of Inaccessible Areas

1. Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Groups 1–3, 5 and 7–9 structures. Further evaluation is recommended of this aging effect for inaccessible areas of these Groups of structures for plants located in moderate to severe weathering conditions.

2. Cracking due to expansion and reaction with aggregates could occur in inaccessible concrete areas for Groups 1–5 and 7–9 structures. Further evaluation is recommended of inaccessible areas of these Groups of structures to determine if a plant-specific AMP is required to manage this aging effect.

3. Cracking and distortion due to increased stress levels from settlement could occur in below-grade inaccessible concrete areas of structures for all Groups, and reduction in foundation strength, and cracking due to differential settlement and erosion of porous concrete subfoundations could occur in below-grade inaccessible concrete areas of Groups 1–3, 5–9 structures. The existing program relies on structure monitoring programs to manage these aging effects. Some plants may rely on a dewatering system to lower the site groundwater level. If the plant’s CLB credits a dewatering system, verification is recommended of the continued functionality of the dewatering system during the subsequent period of extended operation. No further evaluation is recommended if this activity is included in the scope of the applicant’s structures monitoring program.

4. Increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide and carbonation could occur in below-grade inaccessible concrete areas of Groups 1–5 and 7–9 structures. Further evaluation is recommended if leaching is observed in accessible areas that impact intended functions.

3.5.2.2.2.2 Reduction of Strength and Modulus Due to Elevated Temperature

Reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR and BWR Group 1–5 concrete structures. For any concrete elements that exceed specified temperature limits, further evaluations are recommended. Appendix A of American Concrete Institute (ACI) 349-85 specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 66 °C [150 °F] except for local areas, which are allowed to have increased temperatures not to exceed 93 °C [200°F]. Further evaluation is recommended of a plant-specific program if any portion of the safety-related and other concrete structures exceeds specified temperature limits {i.e., general area temperature greater than 66 °C [150°F] and local area temperature greater than 93 °C [200 °F]}. Higher temperatures may be allowed if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations. The acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.5.2.2.2.3 Aging Management of Inaccessible Areas for Group 6 Structures

Further evaluation is recommended for inaccessible areas of certain Group 6 structure/aging effect combinations as identified below, whether or not they are covered by inspections in accordance with the GALL-SLR Report, AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants," or Federal Energy Regulatory Commission (FERC)/U.S. Army Corp of Engineers dam inspection and maintenance procedures.

1. Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Group 6 structures. Further evaluation is recommended of this aging effect for inaccessible areas for plants located in moderate to severe weathering conditions.

2. Cracking due to expansion and reaction with aggregates could occur in inaccessible concrete areas of Group 6 structures. Further evaluation is recommended to determine if a plant-specific AMP is required to manage this aging effect. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3. Increase in porosity and permeability and loss of strength due to leaching of calcium hydroxide and carbonation could occur in inaccessible areas of concrete elements of Group 6 structures. Further evaluation is recommended if leaching is observed in accessible areas that impact intended functions. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.5.2.2.2.4 Cracking Due to Stress Corrosion Cracking, and Loss of Material Due to Pitting and Crevice Corrosion

Cracking due to systems, structures, and components (SSC) and loss of material due to pitting and crevice corrosion could occur for Group 7 and 8 SS tank liners exposed to standing water. Further evaluation is recommended of plant-specific programs to manage these aging effects. The acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.5.2.2.2.5 Cumulative Fatigue Damage Due to Fatigue

Fatigue of component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports is a TLAA as defined in 10 CFR 54.3 only if a CLB fatigue analysis exists. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.3, "Metal Fatigue Analysis," of this SRP-SLR Report.

3.5.2.2.2.6 Reduction of Strength and Mechanical Properties of Concrete Due to Irradiation

Reduction of strength, loss of mechanical properties, and cracking due to irradiation could occur in PWR and BWR Group 4 concrete structures that are exposed to high levels of neutron and gamma radiation. These structures include the reactor (primary/biological) shield wall, the sacrificial shield wall, and the reactor vessel support/pedestal structure. Data related to the effects and significance of neutron and gamma radiation on concrete mechanical and physical properties is limited, especially for conditions (dose, temperature, etc.) representative of light-water reactor (LWR) plants. However, based on literature review of existing research, radiation fluence limits of 1×10^{19} neutrons/cm^2 neutron radiation and 1×10^8 Gy [1×10^{10} rad] gamma dose are considered conservative radiation exposure levels beyond which concrete material properties may begin to degrade markedly (17, 18, 19).

Further evaluation is recommended of a plant-specific program to manage aging effects of irradiation if the estimated (calculated) fluence levels or irradiation dose received by any portion of the concrete from neutron (fluence cutoff energy E > 0.1 MeV) or gamma radiation exceeds the respective threshold level during the subsequent period of extended operation or if plant-specific operating experience of concrete irradiation degradation exists that may impact intended functions. Higher fluence or dose levels may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and/or loss of mechanical properties of concrete from those fluence levels, at or above the operating temperature experienced by the concrete, and the effects are applied to the design calculations. Supporting calculations/analyses, test data, and other technical basis are provided to estimate and evaluate fluence levels and the plant-specific program. The acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

3.5.2.2.3 Quality Assurance for Aging Management of Nonsafety-Related Components

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

3.5.2.2.4 Ongoing Review of Operating Experience

Acceptance criteria are described in Appendix A.4, "Operating Experience for AMPs."

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

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

3.5.2.4 Aging Management Programs

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

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

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

If the applicant chooses to use a plant-specific program that is not a GALL-SLR AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix A.1.2.3 of this SRP-SLR Report).

3.5.2.5 Final Safety Analysis Report Supplement

The summary description of the programs and activities for managing the effects of aging for the subsequent period of extended operation in the FSAR supplement should be appropriate, such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects are managed during the subsequent period of extended operation. The description should also contain any future aging management activities, including enhancements and commitments, to be completed before the subsequent period of extended operation. Table 3.0-1 of this SRP-SLR provides examples of the type of information to be included in the FSAR Supplement. Table 3.5-2 lists the programs that are applicable for this SRP-SLR subsection.

3.5.3 Review Procedures

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

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

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

Furthermore, the reviewer should confirm that the applicant has addressed operating experience identified after the issuance of the GALL-SLR Report. Performance of this review requires the reviewer to confirm that the applicant has identified those aging effects for the SC supports that are contained in the GALL-SLR Report as applicable to its plant.

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

The basic review procedures defined in Section 3.5.3.1 need to be applied first for all of the AMRs and AMPs provided in this section. In addition, if the GALL-SLR AMR item to which the SLRA AMR item is compared identifies that further evaluation is recommended, then additional criteria apply for each of the following aging effect/aging mechanism combinations.

3.5.3.2.1 Pressurized Water Reactor and Boiling Water Reactor Containments

3.5.3.2.1.1 Cracking and Distortion Due to Increased Stress Levels From Settlement; Reduction of Foundation Strength and Cracking Due to Differential Settlement and Erosion of Porous Concrete Subfoundations

Further evaluation is recommended of aging management of (1) cracking and distortion due to increases in component stress level from settlement for PWR and BWR concrete and steel containments and (2) reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundations for all types of PWR and BWR containments if a dewatering system is relied upon to control settlement. The reviewer reviews and confirms that, if the applicant credits a dewatering system in its CLB, the applicant has committed to monitor the functionality of the dewatering system under the applicant's ASME Code Section XI, Subsection IWL or the structures monitoring program. If not, the reviewer evaluates the plant-specific program for monitoring the dewatering system during the subsequent period of extended operation.

3.5.3.2.1.2 Reduction of Strength and Modulus Due to Elevated Temperature

Further evaluation is recommended of programs to manage reduction of strength and modulus of concrete due to elevated temperature for PWR and BWR concrete and steel containments. The implementation of ASME Section XI, Subsection IWL examinations and 10 CFR 50.55a would not be able to detect the reduction of concrete strength and modulus due to elevated temperature and also notes that no mandated aging management exists for managing this aging effect.

A plant-specific evaluation should be performed if any portion of the concrete containment components exceeds specified temperature limits {i.e., general temperature greater than 66 °C [150°F] and local area temperature greater than 93 °C [200°F]}. Higher temperatures may be allowed if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations. The reviewer reviews and confirms that the applicant's discussion in the renewal application indicates that the affected PWR and BWR containment components are not exposed to a temperature that exceeds the temperature limits. If active cooling is relied upon to maintain acceptable temperatures, then the reviewer ensures that the cooling system is being properly age-managed or temperatures are being monitored to identify a problem with the cooling system. If the limits are exceeded the reviewer reviews the technical basis (i.e., tests and/or calculations) provided by the applicant to justify the higher temperature. Otherwise, the reviewer reviews the applicant's proposed programs to ensure that the effects of elevated temperature will be adequately managed during the subsequent period of extended.

3.5.3.2.1.3 Loss of Material Due to General, Pitting, and Crevice Corrosion

1. The GALL-SLR Report identifies programs to manage loss of material due to general, pitting, and crevice corrosion in inaccessible areas of the steel elements in drywell and torus or the steel liner and integral attachments for all types of PWR and BWR containments. The AMP consists of ASME Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J, leak tests. Subsection IWE exempts from examination portions of the containments that are inaccessible, such as embedded or inaccessible portions of steel liners and steel elements in drywell and torus, and integral attachments.

   To cover the inaccessible areas, 10 CFR 50.55a(b)(2)(ix) requires that the applicant evaluate the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas. In addition, further evaluation of plant-specific programs to manage the aging effects for inaccessible areas is recommended if the following cannot be satisfied: (1) concrete meeting the requirements of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment shell or liner; (2) 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; (3) 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; and (4) borated water spills and water ponding on the concrete floor are common and when detected are cleaned up or diverted to a sump in a timely manner. Operating experience has identified significant corrosion in some plants. If any of the above conditions cannot be satisfied, then a plant-specific AMP for corrosion is necessary. The reviewer reviews the applicant's proposed AMP to confirm that, where appropriate, an effective inspection program has been developed and implemented to ensure that the aging effects in inaccessible areas are adequately managed.

2. The GALL-SLR Report identifies programs to manage loss of material due to general, pitting, and crevice corrosion in steel torus shell of Mark I containments. The AMP consists of ASME Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J, leak tests. In addition, further evaluation is recommended of plant-specific programs to manage the aging effects if corrosion is significant. Further evaluation of torus shell corrosion is warranted as a result of industry-wide operating experience that identified a number of incidences of torus corrosion. The reviewer reviews the applicant's proposed AMP to confirm that, where appropriate, an effective inspection program has been developed and implemented to ensure that the aging effects are adequately managed. A plant-specific program may include the recoating of the torus, if necessary.

3. The GALL-SLR Report identifies programs to manage loss of material due to general, pitting, and crevice corrosion in steel torus ring girders and downcomers of Mark I containments, suppression chambers and downcomers of Mark II containments, and interior surface of suppression chamber shell of Mark III containments. GALL-SLR Report AMP XI.S1, "ASME Section XI, Subsection IWE," is recommended for aging management. In addition, further evaluation of plant-specific programs is recommended to manage the aging effects if plant operating experience identified significant corrosion of the torus ring girders, downcomers and suppression chambers.

3.5.3.2.1.4 Loss of Prestress Due to Relaxation, Shrinkage, Creep, and Elevated Temperature

Loss of prestress is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.5 of this SRP-SLR.

3.5.3.2.1.5 Cumulative Fatigue Damage

Fatigue analyses included in the CLB for the containment liner plate, penetrations (including penetration sleeves, dissimilar metal welds, and penetration bellows) for all types of PWR and BWR containments and BWR suppression pool steel shells, vent header, vent line bellows, and downcomers are TLAAs as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.6 of this SRP-SLR Report.

3.5.3.2.1.6 Cracking Due to Stress Corrosion Cracking

Further evaluation is recommended of programs to manage cracking due to SCC for SS penetration sleeves, dissimilar metal welds, and penetration bellows in all types of PWR and BWR containments. Transgranular stress corrosion cracking (TGSCC) is a concern for dissimilar metal welds. In the case of bellows assemblies, SCC may cause aging effects particularly if the material is not shielded from a corrosive environment. Containment inservice inspection (ISI) IWE and leak rate testing may not be sufficient to detect cracks, especially for dissimilar metal welds. Additional appropriate examinations to detect SCC in bellows assemblies and dissimilar metal welds are recommended to address this issue. The reviewer reviews and evaluates the applicant's proposed programs to confirm that adequate inspection methods will be implemented to ensure that cracks are detected.

3.5.3.2.1.7 Loss of Material (Scaling, Spalling) and Cracking Due to Freeze-Thaw

Further evaluation is recommended of programs to manage loss of material (scaling, spalling) and cracking due to freeze-thaw for concrete elements of PWR and BWR containments. Containment ISI Subsection IWL may not be sufficient for plants located in moderate to severe weathering conditions. Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG–1557). The weathering index for the continental United States is shown in ASTM C33-90, Figure 1. A plant-specific program is not required if documented evidence confirms that the existing concrete had air content of 3 percent to 8 percent (including tolerance) and subsequent inspection of accessible areas did not exhibit degradation related to freeze-thaw. Such inspections are considered a part of the evaluation. The reviewer reviews and confirms that the applicant has satisfied the recommendations for inaccessible concrete. Otherwise, the reviewer reviews the applicant's proposed AMP to verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that these aging effects in inaccessible areas for plants located in moderate to severe weathering conditions are adequately managed.

3.5.3.2.1.8 Cracking Due to Expansion from Reaction With Aggregates

Further evaluation is recommended of programs to manage cracking due to expansion and reaction with aggregates in inaccessible areas of concrete elements of PWR and BWR concrete and steel containments. A plant-specific AMP is necessary if (1) reactivity tests or petrographic examinations of concrete samples identify reaction with aggregates, or (2) visual inspections of accessible concrete have identified indications of aggregate reactions, such as “map” or “patterned” cracking or the presence of reaction byproducts (e.g., alkali-silica gel). The reviewer confirms that the applicant has not identified one of the above conditions. Otherwise, the reviewer reviews the applicant’s proposed AMP to verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that this aging effect in inaccessible areas is adequately managed.

3.5.3.2.1.9 Increase in Porosity and Permeability Due to Leaching of Calcium Hydroxide and Carbonation

Further evaluation is recommended of programs to manage increase in porosity and permeability due to leaching of calcium hydroxide and carbonation in inaccessible areas of PWR and BWR concrete and steel containments. A plant-specific AMP is not required, even if reinforced concrete is exposed to flowing water if (1) there is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure. The reviewer confirms that the applicant has satisfied these conditions. Otherwise, the reviewer reviews the applicant’s proposed AMP to verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that this aging effect in inaccessible areas is adequately managed.

3.5.3.2.2 Safety-Related and Other Structures, and Component Supports

3.5.3.2.2.1 Aging Management of Inaccessible Areas

1. Further evaluation is recommended of programs to manage loss of material (spalling, scaling) and cracking due to freeze-thaw in below-grade inaccessible concrete areas of Groups 1–3, 5, and 7–9 structures. Structure monitoring programs may not be sufficient for plants located in moderate to severe weathering conditions. Further evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG–1557). The weathering index for the continental United States is shown in ASTM C33-90, Figure 1. A plant-specific program is not required if documented evidence confirms that the existing concrete had air content of 3 percent to 8 percent and subsequent inspection did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. The reviewer confirms that the applicant has satisfied these conditions. Otherwise, the reviewer reviews the applicant’s proposed AMP to verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that this aging effect in inaccessible areas for plants located in moderate to severe weathering conditions is adequately managed.

2. Further evaluation is recommended to determine if a plant-specific program is required to manage cracking due to expansion from reaction with aggregates in inaccessible concrete areas of Groups 1–5 and 7–9 structures. A plant-specific program is required if (1) reactivity tests or petrographic examinations of concrete samples identify reaction with aggregates, or (2) visual inspections of accessible concrete have identified indications of aggregate reactions, such as “map” or “patterned” cracking or the presence of reaction byproducts (e.g., alkali-silica gel). The reviewer confirms that the applicant has not identified one of the above conditions. Otherwise, the reviewer

reviews the applicant's proposed AMP to verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that the aging effect is adequately managed.

3. Further evaluation is recommended of aging management of (a) cracking and distortion due to increased stress levels from settlement for inaccessible concrete areas of structures for all Groups and (b) reduction of foundation strength, and cracking due to differential settlement and erosion of porous concrete subfoundations for inaccessible concrete areas of Groups 1–3, and 5–9 structures if a dewatering system is relied upon to manage the aging effect. The reviewer confirms that, if the applicant's plant credits a dewatering system in its CLB, the applicant has committed to monitor the functionality of the dewatering system under the applicant's structures monitoring program. If not, the reviewer reviews and evaluates the plant-specific program for monitoring the dewatering system during the subsequent period of extended operation.

4. Further evaluation is recommended of programs to manage increase in porosity and permeability due to leaching of calcium hydroxide and carbonation in below-grade inaccessible concrete areas of Groups 1–5, and 7–9 structures. A plant-specific AMP is not required for the reinforced concrete exposed to flowing water if (1) there is evidence in the accessible areas that the flowing water has not caused leaching of calcium hydroxide and carbonation or (2) evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure. The reviewer confirms that the applicant has satisfied these conditions. Otherwise, the reviewer reviews the applicant's proposed AMP to verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that this aging effect in inaccessible areas is adequately managed.

3.5.3.2.2.2 Reduction of Strength and Modulus Due to Elevated Temperature

Further evaluation is recommended of programs to manage reduction of strength and modulus of concrete structures due to elevated temperature for PWR and BWR safety-related and other structures.

A plant-specific evaluation should be performed if any portion of the concrete Groups 1–5 structures exceeds specified temperature limits {i.e., general temperature greater than 66 °C [150 °F] and local area temperature greater than 93 °C [200 °F]}. Higher temperatures may be allowed if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations. The reviewer reviews and confirms that the applicant's discussion in the renewal application indicates that the affected Groups 1–5 structures are not exposed to temperature that exceeds the temperature limits. If active cooling is relied upon to maintain acceptable temperatures, then the reviewer ensures that the cooling system is being properly age-managed or temperatures are being monitored to identify a problem with the cooling system. If the limits are exceeded the reviewer reviews the technical basis (i.e., tests and/or calculations) provided by the applicant to justify the higher temperature. Otherwise the reviewer reviews the applicant's proposed programs on a case-by-case basis to ensure that the effects of elevated temperature will be adequately managed during the subsequent period of extended operation.

3.5.3.2.2.3 Aging Management of Inaccessible Areas for Group 6 Structures

Further evaluation is recommended for inaccessible areas of certain Group 6 structure/aging effect combinations as identified below, whether or not they are covered by inspections in accordance with GALL-SLR Report AMP XI.S7, or FERC/US Army Corp of Engineers dam inspection and maintenance procedures.

1. Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in below-grade inaccessible concrete areas of Group 6 structures. Further evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG–1557, Ref. 7). The weathering index for the continental U.S. is shown in ASTM C33-90, Figure 1. A plant-specific program is not required if documented evidence confirms that the existing concrete had air content of 3 percent to 8 percent and subsequent inspection of accessible areas did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. The reviewer reviews and confirms that the applicant has satisfied these conditions. Otherwise, the reviewer reviews the applicant's proposed AMP to determine that, where appropriate, an effective inspection program has been developed and implemented to ensure that this aging effect in inaccessible areas for plants located in moderate to severe weathering conditions will be adequately managed.

2. Cracking due to expansion from reaction with aggregates could occur in inaccessible concrete areas of Group 6 structures. Further evaluation is recommended to determine if a plant-specific program is required to manage the aging effect. A plant specific program is required if (1) reactivity tests or petrographic examinations of concrete samples identify reaction with aggregates, or (2) visual inspections of accessible concrete have identified indications of aggregate reactions, such as "map" or "patterned" cracking or the presence of reaction byproducts (e.g., alkali-silica gel). The reviewer confirms that the applicant has not identified one of the above conditions. Otherwise, the reviewer reviews the applicant's proposed AMP to verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that the aging effect will be adequately managed.

3. Increase in porosity and permeability due to leaching of calcium hydroxide and carbonation could occur in below-grade inaccessible concrete areas of Group 6 structures. Further evaluation is recommended to determine if a plant-specific program is required to manage the aging effect. A plant-specific program is not required for the reinforced structures exposed to flowing water if (1) there is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure. The reviewer confirms that the applicant has satisfied these conditions. Otherwise, the reviewer reviews the applicant's proposed AMP to verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that this aging effect in inaccessible areas will be adequately managed.

3.5.3.2.2.4 Cracking Due to Stress Corrosion Cracking and Loss of Material Due to Pitting and Crevice Corrosion

Further evaluation is recommended of plant-specific programs to manage cracking due to SCC and loss of material due to pitting and crevice corrosion for SS tank liners exposed to standing water. The reviewer reviews the applicant's proposed AMP on a case-by-case basis to ensure that the intended functions will be maintained during the subsequent period of the extended operation.

3.5.3.2.2.5 Cumulative Fatigue Damage

Fatigue of support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports is a TLAA as defined in 10 CFR 54.3 only if a CLB fatigue analysis exists. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed separately in Section 4.3 of this SRP-SLR Report.

3.5.3.2.2.6 Reduction of Strength and Mechanical Properties of Concrete Due to Irradiation

Further evaluation is recommended of a plant-specific program to manage reduction of strength, loss of mechanical properties, and of concrete due to irradiation in PWR and BWR Group 4 concrete structures, exposed to high levels of neutron and gamma radiation. These structures include the reactor (primary/biological) shield wall, the sacrificial shield wall, and the reactor vessel support/pedestal structure. The irradiation mechanism consists of radiation interactions with the material and heating due to absorption of radiation energy at the operating temperature experienced by the concrete. The intensity of radiation is typically characterized by the measure of its field or fluence. Both neutron and gamma radiation produce internal heating from absorption of radiation energy and, at high fluence levels, changes in microstructure and certain mechanical properties of concrete (e.g., compressive strength, tensile strength, modulus of elasticity) from radiation interactions with the material. Limited data are available in the open literature related to the effects and significance of radiation fluences (neutron and gamma radiation) on intended functions of concrete structures, especially for conditions (dose, temperature, etc.) representative of existing LWR plants. However, based on literature review of existing research, fluence limits of 1×10^{19} neutrons/cm^2 neutron radiation and 1×10^8 Gy [1×10^{10} rad] gamma dose are considered conservative radiation exposure levels beyond which concrete material properties may begin to degrade markedly.

Plant-specific calculations/analyses should be performed to identify the neutron (fluence cutoff energy $E > 0.1$ MeV) and gamma fields that develop in any portion of the concrete structures of interest at 80 years of operation and compare them to the above threshold limits. The impact of any plant-specific operating experience of concrete irradiation effects on intended functions are evaluated. The reviewer reviews these analyses, operating experience and supporting technical basis (e.g., calculations, test data) on a case-by-case basis. Higher fluence or dose levels may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and/or change in mechanical properties of concrete, if any, from those fluence levels and the effects are applied to the design calculations. The reviewer confirms that the applicant's discussion in the SLRA indicates that the affected PWR and BWR concrete components are not exposed to neutron and gamma radiation fluence levels that exceed the threshold limits. The reviewer also confirms that the impact of any plant-specific operating experience of concrete irradiation degradation on intended functions is addressed. If the limits are exceeded, the technical basis (i.e., tests and/or calculations) provided by the applicant to justify higher fluence or dose limits is reviewed. Otherwise, the applicant's proposed plant-specific program and the supporting technical basis is reviewed to ensure that the effects of irradiation on the concrete components will be adequately managed during the subsequent period of extended operation.

3.5.3.2.3 Quality Assurance for Aging Management of Nonsafety-Related Components

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

3.5.3.2.4 Ongoing Review of Operating Experience

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

In addition, the reviewer confirms that the applicant has provided an appropriate summary description of these activities in the FSAR supplement. An example description is under "Operating Experience" in Table 3.0-1, "FSAR Supplement for Aging Management of Applicable Systems."

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

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

3.5.3.4 Aging Management Programs

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR Report AMP. If the applicant identifies, in the SLRA AMP, an exception to any of the program elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not identified by the SLRA, between the SLRA AMP and the GALL-SLR Report AMP, with which the SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions, or differences. The AMPs evaluated in the GALL-SLR Report pertinent to the containments, SC supports are summarized in Table 3.5-1 of this SRP-SLR. The "GALL-SLR Item" column identifies the AMR item numbers in the GALL-SLR Report, Chapters II and III, presenting detailed information summarized by this row.

Table 3.5-1 of this SRP-SLR may identify a plant-specific AMP. If the applicant chooses to use a plant-specific program that is not a GALL-SLR AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix A.1.2.3 of this SRP-SLR Report).

3.5.3.5 Final Safety Analysis Report Supplement

The reviewer confirms that the applicant has provided in its FSAR supplement information equivalent to that in Table 3.0-1 for aging management of the containments, SC supports. Table 3.5-2 lists the AMPs that are applicable for this SRP-SLR subsection. The reviewer also confirms that the applicant has provided information for Subsection 3.5.3.3, "AMR Results Not Consistent With or Not Addressed in the GALL-SLR Report," equivalent to that in Table 3.0-1.

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

As noted in Table 3.0-1, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should confirm that the applicant has identified and committed in the SLR application to any future aging management activities, including enhancements and commitments, to be completed before the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

3.5.4 Evaluation Findings

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

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

3.5.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

3.5.6 References

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2. 10 CFR Part 50.55a, "Codes and Standards." Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

3. 10 CFR Part 50.59, "Changes, Tests, and Experiments." Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

4. 10 CFR Part 50, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors." Appendix J. Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

5. 10 CFR Part 50.71, "Maintenance of Record, Making of Reports." Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

6. 10 CFR Part 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

7. 10 CFR 54.4, "Scope." Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

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9. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54–The License Renewal Rule." Revision 6. Washington, DC: Nuclear Energy Institute. 1995.

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15. NRC. NUREG–1557, "Summary of Technical Information and Agreements from Nuclear Management and Resource Council Industry Report addressing License Renewal." Washington, DC: U.S. Nuclear Regulatory Commission. October 1996.

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17. Hilsdorf, H.K., J. Kropp, and H.J. Koch. "The Effects of Nuclear Radiation on the Mechanical Properties of Concrete." ACI SP 55-10. pp 223-251. 1978.

18. NRC. NUREG/CR–7171, "A Review of the Effects of Radiation on Microstructure and Properties of Concretes Used in Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. November 2013

19. Field, K.G., Y. Le Pape, and I. Remec. "Perspectives on Radiation Effects in Concrete for Nuclear Power Plants–Part I: Quantification of Radiation Exposure and Radiation Effects." *Nuclear Engineering and Design.* Vol 285. pp 126–143. February 2015.

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	1	BWR/PWR	Concrete: dome; wall; basemat; ring girders; buttresses, concrete elements, all	Cracking and distortion due to increased stress levels from settlement	AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.1.1)	II.A1.CP-101 II.A2.CP-69 II.B1.2.CP-105 II.B2.2.CP-105 II.B3.1.CP-69 II.B3.2.CP-105
M	2	BWR/PWR	Concrete: foundation; subfoundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.1.1)	II.A1.C-07 II.A2.C-07 II.B1.2.C-07 II.B2.2.C-07 II.B3.1.C-07 II.B3.2.C-07
M	3	BWR/PWR	Concrete: dome; wall; basemat; ring girders; buttresses, concrete: containment; wall; basemat, concrete: basemat, concrete fill-in annulus	Reduction of strength and modulus of elasticity due to elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.1.2)	II.A1.CP-34 II.B1.2.CP-57 II.B2.2.CP-57 II.B3.1.CP-65 II.B3.2.CP-108
M	4	BWR	Steel elements (inaccessible areas): drywell shell; drywell head	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	Yes (SRP-SLR Section 3.5.2.2.1.3.1)	II.B3.1.CP-113
M	5	BWR/PWR	Steel elements (inaccessible areas): liner; liner anchors; integral attachments, steel elements (inaccessible areas): suppression chamber; drywell; drywell head;	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	Yes (SRP-SLR Section 3.5.2.2.1.3.1)	II.A1.CP-98 II.A2.CP-98 II.B1.2.CP-63 II.B2.1.CP-63 II.B2.2.CP-63 II.B3.2.CP-98

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			embedded shell; region shielded by diaphragm floor (as applicable)				
M	6	BWR	Steel elements: torus shell	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	Yes (SRP-SLR Section 3.5.2.2.1.3.2)	II.B1.1.CP-48
M	7	BWR	Steel elements: torus ring girders; downcomers;, Steel elements: suppression chamber shell (interior surface)	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE"	Yes (SRP-SLR Section 3.5.2.2.1.3.3)	II.B1.1.CP-109 II.B3.1.CP-158
M	8	BWR/PWR	Prestressing system: tendons	Loss of prestress due to relaxation; shrinkage; creep; elevated temperature	TLAA, SRP-SLR Section 4.5, "Concrete Containment Tendon Prestress"	Yes (SRP-SLR Section 3.5.2.2.1.4)	II.A1.C-11 II.B2.2.C-11
M	9	BWR/PWR	Personnel airlock, equipment hatch, CRD hatch, penetration sleeves; penetration bellows, steel elements: torus; vent line; vent header; vent line bellows; downcomers, suppression pool shell; unbraced downcomers, steel elements: vent header; downcomers	Cumulative fatigue damage due to fatigue (Only if CLB fatigue analysis exists)	TLAA, SRP-SLR Section 4.6, "Containment Liner Plate and Penetration Fatigue Analysis"	Yes (SRP-SLR Section 3.5.2.2.1.5)	II.A3.C-13 II.B1.1.C-21 II.B2.1.C-45 II.B2.2.C-48 II.B4.C-13

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	10	BWR/PWR	Penetration sleeves; penetration bellows	Cracking due to stress corrosion cracking	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	Yes (SRP-SLR Section 3.5.2.2.1.6)	II.A3.CP-38 II.B4.CP-38
M	11	BWR/PWR	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.1.7)	II.A1.CP-147 II.A2.CP-70 II.B3.2.CP-135
M	12	BWR/PWR	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses, containment, concrete fill-in annulus	Cracking due to expansion from reaction with aggregates	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.1.8)	II.A1.CP-67 II.A2.CP-104 II.B1.2.CP-99 II.B2.2.CP-99 II.B3.1.CP-83 II.B3.2.CP-121
D	13						
M	14	BWR/PWR	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses, containment	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.1.9)	II.A1.CP-102 II.A2.CP-53 II.B1.2.CP-110 II.B2.2.CP-110 II.B3.1.CP-53 II.B3.2.CP-122
D	15						
M	16	BWR/PWR	Concrete (accessible areas): basemat, concrete: containment;	Increase in porosity and permeability; cracking; loss of material	AMP XI.S2, "ASME Section XI, Subsection IWL,"	No	II.A1.CP-87 II.A2.CP-72 II.B1.2.CP-106

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			wall	(spalling, scaling) due to aggressive chemical attack	and/or AMP XI.S6, "Structures Monitoring"		II.B2.2.CP-106 II.B3.1.CP-72
D	17						
M	18	BWR/PWR	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses	Loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	No	II.A1.CP-31 II.A2.CP-51 II.B3.2.CP-52
M	19	BWR/PWR	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses, containment; concrete fill-in annulus	Cracking due to expansion from reaction with aggregates	AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	No	II.A1.CP-33 II.A2.CP-58 II.B1.2.CP-59 II.B2.2.CP-59 II.B3.1.CP-66 II.B3.2.CP-60
M	20	BWR/PWR	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses, containment	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	AMP XI.S2, "ASME Section XI, Subsection IWL"	No	II.A1.CP-32 II.A2.CP-155 II.B1.2.CP-54 II.B2.2.CP-54 II.B3.1.CP-156 II.B3.2.CP-55
M	21	BWR/PWR	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses; reinforcing steel	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	No	II.A1.CP-68 II.A2.CP-74 II.B1.2.CP-79 II.B2.2.CP-79 II.B3.1.CP-74 II.B3.2.CP-88

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
D	22						
M	23	BWR/PWR	Concrete (inaccessible areas): basemat; reinforcing steel, dome; wall	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring"	No	II.A1.CP-97 II.A2.CP-75 II.B1.2.CP-80 II.B2.2.CP-80 II.B3.1.CP-75 II.B3.2.CP-89
M	24	BWR/PWR	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses, concrete (accessible areas): dome; wall; basemat	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring"	No	II.A1.CP-100 II.A2.CP-71 II.B3.1.CP-71 II.B3.2.CP-73 II.B3.2.CP-84
D	25						
	26	BWR/PWR	Moisture barriers (caulking, flashing, and other sealants)	Loss of sealing due to wear, damage, erosion, tear, surface cracks, other defects	AMP XI.S1, "ASME Section XI, Subsection IWE"	No	II.A3.CP-40 II.B4.CP-40
	27	BWR/PWR	Penetration sleeves; penetration bellows, steel elements: torus; vent line; vent header; vent line bellows; downcomers, suppression pool shell	Cracking due to cyclic loading (CLB fatigue analysis does not exist)	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	No	II.A3.CP-37 II.B1.1.CP-49 II.B2.1.CP-107 II.B4.CP-37

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
	28	BWR/PWR	Personnel airlock, equipment hatch, CRD hatch	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	No	II.A3.C-16 II.B4.C-16
M	29	BWR/PWR	Personnel airlock, equipment hatch, CRD hatch: locks, hinges, and closure mechanisms	Loss of leak tightness due to mechanical wear	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	No	II.A3.CP-39 II.B4.CP-39
	30	BWR/PWR	Pressure-retaining bolting	Loss of preload due to self-loosening	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	No	II.A3.CP-150 II.B4.CP-150
	31	BWR/PWR	Pressure-retaining bolting, steel elements: downcomer pipes	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE"	No	II.A3.CP-148 II.B1.2.CP-117 II.B2.1.CP-117 II.B2.2.CP-117 II.B4.CP-148
	32	BWR/PWR	Prestressing system: tendons; anchorage components	Loss of material due to corrosion	AMP XI.S2, "ASME Section XI, Subsection IWL"	No	II.A1.C-10 II.B2.2.C-10
	33	BWR/PWR	Seals and gaskets	Loss of sealing due to wear, damage, erosion, tear, surface cracks, other defects	AMP XI.S4, "10 CFR Part 50, Appendix J "	No	II.A3.CP-41 II.B4.CP-41

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
	34	BWR/PWR	Service Level I coatings	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, or physical damage	AMP XI.S8, "Protective Coating Monitoring and Maintenance"	No	II.A3.CP-152 II.B4.CP-152
M	35	BWR/PWR	Steel elements (accessible areas): liner; liner anchors; integral attachments, penetration sleeves, drywell shell; drywell head; drywell shell in sand pocket regions; suppression chamber; drywell; embedded shell; region shielded by diaphragm floor (as applicable)	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	No	II.A1.CP-35 II.A2.CP-35 II.A3.CP-36 II.B1.1.CP-43 II.B1.2.CP-46 II.B2.1.CP-46 II.B2.2.CP-46 II.B3.1.CP-43 II.B3.2.CP-35 II.B4.CP-36
M	36	BWR	Steel elements: drywell head; downcomers	Loss of material due to mechanical wear, including fretting	AMP XI.S1, "ASME Section XI, Subsection IWE"	No	II.B1.1.C-23 II.B1.2.C-23 II.B2.1.C-23 II.B2.2.C-23
	37	BWR	Steel elements: suppression chamber (torus) liner (interior surface)	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	No	II.B1.2.C-49 II.B2.2.C-49
	38	BWR	Steel elements: suppression chamber shell (interior surface)	Cracking due to stress corrosion cracking	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50,	No	II.B3.1.C-24 II.B3.2.C-24

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					Appendix J"		
	39	BWR	Steel elements: vent line bellows	Cracking due to stress corrosion cracking	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	No	II.B1.1.CP-50
	40	BWR	Unbraced downcomers, steel elements: vent header; downcomers	Cracking due to cyclic loading (CLB fatigue analysis does not exist)	AMP XI.S1, "ASME Section XI, Subsection IWE"	No	II.B2.1.CP-142 II.B2.2.CP-64
M	41	BWR	Steel elements: drywell support skirt, steel elements (inaccessible areas): support skirt	None	None	No	II.B1.1.CP-44 II.B1.2.CP-114 II.B2.1.CP-114 II.B2.2.CP-114
M	42	BWR/PWR	Groups 1-3, 5, 7- 9: concrete (inaccessible areas): foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.1.1)	III.A1.TP-108 III.A2.TP-108 III.A3.TP-108 III.A5.TP-108 III.A7.TP-108 III.A8.TP-108 III.A9.TP-108
M	43	BWR/PWR	All Groups except Group 6: concrete (inaccessible areas): all	Cracking due to expansion from reaction with aggregates	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.1.2)	III.A1.TP-204 III.A2.TP-204 III.A3.TP-204 III.A4.TP-204 III.A5.TP-204 III.A7.TP-204 III.A8.TP-204 III.A9.TP-204

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	44	BWR/PWR	All Groups: concrete: all	Cracking and distortion due to increased stress levels from settlement	AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.2.1.3)	III.A1.TP-30 III.A2.TP-30 III.A3.TP-30 III.A4.TP-304 III.A5.TP-30 III.A6.TP-30 III.A7.TP-30 III.A8.TP-30 III.A9.TP-30
D	45						
M	46	BWR/PWR	Groups 1-3, 5-9: concrete: foundation; subfoundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.2.1.3)	III.A1.TP-31 III.A2.TP-31 III.A3.TP-31 III.A5.TP-31 III.A6.TP-31 III.A7.TP-31 III.A8.TP-31 III.A9.TP-31
M	47	BWR/PWR	Groups 1-5, 7-9: concrete (inaccessible areas): exterior above- and below-grade; foundation	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.1.4)	III.A1.TP-67 III.A2.TP-67 III.A3.TP-67 III.A4.TP-305 III.A5.TP-67 III.A7.TP-67 III.A8.TP-67 III.A9.TP-67
M	48	BWR/PWR	Groups 1-5: concrete: all	Reduction of strength and modulus due to elevated temperature (>150°F general;	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.2)	III.A1.TP-114 III.A2.TP-114 III.A3.TP-114 III.A4.TP-114

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
				>200°F local)			III.A5.TP-114
M	49	BWR/PWR	Groups 6 - concrete (inaccessible areas): exterior above- and below-grade; foundation; interior slab	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.3.1)	III.A6.TP-110
M	50	BWR/PWR	Groups 6: concrete (inaccessible areas): all	Cracking due to expansion from reaction with aggregates	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.3.2)	III.A6.TP-220
M	51	BWR/PWR	Groups 6: concrete (inaccessible areas): exterior above- and below-grade; foundation; interior slab	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.3.3)	III.A6.TP-109
M	52	BWR/PWR	Groups 7, 8 - steel components: tank liner	Cracking due to stress corrosion cracking; Loss of material due to pitting and crevice corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.4)	III.A7.T-23 III.A8.T-23
M	53	BWR/PWR	Support members; welds; bolted connections; support anchorage to building structure	Cumulative fatigue damage due to fatigue (Only if CLB fatigue analysis exists)	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.5.2.2.2.5)	III.B1.1.T-26 III.B1.2.T-26 III.B1.3.T-26
	54	BWR/PWR	All groups except 6: concrete (accessible areas): all	Cracking due to expansion from reaction with aggregates	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-25 III.A2.TP-25 III.A3.TP-25 III.A4.TP-25 III.A5.TP-25 III.A7.TP-25

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
							III.A8.TP-25 III.A9.TP-25
M	55	BWR/PWR	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	AMP XI.S6, "Structures Monitoring"	No	III.B1.1.TP-42 III.B1.2.TP-42 III.B1.3.TP-42 III.B2.TP-42 III.B3.TP-42 III.B4.TP-42
M	56	BWR/PWR	Concrete: exterior above- and below-grade; foundation; interior slab	Loss of material due to abrasion; cavitation	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.T-20
M	57	BWR/PWR	Constant and variable load spring hangers; guides; stops	Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.T-28 III.B1.2.T-28 III.B1.3.T-28
M	58	BWR/PWR	Earthen water-control structures: dams; embankments; reservoirs; channels; canals and ponds	Loss of material; loss of form due to erosion, settlement, sedimentation, frost action, waves, currents,	AMP XI.S7, "Inspection of Water-Control Structures Associated with	No	III.A6.T-22

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
				surface runoff, seepage	Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.		
M	59	BWR/PWR	Group 6: concrete (accessible areas): all	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-38
M	60	BWR/PWR	Group 6: concrete (accessible areas): exterior above- and below-grade; foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-36

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	61	BWR/PWR	Group 6: concrete (accessible areas): exterior above- and below-grade; foundation; interior slab	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-37
M	62	BWR/PWR	Group 6: Wooden Piles; sheeting	Loss of material; change in material properties due to weathering, chemical degradation, and insect infestation repeated wetting and drying, fungal decay	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-223
	63	BWR/PWR	Groups 1-3, 5, 7-9: concrete (accessible areas): exterior above- and below-grade; foundation	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-24 III.A2.TP-24 III.A3.TP-24 III.A5.TP-24 III.A7.TP-24 III.A8.TP-24 III.A9.TP-24

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
	64	BWR/PWR	Groups 1-3, 5, 7-9: concrete (accessible areas): exterior above- and below-grade; foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-23 III.A2.TP-23 III.A3.TP-23 III.A5.TP-23 III.A7.TP-23 III.A8.TP-23 III.A9.TP-23
	65	BWR/PWR	Groups 1-3, 5, 7-9: concrete (inaccessible areas): below-grade exterior; foundation, Groups 1-3, 5, 7-9: concrete (accessible areas): below-grade exterior; foundation, Groups 6: concrete (inaccessible areas): all	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-212 III.A1.TP-27 III.A2.TP-212 III.A2.TP-27 III.A3.TP-212 III.A3.TP-27 III.A5.TP-212 III.A5.TP-27 III.A6.TP-104 III.A7.TP-212 III.A7.TP-27 III.A8.TP-212 III.A8.TP-27 III.A9.TP-212 III.A9.TP-27
	66	BWR/PWR	Groups 1-5, 7, 9: concrete (accessible areas): interior and above-grade exterior	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-26 III.A2.TP-26 III.A3.TP-26 III.A4.TP-26 III.A5.TP-26 III.A7.TP-26 III.A9.TP-26
	67	BWR/PWR	Groups 1-5, 7, 9: Concrete: interior; above-grade exterior, Groups 1-3, 5, 7-9 -	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-28 III.A1.TP-29 III.A2.TP-28 III.A2.TP-29

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			concrete (inaccessible areas): below-grade exterior; foundation, Group 6: concrete (inaccessible areas): all	aggressive chemical attack			III.A3.TP-28 III.A3.TP-29 III.A4.TP-28 III.A5.TP-28 III.A5.TP-29 III.A6.TP-107 III.A7.TP-28 III.A7.TP-29 III.A8.TP-29 III.A9.TP-28 III.A9.TP-29
	68	BWR/PWR	High-strength structural bolting	Cracking due to stress corrosion cracking	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-41
M	69	BWR/PWR	High-strength structural bolting	Cracking due to stress corrosion cracking	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-300 III.A2.TP-300 III.A3.TP-300 III.A4.TP-300 III.A5.TP-300 III.A7.TP-300 III.A8.TP-300 III.A9.TP-300 III.B2.TP-300 III.B3.TP-300 III.B4.TP-300
	70	BWR/PWR	Masonry walls: all	Cracking due to restraint shrinkage, creep, aggressive environment	AMP XI.S5, "Masonry Walls"	No	III.A1.T-12 III.A2.T-12 III.A3.T-12 III.A5.T-12 III.A6.T-12

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	71	BWR/PWR	Masonry walls: all	Loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.S5, "Masonry Walls"	No	III.A1.TP-34 III.A2.TP-34 III.A3.TP-34 III.A5.TP-34 III.A6.TP-34
M	72	BWR/PWR	Seals; gasket; moisture barriers (caulking, flashing, and other sealants)	Loss of sealing due to wear, damage, erosion, tear, surface cracks, other defects	AMP XI.S6, "Structures Monitoring"	No	III.A6.TP-7
	73	BWR/PWR	Service Level I coatings	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, or physical damage	AMP XI.S8, "Protective Coating Monitoring and Maintenance"	No	III.A4.TP-301
M	74	BWR/PWR	Sliding support bearings; sliding support surfaces	Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear	AMP XI.S6, "Structures Monitoring"	No	III.B2.TP-46 III.B2.TP-47 III.B4.TP-46 III.B4.TP-47
M	75	BWR/PWR	Sliding surfaces	Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-45 III.B1.2.TP-45 III.B1.3.TP-45
M	76	BWR/PWR	Sliding surfaces: radial beam seats in BWR drywell	Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear	AMP XI.S6, "Structures Monitoring"	No	III.A4.TP-35

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	77	BWR/PWR	Steel components: all structural steel	Loss of material due to corrosion	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-302 III.A2.TP-302 III.A3.TP-302 III.A4.TP-302 III.A5.TP-302 III.A7.TP-302 III.A8.TP-302
M	78	BWR/PWR	Stainless steel fuel pool liner	Cracking due to stress corrosion cracking; Loss of material due to pitting and crevice corrosion	AMP XI.M2, "Water Chemistry," and monitoring of the spent fuel pool water level and leakage from the leak chase channels.	No	III.A5.T-14
	79	BWR/PWR	Steel components: piles	Loss of material due to corrosion	AMP XI.S6, "Structures Monitoring"	No	III.A3.TP-219
M	80	BWR/PWR	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-248 III.A2.TP-248 III.A3.TP-248 III.A4.TP-248 III.A5.TP-248 III.A6.TP-248 III.A7.TP-248 III.A8.TP-248 III.A9.TP-248 III.B2.TP-248 III.B3.TP-248 III.B4.TP-248

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
	81	BWR/PWR	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-226 III.B1.2.TP-226 III.B1.3.TP-226
M	82	BWR/PWR	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-274 III.A2.TP-274 III.A3.TP-274 III.A4.TP-274 III.A5.TP-274 III.A7.TP-274 III.A8.TP-274 III.A9.TP-274 III.B2.TP-274 III.B3.TP-274 III.B4.TP-274
M	83	BWR/PWR	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-221
D	84						

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	85	BWR/PWR	Structural bolting	Loss of material due to pitting, crevice corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-232 III.B1.2.TP-232 III.B1.3.TP-232
	86	BWR/PWR	Structural bolting	Loss of material due to pitting, crevice corrosion	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-235 III.B1.2.TP-235 III.B1.3.TP-235
	87	BWR/PWR	Structural bolting	Loss of preload due to self-loosening	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-229 III.B1.2.TP-229 III.B1.3.TP-229
M	88	BWR/PWR	Structural bolting	Loss of preload due to self-loosening	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-261 III.A2.TP-261 III.A3.TP-261 III.A4.TP-261 III.A5.TP-261 III.A6.TP-261 III.A7.TP-261 III.A8.TP-261 III.A9.TP-261 III.B2.TP-261 III.B3.TP-261 III.B4.TP-261
M	89	PWR	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to boric acid corrosion	AMP XI.M10, "Boric Acid Corrosion"	No	III.B1.1.T-25 III.B1.1.TP-3 III.B1.2.T-25 III.B1.3.TP-3 III.B1.2.TP-3 III.B2.T-25 III.B2.TP-3 III.B3.T-25

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
							III.B3.TP-3 III.B4.T-25 III.B4.TP-3
M	90	BWR/PWR	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-10
	91	BWR/PWR	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to general, pitting corrosion	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.T-24 III.B1.2.T-24 III.B1.3.T-24
M	92	BWR/PWR	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to general, pitting corrosion	AMP XI.S6, "Structures Monitoring"	No	III.B2.TP-43 III.B3.TP-43 III.B4.TP-43
	93	BWR/PWR	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to pitting, crevice corrosion	AMP XI.S6, "Structures Monitoring"	No	III.B2.TP-6 III.B4.TP-6
M	94	BWR/PWR	Vibration isolation elements	Reduction or loss of isolation function due to radiation hardening, temperature, humidity, sustained vibratory loading	AMP XI.S3, "ASME Section XI, Subsection IWF" and/or AMP XI.S6, "Structures Monitoring"	No	III.B1.1.T-33 III.B1.2.T-33 III.B1.3.T-33 III.B4.TP-44

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	95	BWR/PWR	Aluminum, galvanized steel and stainless steel support members; welds; bolted connections; support anchorage to building structure exposed to air – indoor uncontrolled	None	None	No	III.B1.1.TP-4 III.B1.1.TP-8 III.B1.2.TP-4 III.B1.2.TP-8 III.B1.3.TP-4 III.B1.3.TP-8 III.B2.TP-4 III.B2.TP-8 III.B3.TP-4 III.B3.TP-8 III.B4.TP-4 III.B4.TP-8
N	96	BWR/PWR	Groups 6: concrete (accessible areas): all	Cracking due to expansion from reaction with aggregates	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants"	No	III.A6.T-34
N	97	BWR/PWR	Group 4: Concrete (reactor cavity area proximate to the reactor vessel): reactor (primary/biological) shield wall; sacrificial shield wall; reactor vessel support/pedestal structure	Reduction of strength; loss of mechanical properties due to irradiation (i.e., radiation interactions with material and radiation-induced heating)	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.6)	III.A4.T-35

Table 3.5-2. AMPs and Additional Guidance Appendices Recommended for Containments, Structures, and Component Supports	
GALL-SLR Report Chapter/AMP	**Program Name**
Chapter XI.M2	Water Chemistry
Chapter XI.M10	Boric Acid Corrosion
Chapter XI.M18	Bolting Integrity
Chapter XI.S1	ASME Section XI, Subsection IWE
Chapter XI.S2	ASME Section XI, Subsection IWL
Chapter XI.S3	ASME Section XI, Subsection IWF
Chapter XI.S4	10 CFR Part 50, Appendix J
Chapter XI.S5	Masonry Walls
Chapter XI.S6	Structures Monitoring
Chapter XI.S7	Inspection of Water-Control Structures Associated with Nuclear Power Plants
Chapter XI.S8	Protective Coating Monitoring and Maintenance
GALL-SLR Report Appendix A	Quality Assurance for Aging Management Programs
GALL-SLR Report Appendix B	Operating Experience for Aging Management Programs
SRP-SLR Appendix A.1	Aging Management Review—Generic (Branch Technical Position RLSB-1)

3.6 Aging Management of Electrical and Instrumentation and Controls

Review Responsibilities

Primary—Branches assigned responsibility by Project Manager (PM) as described in this Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Section 3.0.

3.6.1 Areas of Review

This section addresses the aging management review (AMR) and the associated aging management programs (AMPs) of the electrical and instrumentation and control (I&C). For a recent vintage plant, the information related to the electrical and I&C is contained in Chapter 7, "Instrumentation and Controls," and Chapter 8, "Electric Power," of the plant's Final Safety Analysis Report (FSAR), consistent with the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG–0800) (Ref. 1). For older plants, the location of applicable information is plant-specific because an older plant's FSAR may have predated NUREG–0800. Typical electrical and I&C components that are subject to an AMR for subsequent license renewal (SLR) are electrical cables and connections, metal enclosed buses, cable bus, fuse holders, high-voltage insulators, transmission conductors and connections, and switchyard bus and connections.

The responsible review organization is to review the following subsequent license renewal application (SLRA) AMR and AMP items assigned to it, per SRP-SLR Section 3.0:

AMRs

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

AMPs

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

FSAR Supplement

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

3.6.2 Acceptance Criteria

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

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

The AMRs and the AMPs applicable to the electrical and I&C components are described and evaluated in Chapter VI of the Generic Aging Lessons Learned (GALL-SLR) Report.

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

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

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

The basic acceptance criteria defined in Section 3.6.2.1 need to be applied first for all of the AMRs and AMPs reviewed as part of this section. In addition, if the GALL-SLR Report AMR item to which the SLRA AMR item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL-SLR Report for each of the following aging effect/aging mechanism combinations. Refer to Table 3.6-1, comparing the "Further Evaluation Recommended" and the "GALL-SLR Item" column, for the AMR items that reference the following subsections.

3.6.2.2.1 Electrical Equipment Subject to Environmental Qualification

Environmental qualification is a time-limited aging analysis (TLAA) as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The evaluation of this TLAA is addressed separately in Section 4.4, "Environmental Qualification (EQ) of Electrical Equipment," of this SRP-SLR.

3.6.2.2.2 Reduced Insulation Resistance Due to Loss of Material Due to General, Pitting, and Crevice Corrosion, Loosening of Bolts Caused by Thermal Cycling and Ohmic Heating, Degradation Caused Thermal/Thermoxidative Degradation of Organics and Photolysis (UV Sensitive Materials Only) of Organics, Moisture/Debris Intrusion and Ohmic Heating

Reduced insulation resistance due to loss of material due to general, pitting, and crevice corrosion, loosening of bolts caused by thermal cycling and ohmic heating, degradation caused thermal/thermoxidative degradation of organics and photolysis [ultraviolet (UV) sensitive materials only] of organics and moisture/debris intrusion could occur in cable bus assemblies. The GALL-SLR Report recommends further evaluation of a plant-specific Cable Bus AMP to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position (BTP) RLSB-1 (Appendix A.1 of this SRP-SLR).

3.6.2.2.3 Loss of Material Due to Wind-Induced Abrasion, Loss of Conductor Strength Due to Corrosion, and Increased Resistance of Connection Due to Oxidation or Loss of Preload

Loss of material due to wind-induced abrasion, loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of preload could occur in transmission conductors and connections, and in switchyard bus and connections. The GALL-SLR Report recommends further evaluation of a plant-specific AMP to ensure that this aging effect is adequately managed. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

3.6.2.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

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

3.6.2.2.5 Ongoing Review of Operating Experience

Acceptance criteria are described in Appendix A.4, "Operating Experience for AMPs."

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

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

3.6.2.4 Aging Management Programs

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

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

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

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

3.6.2.5 Final Safety Analysis Review Supplement

The summary description of the programs and activities for managing the effects of aging for the subsequent period of extended operation in the FSAR supplement should be sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects are managed during the subsequent period of extended operation. The description should also contain any future aging management activities, including commitments, license conditions, enhancements, and exceptions, to be implemented prior to or during the subsequent period of extended operation. Table 3.0-1 of this SRP-SLR provides examples of the type of information to be included in the FSAR Supplement. Table 3.6-2 lists the programs that are applicable for this SRP-SLR subsection.

3.6.3 Review Procedures

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

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

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

Furthermore, the reviewer should confirm that the applicant has addressed operating experience identified after the issuance of the GALL-SLR Report. Performance of this review includes confirming that the applicant has identified those aging effects for the electrical and I&C components that are contained in the GALL-SLR Report as applicable to its plant.

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

The basic review procedures defined in Section 3.6.3.1 need to be applied first for all of the AMRs and AMPs provided in this section. In addition, if the GALL-SLR AMR item to which the SLRA AMR item is compared identifies that "further evaluation is recommended," then additional criteria apply as identified by the GALL-SLR Report for each of the following aging effect/aging mechanism combinations.

3.6.3.2.1 Electrical Equipment Subject to Environmental Qualification

Environmental qualification is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The NRC staff reviews the evaluation of this TLAA separately following the guidance in Section 4.4 of this SRP-SLR.

3.6.3.2.2 Reduced Insulation Resistance Due to Loss of Material Due to General, Pitting, and Crevice Corrosion, Loosening of Bolts Caused by Thermal Cycling and Ohmic Heating, Degradation Caused by Thermal/Thermoxidative Degradation of Organics and Photolysis (UV Sensitive Materials Only) of Organics, Moisture/Debris Intrusion and Ohmic Heating

The GALL SLR Report recommends a plant-specific Cable Bus AMP for the management of reduced insulation resistance due to loss of material due to general, pitting, and crevice corrosion, loosening of bolts caused by thermal cycling and ohmic heating, degradation caused thermal/thermoxidative degradation of organics and photolysis (UV sensitive materials only) of organics and moisture/debris intrusion. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.6.3.2.3 Loss of Material Due to Wind-Induced Abrasion, Loss of Conductor Strength Due to Corrosion, and Increased Resistance of Connection Due to Oxidation or Loss of Preload

The GALL-SLR Report recommends a plant-specific AMP for the management of loss of material due to wind-induced abrasion, loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of preload in transmission conductors and connections, and in switchyard bus and connections. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.6.3.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components

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

3.6.3.2.5 Ongoing Review of Operating Experience

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

In addition, the reviewer confirms that the applicant has provided an appropriate summary description of these activities in the FSAR supplement. An example description is under

"Operating Experience" in Table 3.0-1, "FSAR Supplement for Aging Management of Applicable Systems."

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

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

3.6.3.4 Aging Management Programs

The reviewer confirms that the applicant has identified the appropriate AMPs as described and evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR Report AMP. If the applicant identifies, in the SLRA AMP, an exception to any of the program elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not identified by the SLRA, between the SLRA AMP and the GALL-SLR Report AMP with which the SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting enhancements, exceptions, or differences. The AMPs evaluated in the GALL-SLR Report pertinent to the electrical and I&C components are summarized in Table 3.6-1 of this SRP-SLR. The "GALL-SLR Item" column identifies the AMR item numbers in the GALL-SLR Report, Chapters VI, presenting detailed information summarized by this row.

Table 3.6-1 of this SRP-SLR may identify a plant-specific AMP. If the applicant chooses to use a plant-specific program that is not a GALL-SLR AMP, the NRC reviewer should confirm that the plant-specific program satisfies the criteria of BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

3.6.3.5 Final Safety Analysis Report Supplement

The reviewer confirms that the applicant has provided in its FSAR supplement information equivalent to that in Table 3.0-1 for aging management of the Electrical and I&C System. Table 3.6-2 lists the AMPs that are applicable for this SRP-SLR subsection. The reviewer also confirms that the applicant has provided information for Subsection 3.6.3.3, "AMR Results Not Consistent With or Not Addressed in the GALL-SLR Report," equivalent to that in Table 3.0-1.

The applicant updates its FSAR to include this FSAR supplement at the next update required pursuant to 10 CFR 50.71(e)(4).

As noted in Table 3.0-1, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should confirm that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements, exception, and commitments to be completed prior to or during the subsequent period of extended operation.

3.6.4 Evaluation Findings

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

On the basis of its review the NRC staff concludes that the applicant has demonstrated that the aging effects associated with the electrical and I&C components will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the subsequent period of extended operation, as required by 10 CFR 54.21(a)(3).

The NRC staff also reviewed the applicable FSAR Supplement program summary descriptions and concludes that they adequately describe the AMPs credited for managing aging of electrical and I&C, as required by 10 CFR 54.21(d).

3.6.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

3.6.6 References

1. NRC. NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. March 2007.

Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	1	BWR/PWR	Electrical equipment subject to 10 CFR 50.49 EQ requirements composed of various polymeric and metallic materials in plant areas subject to a harsh environment (i.e., loss of coolant accident (LOCA), high energy line break (HELB), or post LOCA environment or; An adverse localized environment for the most limiting qualified condition for temperature, radiation, or moisture for the component material (e.g., cable or connection insulation).	Various aging effects due to various mechanisms in accordance with 10 CFR 50.49	EQ is a time-limited aging analysis (TLAA) to be evaluated for the subsequent period of extended operation. See the Standard Review Plan, Section 4.4, "Environmental Qualification (EQ) of Electrical Equipment," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1)(i) and (ii). See AMP X.E1, "Environmental Qualification (EQ) of Electric Components," of this report for meeting the requirements of 10 CFR 54.21(c)(1)(i)-(iii). See Standard Review Plan, Section 4.4, "Environmental Qualification (EQ) of Electrical Equipment and AMP X.E1, "Environmental Qualification (EQ) of Electric Components," of this report for meeting	Yes, TLAA (See subsection 3.6.2.2.1)	VI.B.L-05

Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					the requirements of 10CFR 54.21(c)(1)(iii).		
M	2	BWR/PWR	High-voltage electrical insulators composed of porcelain; malleable iron; aluminum; galvanized steel; cement exposed to air – outdoor	Loss of material due to mechanical wear caused by movement of transmission conductors due to significant wind	AMP XI.E7, "High Voltage Insulators" A plant-specific aging management program is to be evaluated	No	VI.A.LP-32
M	3	BWR/PWR	High-voltage insulators composed of porcelain; malleable iron; aluminum; galvanized steel; cement exposed to air – outdoor	Reduced electrical insulation resistance due to presence of salt deposits or surface contamination	AMP XI.E7, "High Voltage Insulators"	No)	VI.A.LP-28
	4	BWR/PWR	Transmission conductors composed of aluminum; steel exposed to air – outdoor	Loss of conductor strength due to corrosion	A plant-specific aging management program is to be evaluated for ACSR	Yes, plant-specific (See subsection 3.6.2.2.3)	VI.A.LP-38
M	5	BWR/PWR	Transmission connectors composed of aluminum; steel exposed to air – outdoor	Increased electrical resistance of connection due to oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated	Yes, plant-specific (See subsection 3.6.2.2.3)	VI.A.LP-48

Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	6	BWR/PWR	Switchyard bus and connections composed of Aluminum; copper; bronze; stainless steel; galvanized steel exposed to air – outdoor	Loss of material due to wind-induced abrasion; Increased electrical resistance of connection due to oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated	Yes, plant-specific (See subsection 3.6.2.2.3)	VI.A.LP-39
	7	BWR/PWR	Transmission conductors composed of aluminum; steel exposed to air – outdoor	Loss of material due to wind-induced abrasion	A plant-specific aging management program is to be evaluated for ACAR and ACSR	Yes, plant-specific (See subsection 3.6.2.2.3)	VI.A.LP-47
M	8	BWR/PWR	Electrical insulation for electrical cables and connections (including terminal blocks, etc.) composed of various organic polymers (e.g., EPR, SR, EPDM, XLPE) exposed to an adverse localized environment caused by heat, radiation, or moisture	Reduced electrical insulation resistance due to thermal/thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	AMP XI.E1, "Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No	VI.A.LP-33
M	9	BWR/PWR	Electrical insulation for electrical cables and connections used in instrumentation	Reduced electrical insulation resistance due to thermal/thermoxidative degradation of organics, radiolysis, and photolysis	AMP XI.E2, "Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental	No	VI.A.LP-34

Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			circuits that are sensitive to reduction in conductor insulation resistance (IR) composed of various organic polymers (e.g., EPR, SR, EPDM, XLPE) exposed to an adverse localized environment caused by heat, radiation, or moisture	(UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	Qualification Requirements Used in Instrumentation Circuits"		
M	10	BWR/PWR	Electrical conductor insulation for inaccessible power, instrumentation, and control cables (e.g., installed in conduit or direct buried) composed of various organic polymers (e.g., EPR, SR, EPDM, XLPE) exposed to an adverse localized environment caused by significant moisture	Reduced electrical insulation resistance due to moisture	AMPs XI.E3A, XI.E3B, and XI.E3C, "Inaccessible Power Instrumentation, and Control Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No	VI.A.LP-35
	11	BWR/PWR	Metal enclosed bus: enclosure assemblies composed of elastomers exposed	Surface cracking, crazing, scuffing, dimensional change (e.g. "ballooning" and "necking"), shrinkage,	AMP XI.E4, "Metal Enclosed Bus," or AMP XI.M38, "Inspection of Internal Surfaces in	No	VI.A.LP-29

Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			to air – indoor controlled or uncontrolled, air – outdoor	discoloration, hardening and loss of strength due to elastomer degradation	Miscellaneous Piping and Ducting Components"		
M	12	BWR/PWR	Metal enclosed bus: bus/connections composed of various metals used for electrical bus and connections exposed to air – indoor controlled or uncontrolled, air – outdoor	Increased electrical resistance of connection due to the loosening of bolts caused by thermal cycling and ohmic heating	AMP XI.E4, "Metal Enclosed Bus"	No	VI.A.LP-25
M	13	BWR/PWR	Metal enclosed bus: electrical insulation; insulators composed of porcelain; xenoy; thermo-plastic organic polymers exposed to air – indoor controlled or uncontrolled, air – outdoor	Reduced electrical insulation resistance due to thermal/thermoxidative degradation of organics/thermoplastics , radiation-induced oxidation, moisture/debris intrusion, and ohmic heating	AMP XI.E4, "Metal Enclosed Bus"	No	VI.A.LP-26
	14	BWR/PWR	Metal enclosed bus: external surface of enclosure assemblies composed of steel exposed to air – indoor uncontrolled, air – outdoor	Loss of material due to general, pitting, crevice corrosion	AMP XI.E4, "Metal Enclosed Bus," or AMP XI.S6, "Structures Monitoring"	No	VI.A.LP-43

Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
	15	BWR/PWR	Metal enclosed bus: external surface of enclosure assemblies composed of galvanized steel; aluminum exposed to air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.E4, "Metal Enclosed Bus," or AMP XI.S6, "Structures Monitoring"	No	VI.A.LP-42
M	16	BWR/PWR	Fuse holders (not part of active equipment): metallic clamps composed of various metals used for electrical connections exposed to air – indoor uncontrolled	Increased electrical resistance of connection due to chemical contamination, corrosion, and oxidation. (in an air, indoor controlled environment, increased resistance of connection due to chemical contamination, corrosion and oxidation do not apply);	AMP XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are located in an environment that does not subject them to environmental aging mechanisms and effects due to chemical contamination, corrosion, and oxidation.	No	VI.A.LP-23
N	17	BWR/PWR	Fuse holders (not part of active equipment): metallic clamps composed of various metals used for electrical connections exposed to air-indoor controlled or uncontrolled	Increased electrical resistance of connection due to fatigue from ohmic heating, thermal cycling, electrical transients	AMP XI.E5, Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are not subject to fatigue due to ohmic heating, thermal cycling, electrical	No	VI.A.L-07

Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					transients		
M	18	BWR/PWR	Fuse holders (not part of active equipment): metallic clamps composed of various metals used for electrical connections exposed to air – indoor controlled or uncontrolled	Increased electrical resistance of connection due to fatigue caused by frequent fuse removal/manipulation or vibration	AMP XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are not subject to fatigue caused by frequent fuse removal/manipulation or vibration	No	VI.A.LP-31
M	19	BWR/PWR	Cable connections (metallic parts) composed of various metals used for electrical contacts exposed to air – indoor controlled or uncontrolled, air – outdoor	Increased electrical resistance of connection due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	AMP XI.E6, "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No	VI.A.LP-30
M	20	PWR	Electrical connector contacts for electrical connectors composed of various metals used for electrical contacts exposed to air with borated water	Increased electrical resistance of connection due to corrosion of connector contact surfaces caused by intrusion of borated water	AMP XI.M10, "Boric Acid Corrosion"	No	VI.A.LP-36

Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			leakage				
M	21	BWR/PWR	Transmission conductors composed of aluminum exposed to air – outdoor	Loss of conductor strength due to corrosion	None - for Aluminum Conductor Aluminum Alloy Reinforced (ACAR) and All Aluminum Conductor (AAC)	None	VI.A.LP-46
M	22	BWR/PWR	Fuse holders (not part of active equipment): insulation material composed of electrical insulation material: bakelite; phenolic melamine or ceramic; molded polycarbonate, and other, exposed to air – indoor controlled or uncontrolled	Reduced electrical insulation resistance due to thermal/thermoxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	AMP XI.E5, "Fuse Holders" No aging management program is required for those applicants who can demonstrate these fuse holders are located in an environment that does not subject them to environmental aging mechanisms	No	VI.A.LP-24
N	23	BWR/PWR	Metal enclosed bus: external surface of enclosure assemblies. Galvanized steel; aluminum. air – indoor controlled or uncontrolled	None	None	No	VI.A.LP-41

Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	24	BWR/PWR	Metal enclosed bus: external surface of enclosure assemblies. Steel air – indoor controlled	None	None	No	VI.A.LP-44
N	26	BWR/PWR	Cable bus: enclosure assemblies composed of elastomers exposed to air – indoor controlled or uncontrolled, air – outdoor	Surface cracking, crazing, scuffing, dimensional change (e.g. "ballooning" and "necking"), shrinkage, discoloration, hardening and loss of strength due to elastomer degradation	A plant-specific aging management program is to be evaluated	Yes, plant-specific (See subsection 3.6.2.2.2)	VI.A.L-08
N	27	BWR/PWR	Cable bus: external surface of enclosure assemblies galvanized steel; aluminum; air – indoor controlled or uncontrolled	None	None	No	VI.A.L-09
N	28	BWR/PWR	Cable bus: bus/connections composed of various metals used for electrical bus connections exposed to air – indoor controlled or uncontrolled, air – outdoor	Increased electrical resistance of connection due to the loosening of bolts caused by thermal cycling and ohmic heating	A plant-specific aging management program is to be evaluated	Yes, plant-specific (See subsection 3.6.2.2.2)	VI.A.L-10

Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report

New (N), Modified (M), Deleted (D) Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
N	29	BWR/PWR	Cable bus: electrical insulation; insulators – exposed to air – indoor controlled or uncontrolled, air – outdoor	Reduced electrical insulation resistance due to degradation caused thermal/thermoxidative degradation of organics and photolysis (UV sensitive materials only) of organics, moisture/debris intrusion and ohmic heating	A plant-specific aging management program is to be evaluated	Yes, plant-specific (See subsection 3.6.2.2.2)	VI.A.L-11
N	30	BWR/PWR	Cable bus: external surface of enclosure assemblies composed of steel exposed to air – indoor uncontrolled or air – outdoor	Loss of material due to general, pitting, crevice corrosion	A plant-specific aging management program is to be evaluated	Yes, plant-specific (See subsection 3.6.2.2.2)	VI.A.L-12
N	31	BWR/PWR	Cable bus external surface of enclosure assemblies composed of galvanized steel; aluminum exposed to air – outdoor	Loss of material due to general, pitting, crevice corrosion	A plant-specific aging management program is to be evaluated	Yes, plant-specific (See subsection 3.6.2.2.2)	VI.A.L-13
N	32	BWR/PWR	Cable bus: external surface of enclosure assemblies: composed of steel; air – indoor controlled	None	None	No	VI.A.L-14

Table 3.6-2. AMPs and Additional Guidance Appendices Recommended for Electrical and Instrumentation and Control Systems	
GALL-SLR Report Chapter/AMP	**Program Name**
AMP X.E1	Environmental Qualification of Electric Components
AMP XI.E1	Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
AMP XI.E2	Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits
AMP XI.E3A	Electrical Insulation for Inaccessible Medium Voltage Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
AMP XI.E3B	Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
AMP XI.E3C	Electrical Insulation for Inaccessible Low Voltage Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
AMP XI.E4	Metal Enclosed Bus
AMP XI.E5	Fuse Holders
AMP XI.E6	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
AMP XI.E7	High Voltage Insulators
AMP XI.M10	Boric Acid Corrosion
AMP XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
AMP XI.S6	Structures Monitoring
GALL-SLR Report Appendix A	Quality Assurance for Aging Management Programs
GALL-SLR Report Appendix B	Operating Experience for Aging Management Programs
SRP-SLR Appendix A.1	Aging Management Review—Generic (Branch Technical Position RLBS-1)

4 TIME-LIMITED AGING ANALYSES

4.1 Identification of Time-Limited Aging Analyses and Exemptions

Review Responsibilities

Primary—Branch responsible for the time-limited aging analysis (TLAA) issues

Secondary—Other branches responsible for engineering, as appropriate

4.1.1 Areas of Review

This review plan section addresses the identification of TLAAs. The technical review of TLAAs is addressed in Sections 4.2 through 4.7. As explained in more detail below, the list of TLAAs are certain plant-specific safety analyses that are defined, in part, by the current operating term. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(c)(1), a license renewal applicant is required to provide a list of TLAAs, as defined in 10 CFR 54.3. The area relating to the identification of TLAAs is reviewed.

TLAAs may have developed since issuance of a plant's operating license. As indicated in 10 CFR 54.30, the adequacy of the plant's current licensing basis (CLB), which includes TLAAs, is not an area within the scope of the license renewal review. Any questions regarding the adequacy of the CLB are addressed under the backfit rule (10 CFR 50.109) and are separate from the license renewal process.

In addition, pursuant to 10 CFR 54.21(c)(2), an applicant must provide a list of plant-specific exemptions granted under 10 CFR 50.12 that are based on TLAAs. The U.S. Nuclear Regulatory Commission (NRC) staff should focus its review to confirm that the applicant did not omit any TLAAs, as defined in 10 CFR 54.3.

Pursuant to 10 CFR 54.21(d), each application includes a final safety analysis report (FSAR), updated final safety analysis report (UFSAR), or updated safety analysis report (USAR), as appropriate for the CLB supplement summary description for each TLAA that is identified in accordance with 10 CFR 54.3.

4.1.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Subsection 4.1.1 of this review plan section delineate acceptable methods for meeting the requirements of the NRC's regulations in 10 CFR 54.21(c)(1). For the applicant's list of exemptions to be acceptable under the requirement in 10 CFR 54.21(c)(2), the NRC staff should have reasonable assurance that there has been no omission of TLAAs from the subsequent license renewal application (SLRA) that were used as the basis for receiving NRC approval of regulatory exemptions granted in accordance with 10 CFR 50.12 requirements.

TLAAs are those licensee calculations and analyses that meet all six of the following criteria, as defined in 10 CFR 54.3(a):

1. Involve systems, structures, and components within the scope of license renewal, as delineated in 10 CFR 54.4(a);

2. Consider the effects of aging;

3. Involve time-limited assumptions defined by the current operating term, for example, 40 years;

4. Were determined to be relevant by the licensee in making a safety determination;

5. Involve conclusions or provide the basis for conclusions related to the capability of the system, structure, or component to perform its intended function(s), as delineated in 10 CFR 54.4(b); and

6. Are contained or incorporated by reference in the CLB.

The TLAA identification criterion in Criterion 1 is based only on a comparison to the scoping requirements in 10 CFR 54.4 and therefore does not limit the applicability of TLAAs only to those components that would be required to be screened in for an AMP in accordance with the requirement in 10 CFR 54.21(a)(1). Thus, the possibility exists that, for a given CLB, a TLAA may need to be identified for a given active component if the analysis in the CLB is determined to be in conformance with all six of the criteria in 10 CFR 54.3(a) for identifying an analysis as a TLAA. Fatigue flaw growth analyses of pressurized water reactor (PWR) reactor coolant pump flywheels are examples of plant-specific analyses that apply to an active component type and may need to be identified as a TLAA for a given application.

The applicant's FSAR (as updated) identifies TLAAs that were incorporated by reference into the CLB. In addition, for subsequent license renewal (SLR) applications, there may be situations where an analysis of record was not required to be identified as a TLAA for the current operating period (as approved in the renewed operating license for the facility), but will need to be identified as a TLAA for a proposed subsequent period of extended operation, as required by the regulation in 10 CFR 54.21(c)(1). Specifically, criterion 3 for TLAAs in 10 CFR 54.3(a) establishes that to be a TLAA the analysis has to involve time-limited assumptions defined by the current operating term. In *Federal Register Notice* (FRN) No. 95-11136, Volume 60, Number 88, dated May 8, 1995 (Ref. 3), the NRC identified that TLAAs are those:

> analyses with (i) time-related assumptions, (ii) utilized in determining the acceptability of SSCs, within the scope of license renewal (as defined in 10 CFR 54.4), (iii) which are based upon a period of plant operation equal to or greater than the current license term, but less than the cumulative period of plant operation (viz., the existing license term plus the period of extended operation requested in the renewed application).

For example, for an existing analysis that is part of the CLB and is based on a 60-year time assumption, the analysis would not necessarily have to be identified as a TLAA for the initial license renewal request because it would not conform to the definition of a TLAA, as clarified in FRN No. 95-11136; however, if the same analysis was left unchanged in the CLB and was going to be relied upon for a proposed SLR period, the analysis would conform to the third criterion for TLAAs in 10 CFR 54.3(a) because the 60-year assumed life would form the updated current operating term basis for the proposed SLR period.

The reviewer reviews the FSAR supplement for each TLAA identified as being within the scope of the SLRA, as defined in 10 CFR 54.3.

4.1.3 Review Procedures

For each area of review described in Subsection 4.1.1, the reviewer adheres to the following review procedures:

The reviewer uses the plant FSAR (as updated) and other CLB documents, such as NRC staff safety evaluation report (SERs), to perform the review. The reviewer selects analyses that the applicant did not identify as TLAAs that are likely to meet the six criteria identified in Subsection 4.1.2. The reviewer verifies that the selected analyses, not identified by the applicant as TLAAs, do not meet at least one of the following criteria:

Sections 4.2 through 4.6 identify typical types of TLAAs for most plants. Information on the applicant's methodology for identifying TLAAs also may be useful in identifying calculations that did not meet the six criteria below.

1. Involve systems, structures, and components within the scope of license renewal, as delineated in 10 CFR 54.4(a). Chapter 2 of this SRP-SLR provides the reviewer guidance on the scoping and screening methodology, and on plant-level and various system-level scoping results.

2. Consider the effects of aging. The effects of aging include, but are not limited to, loss of material, change in dimension, change in material properties, loss of toughness, loss of prestress, settlement, cracking, and loss of dielectric properties.

3. Involve time-limited assumptions defined by the current operating term (e.g., 40 years). The defined operating term should be explicit in the analysis. Simply asserting that a component is designed for a service life or plant life is not sufficient. The assertion is supported by calculations or other analyses that explicitly include a time limit.

4. Were determined to be relevant by the licensee in making a safety determination. Relevancy is a determination that the applicant makes based on a review of the information available. A calculation or analysis is relevant if it can be shown to have a direct bearing on the action taken as a result of the analysis performed. Analyses are also relevant if they provide the basis for a licensee's safety determination, and, in the absence of the analyses, the applicant might have reached a different safety conclusion.

5. Show capability of the system, structure, or component to perform its intended function(s), as delineated. Involve conclusions or provide the basis for conclusions related to 10 CFR 54.4(b). Analyses that do not affect the intended functions of systems, structures, and components (SSCs) are not TLAAs.

6. Are contained or incorporated by reference in the CLB. The CLB includes the technical specifications as well as design basis information (as defined in 10 CFR 50.2), or licensee commitments documented in the plant-specific documents contained or incorporated by reference in the CLB, including but not limited to the FSAR, NRC SERs, the fire protection plan/hazards analyses, correspondence to and from the NRC, the quality assurance (QA) plan, and topical reports included as references to the FSAR. Calculations and analyses that are not contained in the CLB or not incorporated by reference in the CLB are not TLAAs. If a code of record is in the FSAR for particular groups of structures or components, reference material includes all calculations called for by that code of record for those structures and components (SCs).

TLAAs that need to be addressed are not necessarily those analyses that have been previously reviewed or approved by the NRC. The following examples illustrate TLAAs that need to be addressed that were not previously reviewed and approved by the NRC:

- The FSAR states that the design complies with a certain national code and standard. A review of the code and standard reveals that it calls for an analysis or calculation. Some of these calculations or analysis will be TLAAs. The actual calculation was performed by the applicant to meet the code and standard. The specific calculation was not referenced in the FSAR. The NRC had not reviewed the calculation. In response to a generic letter (GL), a licensee submitted a letter to the NRC committing to perform a TLAA that would address the concern in the GL. The NRC had not documented a review of the applicant's response and had not reviewed the actual analysis.

The following examples illustrate analyses that are *not* TLAAs and need not be addressed under 10 CFR 54.21(c):

- Population projections (Section 2.1.3 of NUREG–0800) (Ref. 2).
- Cost-benefit analyses for plant modifications.
- Analysis with time-limited assumptions defined short of the current operating term of the plant, for example, an analysis for a component based on a service life that would not reach the end of the current operating term.

The number and type of TLAAs vary depending on the plant-specific CLB. All six criteria set forth in 10 CFR 54.3 (and repeated in Subsection 4.1.2) must be satisfied to conclude that a calculation or analysis is a TLAA. Table 4.1-1 provides examples of how these six criteria may be applied (Ref. 1). Table 4.1-2 provides a list of generic TLAAs that are included in the SRP-SLR. Table 4.7-1 in SRP-SLR Section 4.7 provides examples of potential plant-specific TLAAs that have been identified by license renewal applicants (LRA). It is not expected that all applicants would identify all the analyses in these tables as TLAAs for their plants. Also, an applicant may perform specific TLAAs for its plant that are not shown in these tables.

Criterion 3 for TLAAs in 10 CFR 54.3(a) establishes that, as one of the six criteria that are used to define a given analysis as a TLAA, the analysis has to involve time-limited assumptions defined by the current operating term (e.g., 40 years). Therefore, for proposed SLR applications, there may be instances where an existing, time-dependent analysis did not conform to Criterion 3 for TLAAs in 10 CFR 54.3(a) for the current period of extended operation, but would conform to this criterion for the subsequent period of extended operation that is requested for NRC approval. Therefore, the reviewer should perform a review of the CLB to determine whether there are any existing analyses for the CLB that will need to be identified as analyses that conform to Criterion 3 for TLAAs for the proposed subsequent period of extended operation even though the analyses did not conform to Criterion 3 for TLAAs for the previous period of extended operation that was approved in the renewed operating license for that period. For those cases where the addition of a proposed subsequent period of extended operation would cause a given analysis to conform to Criterion 3 for TLAAs in 10 CFR 54.3(a), the reviewer should assess whether the analysis also conforms to the remaining five criteria for identifying TLAAs in 10 CFR 54.3(a), and determine whether the analysis needs to be identified as a TLAA for the subsequent period of extended operation in accordance with the requirement in 10 CFR 54.21(c)(1).

As appropriate, NRC staff from other branches of the Office of Nuclear Reactor Regulation (NRR) review the application in their assigned areas without examining the identification of TLAAs. However, they may come across situations in which they may question why the applicant did not identify certain analyses as TLAAs. The reviewer coordinates the resolution of any such questions with these other NRC staff to determine whether these analyses should be evaluated as TLAAs.

In order to determine whether there is reasonable assurance that the applicant has identified the TLAAs for its plant, the reviewer should find that the analyses omitted from the applicant's list are not TLAAs. Should an applicant identify a TLAA that is also a basis for a plant-specific exemption that was granted pursuant to 10 CFR 50.12 and the exemption is in effect for the current operating period, the reviewer verifies that the applicant also has identified that exemption pursuant to 10 CFR 54.21(c)(2). Examples of an exemptions that may have been granted in accordance with 10 CFR 50.12 and based on a TLAA are those NRC-granted exemptions that approved American Society of Mechanical Engineers (ASME) Code N-514 as an alternative basis for complying with the pressure lift and system enable temperature setpoint requirements for PWR low temperature overpressure protection systems in 10 CFR Part 50, Appendix G and the ASME Code Section XI, Appendix G.

4.1.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section, and whether the NRC staff's evaluation supports conclusions of the following type, to be included in the SER:

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided an acceptable list of TLAAs as defined in 10 CFR 54.3, and that no 10 CFR 50.12 exemptions have been granted on the basis of a TLAA, as defined in 10 CFR 54.3.

4.1.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method, the method described herein are used by the NRC staff to evaluate conformance with NRC regulations.

4.1.6 References

1. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54–The License Renewal Rule." Revision 6. Washington, DC: Nuclear Energy Institute. 1995.

2. NRC. NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. March 2007.

3. NRC. "Nuclear Power Plant License Renewal; Revisions." *Federal Register:* Vol. 60. No. 88, pp. 22,461–22,495. May 8, 1995

Table 4.1-1. Sample Process for Identifying Potential Time-Limited Aging Analyses (TLAA) and Basis for Disposition

Example of an analysis that meets all six of the criteria in 10 CFR 54.3(a) for defining an analysis as a TLAA: The current licensing basis (CLB) includes a time-dependent fatigue flaw growth analysis for the reactor coolant pump (RCP) flywheels. An age-related fatigue failure of flywheels could potentially be a source of missiles that have the potential to impact the structural integrity and pressure retaining function of the reactor coolant pressure boundary. The applicant has identified that the RCP flywheels are components that meet the scoping definition in Title 10 of the *Code of Federal Regulations* (10 CFR) 54.4(a)(1), in that the flywheels assure adequate heat removal during a plant trip and loss of power to the RCPs, as well as initiation of natural circulation flow as part of necessary safe shutdown activities.

The applicant has not included the RCP flywheels are components that need to be within the scope of an aging management review (AMR), as would otherwise be required in accordance with 10 CFR 54.21(a)(1). The analysis is referenced in the updated final safety analysis report UFSAR and is based on design basis transients that are assumed and evaluated in the UFSAR based on a 40-year design life. The analysis is relied upon to establish a 10-year augmented inservice inspection interval for performing inspections of RCP flywheels and to demonstrate that fatigue-induced growth of a flaw in the flywheels would not result in a flywheel missile that could threaten the structure integrity of the reactor coolant pressure boundary during the life of the plant.

Criterion in 10 CFR 54.3(a)	*Disposition Basis for Comparing to the Criterion in 10 CFR 54.3(a)*
Criterion 1: *The analysis must involve systems, structures, and components within the scope of license renewal, as delineated in 10 CFR 54.4(a).*	Although the RCP flywheels are active components and do not need to be subjected to an AMR (as defined in 10 CFR 54.21(a)(1)), the components are within the scope of license renewal application because their failure could impact the intended pressure retaining function of a component that is located in the reactor coolant pressure boundary (RCPB). Therefore, the fatigue flaw growth analysis does conform to Criterion 1 in 10 CFR 54.3(a) because the flywheels do need to be within the scope of license renewal as a component whose failure could impact the intended function of a component that has been scoped in for renewal in accordance with 10 CFR 54.4(a)(1).
Criterion 2: *The analysis must consider the effects of aging.*	The fatigue flaw growth analysis for the RCP flywheels does meet Criterion 2 because the analysis assumes the presence of a postulated crack in the components and assumes that an age-related growth mechanism (fatigue flaw growth) will grow the flaw under the assumed transient loading conditions for the analysis.
Criterion 3: *The analysis must involve time-limited assumptions defined by the current operating term (for example, 40 years).*	The fatigue flaw growth analysis for the RCP flywheels does meet Criterion 3 because the analysis assumes that the loading conditions that induced fatigue flaw growth in the flywheel discs are based on the 40-year cyclic transient assumptions for specific design transients in the UFSAR. The 40-year cyclical nature of this assumption defines this analysis as one that involves time-limited assumptions defined by the current operating term.
Criterion 4: *The analysis must be determined to be relevant by the licensee in making a safety determination.*	The analysis conforms to Criterion 4 because the applicant is relying on the fatigue flaw growth analysis to establish a safety-related decision at the facility, which amounts to the applicant's safety decision to perform augmented inservice inspection of the RCP flywheels on a 10-year inservice inspection interval and relates to the applicant's basis for maintaining the integrity of the reactor coolant pressure boundary during the life of the plant.

Table 4.1-1. Sample Process for Identifying Potential Time-Limited Aging Analyses (TLAA) and Basis for Disposition

Criterion 5: *The analysis must involve conclusions or provide the basis for conclusions related to the capability of the system, structure, or component to perform its intended function(s), as delineated in 10 CFR 54.4(b).*	The analysis conforms to Criterion 5 because the analysis evaluates the structural integrity of the RCP flywheels for fatigue-induced growth to ensure the integrity of the flywheels will be maintained during the licensed period of operation for the facility and that the integrity of the reactor coolant pressure boundary will be protected against the consequences of postulated flywheel missiles during the life of the plant.
Criterion 6: *The analysis is contained or incorporated by reference in the CLB.*	The analysis conforms to Criterion 6 because the analysis is referenced in the UFSAR for the facility.
Example of analyses that do not meet the six of the criteria for TLAAs in 10 CFR 54.3(a):	
Example of an analysis that does not meet Criterion 1 in 10 CFR 54.3(a): *The analysis must involve systems, structures, and components within the scope of license renewal, as delineated in 10 CFR 54.4(a).*	The CLB includes a time-dependent corrosion analysis for both a refueling water storage tank (RWST) and a standby RWST that is included in the plant design. The applicant can align the standby RWST to the safety injection system and containment spray system for the facility during a postulated loss of coolant accident and the applicant has performed a 40-year time-dependent corrosion analysis of both the RWST and standby RWST. The RWST is credited as a safety-related component that is credited for accident mitigation objectives in the plant's accident analyses that are defined and evaluated in the UFSAR. In contrast, the standby RWST is not credited for accident mitigation in the accident analyses defined in the UFSAR. A postulated failure of the standby RWST does not have the ability to impact the intended function [as defined in 10 CFR 54.4(b)] of any safety-related component or structure that is required to be scoped in for renewal in accordance with 10 CFR 54.4(a)(1); nor is the standby RWST within the scope of any special regulations, as defined in 10 CFR 54.4(a)(3). The applicant has not identified the standby RWST as a tank that is within the scope of license renewal. Although the corrosion analysis for the standby RWST is part of the plant design, the analysis does not apply to a plant component that is within the scope of the SLRA because the component is not required to be within the scope of the license renewal application in accordance with 10 CFR 54.4 (a)(1), (a)(2), or (a)(3). Therefore, under this example, the corrosion analysis for the standby RWST does meet Criterion 1 in 10 CFR 54.3(a) and does not meet the definition of a TLAA in the 10 CFR Part 54 rule.
Example of an analysis that does not meet Criterion 2 in 10 CFR 54.3(a): *The analysis must consider the effects of aging.*	The CLB and design basis includes a stress analysis for a reactor coolant loop elbow that is compared to American Society of Mechanical Engineers (ASME) Code Section III allowable stress values. The stress analysis is performed in accordance with ASME Section III requirements, as invoked by 10 CFR 50.55a requirements. Although the stress analysis is required by the U.S. Nuclear Regulatory Commission (NRC) regulations and ASME Code requirements and is part of the CLB, it does not involve any analysis of an applicable or postulated aging effect. Therefore, under this example, the analysis does not conform to Criterion 2 in 10 CFR 54.3(a) and does not meet the definition of a TLAA in the 10 CFR Part 54 rule.

Table 4.1-1. Sample Process for Identifying Potential Time-Limited Aging Analyses (TLAA) and Basis for Disposition

Example of an analysis that does not meet Criterion 3 in 10 CFR 54.3(a): *The analysis must involve time-limited assumptions defined by the current operating term (for example, 40 years).*	The applicant has detected a flaw in one of its reactor vessel nozzle-to-safe end welds and has performed an ASME Code Section XI inservice inspection flaw growth analysis of the flaw in the components to justify further service of the impacted weld until the next outage in which the flaw would be inspected for acceptability, without the need of repair or replacement. The ASME-based flaw evaluation is part of the CLB and assumes the Class 1 design basis transients occur over a 20-year period from the time the flaw was detected. The analysis does not involve time-dependent assumptions defined by the current operating period because the assessment of design basis transient cycles was made on a time period less than that used for the current operating term. Therefore, under this example, the fatigue flaw analysis would not conform to Criterion 3 in 10 CFR 54.3(a) and would not meet the definition of a TLAA in the 10 CFR Part 54 rule.
Example of an analysis that does not meet Criterion 4 in 10 CFR 54.3(a): *The analysis must be determined to be relevant by the licensee in making a safety determination.*	The original licensing basis for a pressurized water reactor (PWR) included a high-energy line break (HELB) analysis for a piping location in the main reactor coolant loop that was based on ASME Section III cumulative usage factor (CUF) analysis requirements for high energy line break locations and demonstrated the need for inclusion of a pipe whip restraint in the design of the piping location. Subsequent to the performance of this analysis, the applicant submitted a leak-before-break (LBB) analysis for the main coolant loop piping that demonstrated conformance with the revised dynamic effect requirements in NRC General Design Criterion 4. The results of the LBB analysis demonstrated that the licensee would be capable of detecting a leak in the affected piping prior to a catastrophic failure of the component and that the pipe whip restraints could be removed from the design of the component. The LBB analysis was approved as part of an update of the CLB for the facility such that the HELB analysis is no longer relied upon as part of the CLB for this piping location. The original HELB analysis for this piping location is no longer relied upon for the CLB because it was replaced by the NRC-approved LBB analysis for the main coolant loops, which included these piping locations. Therefore, the original HELB analysis for this piping location is not relevant in making a safety determination relative to the inclusion of a pipe whip restraint on the piping component. Under this example, the HELB analysis for this specific piping location does not conform to Criterion 4 in 10 CFR 54.3(a) and does not meet the definition of a TLAA in the 10 CFR Part 54 rule. HELB analyses for piping locations not excluded by LBB would still be relied upon for the CLB and would need to be identified as TLAAs for the LRA.
Example of an analysis that does not meet Criterion 5 in 10 CFR 54.3(a): *The analysis must involve conclusions or provide the basis for conclusions related to the capability of the system, structure, or component to perform its intended function(s), as*	The original licensing basis for a BWR included an evaluation of the number of paint coats that would be applied to the inside surfaces of its condensate storage tanks (CSTs). The CSTs have been included in the scope of the license renewal application in accordance with 10 CFR 54.4(a)(1) requirements and are within the scope of an applicable AMR, as performed in accordance with 10 CFR 54.21(a)(1) requirements. Although the coating analysis for the inside surfaces of the CST is discussed in the UFSAR, the UFSAR states that the analysis is not relied upon for the structural integrity of the CST or for drawing a conclusion that the CST will fulfill its accident mitigation and safe shutdown functions. Although the coating analysis is part of the design basis, it is not used to draw a conclusion or provide the basis for concluding that the structural integrity of the CST walls will be maintained during the design life of the plant or the ability of the CST coolant inventory to meet the accident mitigation or safe shutdown objectives for the plant design.

Table 4.1-1. Sample Process for Identifying Potential Time-Limited Aging Analyses (TLAA) and Basis for Disposition

delineated in 10 CFR 54.4(b).	Therefore, the coating analysis for the CST does not involve conclusions or provide the basis for conclusions related to the capability of the CST to perform its intended functions, as defined in 10 CFR 54.4(b). Under this example, the coating analysis for the CST does not conform to Criterion 5 in 10 CFR 54.3(a) and does not meet the definition of a TLAA in the 10 CFR Part 54 rule.
Example of an analysis that does not meet Criterion 6 in 10 CFR 54.3(a): *The analysis is contained or incorporated by reference in the CLB.*	The CLB for a PWR includes a plant-specific, probabilistic main turbine missile analysis that is used as basis for meeting 10 CFR Part 50, Appendix A, dynamic effect analysis design requirements, as given in General Design Criterion 4, "*Dynamic Effects*." This analysis is described and evaluated in the UFSAR, and states that the analysis was performed to demonstrate the main turbines will not generate a missile that could threaten the integrity of safety-related structures and components in the facility. The UFSAR indicates that the probabilistic turbine missile analysis was performed in lieu of a generic time-dependent turbine missile analysis that is provided in a specific vendor report and that meets all six of the criteria for defining TLAAs in 10 CFR 54.3(a). In this case, although the generic time dependent turbine missile analysis in the vendor report could have been relied upon for the CLB, the applicant does not rely on the analysis in this report as its basis for meeting General Design Criterion 4 requirements in 10 CFR Part 50, Appendix A. Therefore, the generic analysis in the vendor report is not contained or incorporated by reference in the CLB. Under this example, the generic turbine missile analysis in the vendor report does not conform to Criterion 6 in 10 CFR 54.3(a) and does not meet the definition of a TLAA in the 10 CFR Part 54 rule.

Table 4.1-2. Generic Time-Limited Aging Analyses	
Reactor Vessel Neutron Embrittlement (Subsection 4.2)	Neutron Fluence
	Pressurized Thermal Shock (PWRs Only)
	Upper Shelf Energy (PWRs and BWRs)
	Pressure Temperature (P-T) Limits (PWRs and BWRs)
	Low Temperature Overpressure Protection System Setpoints (PWRs Only)
	Ductility Reduction Evaluation for Reactor Internals (B&W designed PWRs only)
	RPV Circumferential Weld Relief–Probability of Failure and Mean Adjusted Reference Temperature Analysis for the RPV Circumferential Welds (BWRs only)
	Reactor Vessel Axial Weld Probability of Failure and Mean Adjusted Reference Temperature Analysis (BWRs only)
Metal Fatigue (Subsection 4.3)	Metal Fatigue of Class 1 Components
	Metal Fatigue of Non-Class 1 Components
	Environmentally-Assisted Fatigue
	High Energy Line Break Analyses
	Cycle-dependent Fracture Mechanics or Flaw Evaluations
	Cycle-dependent Fatigue Waivers
Environmental Qualification of Electrical Equipment (Subsection 4.4)	
Concrete Containment Tendon Prestress (Subsection 4.5)	
Containment Liner Plate, Metal Containments, and Penetrations Fatigue (Subsection 4.6)	

4.2 Reactor Pressure Vessel Neutron Embrittlement Analysis

Review Responsibilities

Primary—Branch responsible for the time-limited aging analysis (TLAA) issues

Secondary—Branch responsible for reactor systems

4.2.1 Areas of Review

During plant service, neutron irradiation reduces the fracture toughness of ferritic steel in the reactor pressure vessel (RPV) beltline region of light-water nuclear power reactors, where RPV beltline region is described in Regulatory Issue Summary (RIS) 2014-11. Areas of review to ensure that the RPV has adequate fracture toughness to prevent brittle failure during normal and off-normal operating conditions are (a) upper-shelf energy, (b) pressurized thermal shock (PTS) for pressurized water reactor (PWRs), (c) heat-up and cool-down (pressure-temperature limits) curves, (d) BWRVIP-05 analysis for elimination of circumferential weld inspection and analysis of the axial welds, and (e) other plant-specific TLAAs on RPV neutron embrittlement. The adequacy of the analyses for these five areas is reviewed for the subsequent period of extended operation.

The branch responsible for reactor systems reviews neutron fluence and dosimetry information in the application.

4.2.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Subsection 4.2.1 of this review plan section delineate acceptable methods for meeting the requirements of the U.S. Nuclear Regulatory Commission (NRC) regulation in Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(c)(1) (Refs. 2, 3).[1]

4.2.2.1 Time-Limited Aging Analysis

Pursuant to 10 CFR 54.21(c)(1)(i)–(iii), an applicant must demonstrate one of the following:

(i) The analyses remain valid for the period of extended operation;

(ii) The analyses have been projected to the end of the period of extended operation; or

(iii) The effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

For the first three areas of review for the analysis of RPV neutron embrittlement, the specific acceptance criteria depend on the applicant’s choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii).

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[1] For subsequent license renewal applications, the period of extended operation concerns the period of operation after the expiration of the renewed license (i.e., operation from 60 to 80 years).

4.2.2.1.1 Neutron Fluence

Neutron fluence is the number of neutrons accumulated per unit area during a certain period of neutron irradiation. A RPV neutron fluence analysis involves time-limited assumptions (e.g., 40 years of original design life) and is used to determine the loss of fracture toughness due to neutron irradiation embrittlement of the RPV. Appendix H to 10 CFR Part 50 (Ref. 4) requires that an applicant must implement a RPV Surveillance program for a RPV if the peak neutron fluence at the end of the design life of the RPV exceeds a neutron fluence of 10^{17} n/cm^2 [E > 1 MeV]. The RPV neutron fluence analysis is also integral to other neutron embrittlement TLAAs [e.g., upper shelf energy and pressure-temperature (P-T) limits analyses] because neutron fluence is a fundamental parameter which is used to determine the level of neutron irradiation embrittlement of a RPV. As discussed above, the RPV neutron fluence analysis is important in making a safety determination for a RPV in terms of loss of fracture toughness due to neutron irradiation embrittlement.

Typically, the RPV neutron fluence analysis is described in the applicant's Final Safety Analysis Report (FSAR) or other design documents approved by NRC. In its subsequent license renewal application (SLRA), the applicant identifies (a) the neutron fluence for each beltline material at the end of extended license term, (b) the NRC staff-approved methodology used to calculate the neutron fluence or submits the methodology for NRC staff review, (c) whether the methodology is consistent with the guidance in NRC Regulatory Guide (RG) 1.190 (Ref. 5), and (d) how the neutron fluence is monitored during the subsequent period of extended operation. An applicant may take any one of the following three dispositions for the RPV neutron fluence analysis.

4.2.2.1.1.1 10 CFR 54.21(c)(1)(i)

A neutron fluence analysis typically accounts for planned operation by including assumptions regarding the neutron flux emitted from the core. The flux is integrated over time to yield the estimated fluence. Frequently, neutron fluence calculations will include projected fluence values for multiple periods of exposure, (e.g., 40, 60, and 80 calendar years). In order to use a disposition for fluence pursuant to 10 CFR 54.21(c)(1)(i), the applicant will demonstrate the existing RPV neutron fluence analysis, including the projected flux for planned operation, in the current licensing basis (CLB) remains valid during the subsequent period of extended operation. The fluence calculation will be re-evaluated to confirm its validity.

4.2.2.1.1.2 10 CFR 54.21(c)(1)(ii)

For a disposition in accordance with 10 CFR 54.21(c)(1)(ii), the applicant will provide new or updated calculations that address the fluence effects during the subsequent period of extended operation. The new or updated RPV neutron fluence analysis is evaluated to consider the subsequent period of extended operation in accordance with (1) NRC RG 1.190, or (2) a methodology that has been approved for use by the NRC.

4.2.2.1.1.3 10 CFR 54.21(c)(1)(iii)

In the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report AMP X.M2, "Neutron Fluence Monitoring," the NRC staff has evaluated an aging management program (AMP) for projecting and monitoring neutron fluence for the subsequent period of extended operation. The staff has determined that this program is acceptable to project and monitor neutron fluence for managing loss of fracture toughness due to neutron irradiation embrittlement of RPVs in accordance with 10 CFR 54.21(c)(1)(iii).

4.2.2.1.2 Upper-Shelf Energy

10 CFR Part 50 Appendix G (Ref. 6) paragraph IV.A.1 requires that the RPV beltline materials have a Charpy upper-shelf energy (USE) of no less than 68 J [50 ft-lb] throughout the life of the RPV, unless otherwise approved by the NRC. An applicant may take any one of the following three approaches.

4.2.2.1.2.1 10 CFR 54.21(c)(1)(i)

The RPV components evaluated in the existing USE analysis or NRC-approved equivalent margins analysis (EMA) are reevaluated to demonstrate that the existing analysis remains valid during the subsequent period of extended operation because the neutron fluence projected to the end of the subsequent period of extended operation is bounded by the neutron fluence in the existing NRC-approved USE or EMA analysis.

4.2.2.1.2.2 10 CFR 54.21(c)(1)(ii)

The RPV components evaluated in the existing USE analysis or NRC-approved EMA are reevaluated to consider the subsequent period of extended operation in accordance with 10 CFR Part 50, Appendix G.

10 CFR Part 50, Appendix G, Section IV.A.1 (the rule) requires applicants to take further corrective actions where the 50 ft-lbs [68 joules] end-of-life (EOL) USE criterion cannot be met. When this occurs, the rule requires a licensee to submit a supplemental analysis for NRC approval. The applicant will need to submit a plant-specific engineering analysis (usually an EMA) for NRC approval as supplemental information for subsequent license renewal (SLR). Otherwise, failure to meet the USE requirements of 10 CFR Part 50, Appendix G for the RPV materials as evaluated using the neutron fluence that are projected for the subsequent period of extended operation mandates imposition of additional commitments or license conditions on USE for the SLRA.

4.2.2.1.2.3 10 CFR 54.21(c)(1)(iii)

Acceptance criteria for accepting USE TLAAs in accordance with 10 CFR 54.21(c)(1)(iii) have yet to be developed. They will be evaluated on a case-by-case basis to ensure that the aging effects will be managed such that the intended function(s) will be maintained during the subsequent period of extended operation.

4.2.2.1.3 Pressurized Thermal Shock (for PWRs)

For PWRs, 10 CFR 50.61 (Ref. 7) requires that the reference temperature for RPV beltline materials evaluated at the neutron fluence corresponding to the end of the subsequent period of extended operation, reference temperature pressurized thermal shock (RT_{PTS}), be less than the PTS screening criteria at the expiration date of the operating license, unless otherwise approved by the NRC. The PTS screening criteria are 132 °C [270 °F] for plates, forgings, and axial weld materials, and 149 °C [300 °F] for circumferential weld materials. Alternatively, the licensee may comply with the requirements of 10 CFR 50.61a (Ref. 8). The regulations require updating of the PTS assessment upon a request for a change in the expiration date of a facility's operating license, or whenever there is a significant change in projected values of RT_{PTS}. Therefore, the RT_{PTS} value must be calculated for the entire licensed operating period of the facility, including the subsequent period of extended operation. If the analyses result in RT_{PTS}

values that exceed the PTS screening criteria at the end of the subsequent period of extended operation, the applicant is required to implement additional corrective actions as described in 10 CFR Part 50.61 or 10 CFR 50.61a. The PTS TLAA may be handled as follows.

4.2.2.1.3.1 10 CFR 54.21(c)(1)(i)

The existing PTS analysis based on 10 CFR 50.61 remains valid during the subsequent period of extended operation because the neutron fluence projected to the end of the subsequent period of extended operation is bound by the neutron fluence assumed in the existing analysis. If the existing PTS analysis is based on 10 CFR 50.61a, the applicant demonstrates that the current analysis remains applicable for the subsequent period of extended operation.

4.2.2.1.3.2 10 CFR 54.21(c)(1)(ii)

The PTS analysis is reevaluated to consider the subsequent period of extended operation in accordance with 10 CFR 50.61 or 10 CFR 50.61a. If the analyses result in RT_{PTS} values that exceed the PTS screening criteria at the end of the subsequent period of extended operation, the applicant is required to implement additional corrective actions as described in 10 CFR Part 50.61 or 10 CFR 50.61a. If the existing PTS analysis is based on 10 CFR 50.61a, the applicant updates the submittal to reflect the subsequent period of extended operation.

4.2.2.1.3.3 10 CFR 54.21(c)(1)(iii)

The NRC staff position for license renewal (LR) on this option is described in a May 27, 2004 letter from L.A. Reyes (EDO) to the Commission (Ref. 9), which states that if the applicant does not extend the TLAA, the applicant provides an assessment of the CLB TLAA for PTS, a discussion of the flux reduction program implemented in accordance with 10 CFR 50.61(b)(3), if necessary, and an identification of the viable options that exist for managing the aging effect in the future.

4.2.2.1.4 Pressure-Temperature Limits

10 CFR Part 50, Appendix G (Ref. 4) requires that the RPV be maintained within established P-T limits during normal operating conditions of the plant (including heatups and cooldowns of the reactor and anticipated operational transients), and during pressure tests and system leak tests. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the RPV becomes embrittled and its fracture toughness is reduced, the allowable pressure (given the required minimum temperature) is reduced. Regulatory Issue Summary (RIS) 2014-11 clarifies issues that must be addressed in developing P-T limits (Ref. 1).

P-T limits are TLAAs for the application if the plant currently has P-T limit curves approved for the expiration of the current period of operation [i.e., 54 effective full power year (EFPY) or some other licensed EFPY value defined for the expiration date of the current license]. However, the P-T limits for the subsequent period of extended operation need not be submitted as part of the SLRA since the P-T limits need to be updated through the 10 CFR 50.90 licensing process when necessary for P-T limits that are located in the limiting conditions of operations (LCOs) of the Technical Specifications (TS). For those plants that have approved pressure-temperature limit reports (PTLRs), the P-T limits for the subsequent period of extended operation will be updated at the appropriate time through the plant's Administrative Section of the TS and the plant's PTLR process. In either case, the 10 CFR 50.90 or the PTLR processes, which constitute the CLB, will ensure that the P-T limits for the subsequent period of extended operation will be updated prior to expiration of the P-T limit curves for the current period of operation.

P-T limits may be handled as follows.

4.2.2.1.4.1 10 CFR 54.21(c)(1)(i)

The applicant demonstrates (on a case-by-case basis) that existing P-T limits in the CLB will remain valid during the subsequent period of extended operation.

4.2.2.1.4.2 10 CFR 54.21(c)(1)(ii)

The P-T limits are updated for the subsequent period of extended operation in accordance with 10 CFR Part 50, Appendix G (Ref. 4) and the applicant's appropriate TS change process for updating the P-T limit curves.

For P-T limit curves that are included in and controlled by requirements in the limiting conditions of operations of the plant TS, the applicant submits the changes to the P-T limits as a license amendment request (i.e., a TS change request) for the LRA that is submitted in accordance with the requirements 10 CFR 54.22 and uses the license amendment submittal as the basis for accepting the TLAA in accordance with 10 CFR 54.21(c)(1)(ii).

For P-T limits that are controlled by Administrative Controls TS requirements and located in an NRC-approved PTLR, the applicant updates the P-T limits in accordance with the methodology or methodologies approved in the applicable Administrative Controls TS section for its PTLR process and submits the updated PTLR(s) containing the updated P-T limits to the NRC (as information) in accordance the reporting requirements in the applicable Administrative Controls TS section. The applicant uses the submittal of the updated PTLR as the basis for accepting the TLAA in accordance with 10 CFR 54.21(c)(1)(ii).

4.2.2.1.4.3 10 CFR 54.21(c)(1)(iii)

Updated P-T limits for the subsequent period of extended operation must be established and completed using the applicable TS change process for updating the P-T limit curves prior to the plant's entry into the subsequent period of extended operation. The 10 CFR 50.90 (Ref. 10) process for P-T limits located in the LCOs or the Administrative Controls Process for P-T limits that are administratively amended through a PTLR process can be considered adequate AMPs or aging management activities within the scope of 10 CFR 54.21(c)(1)(iii), such that P-T limits will be maintained through the subsequent period of extended operation.

4.2.2.1.5 Elimination of Boiling Water Reactor Circumferential Weld Inspections

Some boiling water reactors (BWRs) have an approved technical alternative, which eliminates the RPV circumferential shell weld inspections from the Section XI program for the current license term. Approved technical alternatives for SLR have yet to be developed. They will be evaluated on a case-by-case basis to ensure that the aging effects will be managed in accordance with 10 CFR 54.21(c)(1) such that the intended function(s) will be maintained during the subsequent period of extended operation.

4.2.2.1.6 BWR Axial Welds

Those BWRs that have been approved to use the circumferential weld technical alternative also had to justify acceptable conditional probability of failure for their RPV axial shell weld examination coverage from the Section XI program for the current license term. Approved technical alternatives for SLR have yet to be developed. They will be evaluated on a case-by-case basis to ensure that the aging effects will be managed in accordance with 10 CFR 54.21(c)(1) such that the intended function(s) will be maintained during the subsequent period of extended operation.

4.2.2.2 Final Safety Analysis Report Supplement

The specific criterion for meeting 10 CFR 54.21(d) is that the summary description of the evaluation of TLAAs for the subsequent period of operation in the FSAR supplement is appropriate, such that later changes can be controlled by 10 CFR 50.59 (Ref. 11). The description contains information associated with the TLAAs regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.2.3 Review Procedures

For each area of review described in Subsection 4.2.1, the following review procedures should be followed.

4.2.3.1 Time-Limited Aging Analysis

For the first four areas of review for the analysis of RPV neutron embrittlement, the review procedures depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii). For each area, the applicant's three options under section 54.21(c)(1) are discussed in turn.

The applicant may identify activities to be performed to verify the assumption basis of the neutron fluence calculations that are used to evaluate the RPV neutron embrittlement analyses. An evaluation of that verification activity is provided by the applicant in the SLRA. The reviewer assures that the applicant's verification activity is sufficient to confirm the calculation assumptions for the 80-year period. If the assumption basis is not verified, the applicant must reevaluate the analysis and take appropriate corrective actions as necessary, consistent with the requirements of the affected regulation.

4.2.3.1.1 Neutron Fluence

4.2.3.1.1.1 10 CFR 54.21(c)(1)(i)

The reviewer confirms that the applicant's existing RPV neutron fluence analysis remains valid during the subsequent period of extended operation. The reviewer also confirms that the applicant identifies (a) the neutron fluence for each beltline material at the end of the subsequent period of extended operation, (b) the NRC staff-approved methodology used to determine the neutron fluence or submits the methodology for NRC staff review, and (c) whether the methodology is consistent with the guidance in NRC RG 1.190.(Ref. 5).

4.2.3.1.1.2 10 CFR 54.21(c)(1)(ii)

The reviewer confirms that the applicant adequately reevaluated its RPV neutron fluence analysis for the subsequent period of extended operation. As part of its review, the review confirms that the applicant identifies (a) the neutron fluence for each beltline material at the end of the subsequent period of extended operation, (b) the NRC staff-approved methodology used to determine the neutron fluence or submits the methodology for NRC staff review, and (c) whether the methodology is consistent with the guidance in NRC RG 1.190.

4.2.3.1.1.3 10 CFR 54.21(c)(1)(iii)

GALL-SLR Report AMP X.M2, “Neutron Fluence Monitoring” of the GALL-SLR Report provides an acceptable method to project and monitor RPV neutron fluence through the subsequent period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii). The NRC staff reviews an applicant’s program for dispositioning the TLAA in accordance with the requirements in 10 CFR 54.21(c)(1)(iii) and the guidance in GALL-SLR Report AMP X.M2. Plant-specific approaches to projecting and monitoring neutron fluence will be evaluated on a case-by-case basis to ensure that the aging effects due to neutron irradiation embrittlement will be managed such that the intended functions(s) will be adequately maintained for the subsequent period of extended operation.

4.2.3.1.2 Upper-Shelf Energy

4.2.3.1.2.1 10 CFR 54.21(c)(1)(i)

The projected ¼T neutron fluence at the end of the subsequent period of extended operation is reviewed for all beltline materials to verify that it is bounded by the neutron fluence assumed in the existing NRC-approved USE or EMA analysis in the CLB.

4.2.3.1.2.2 10 CFR 54.21(c)(1)(ii)

The documented results of the revised USE analysis (or revised EMA analysis, as applicable) based on the projected neutron fluence at the end of the subsequent period of extended operation are reviewed for compliance with 10 CFR Part 50, Appendix G. The applicant may use NRC RG 1.99 Rev. 2 (Ref. 12) as the basis for using the ¼ T neutron fluence values for the reactor vessel beltline components (as projected to the end of the SLR period) to project the USE values for the reactor vessel beltline components at the end of the subsequent period of extended operation. The applicant also may use ASME Code Section XI Appendix K (Ref. 13) for the purpose of performing an equivalent margins analysis to demonstrate that adequate protection for ductile failure is maintained to the end of the subsequent period of extended operation. The NRC staff reviews the applicant’s methodology for this evaluation. Branch Technical Position (BTP) MTEB 5-3, “Fracture Toughness Requirements,” in Standard Review Plan (Ref. 14), Section 5.3.2, “Pressure Temperature Limits, Upper-Shelf Energy, and Pressurized Thermal Shock,” provides additional NRC positions on estimations of USE values for RPV beltline materials.

The NRC staff confirms that the applicant has provided sufficient information for all USE and/or equivalent margins analysis calculations for the subsequent period of extended operation as follows:

> The applicant identifies the neutron fluence at the ¼T location for each beltline material at the expiration of the subsequent period of extended operation.

To confirm that the USE analysis meets the requirements of Appendix G of 10 CFR Part 50 (Ref. 6) at the end of the subsequent period of extended operation, the NRC staff determines whether:

1. For each beltline material, the applicant provides the unirradiated USE and the projected USE at the end of the subsequent period of extended operation, and whether the drop in USE was determined using the limit lines in Figure 2 of NRC RG 1.99, Rev 2, based on the material copper content, or from surveillance data.

2. If an equivalent margins analysis is used to demonstrate compliance with the USE requirements in Appendix G of 10 CFR Part 50, the applicant provides the analysis or identifies an NRC-approved topical report that contains the analysis which is applicable to the subsequent period of extended operation. Information the NRC staff considers to assess the equivalent margins analysis includes the unirradiated USE (if available) for the material, its copper content, the neutron fluence (¼T and at 1-inch depth), the projected SLR USE, the operating temperature in the downcomer at full power, the vessel radius, the vessel wall thickness, the J-applied analysis for Service Level C and D, the vessel accumulation pressure, and the vessel bounding heatup/cooldown rate during normal operation.

4.2.3.1.2.3 10 CFR 54.21(c)(1)(iii)

The applicant's proposal to demonstrate that the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation is reviewed on a case-by-case basis.

4.2.3.1.3 Pressurized Thermal Shock (for PWRs)

4.2.3.1.3.1 10 CFR 54.21(c)(1)(i)

The projected clad-to-base metal interface neutron fluence at the end of the subsequent period of extended operation is reviewed to verify that it is bounded by the neutron fluence assumed in the existing PTS analysis.

For PTS analysis based on a NRC-approved submittal based on 10 CFR 50.61a, the applicant demonstrates that the analysis bounds the subsequent period of extended operation.

4.2.3.1.3.2 10 CFR 54.21(c)(1)(ii)

The documented results of the revised PTS analysis based on the projected neutron fluence at the end of the subsequent period of extended operation are reviewed for compliance with 10 CFR 50.61or 10 CFR 50.61a.
(Ref. 7, 8)

The NRC staff confirms that the applicant has provided sufficient information for PTS for the subsequent period of extended operation as follows:

> The applicant identified the neutron fluence at the clad-to-base metal interface for each beltline material at the expiration of the subsequent period of extended operation.

There are two methodologies from 10 CFR 50.61 that can be used in the PTS analysis, based on the projected neutron fluence at the end of the subsequent period of extended operation. RT_{NDT} is the reference temperature (NDT means nil-ductility temperature) used as an indexing parameter to determine the fracture toughness and the amount of embrittlement of a material. RT_{PTS} is the reference temperature used in the PTS analysis and is related to RT_{NDT} at the end of the facility’s operating license.

The first methodology does not rely on plant-specific surveillance data to calculate delta RT_{NDT} (i.e., the mean value of the adjustment or shift in reference temperature caused by irradiation). The delta RT_{NDT} is determined by multiplying a chemistry factor from the tables in 10 CFR 50.61 by a neutron fluence factor calculated from the neutron flux using an equation.

The second methodology relies on plant-specific surveillance data to determine the delta RT_{NDT}. In this methodology, two or more sets of surveillance data are needed. A surveillance datum consists of a measured delta RT_{NDT} for corresponding neutron fluence. 10 CFR 50.61 specifies a procedure and a criterion for determining whether the surveillance data are credible. For the surveillance data to be defined as credible, the difference in the predicted value and the measured value for delta RT_{NDT} must be less than −2.2 °C [28 °F] for weld metal. When a credible surveillance data set exists, the chemistry factor can be determined from these data in lieu of a value from the table in 10 CFR 50.61. Then the standard deviation of the increase in the RT_{NDT} can be reduced from −2.2 °C [28°F] to −10 °C [14°F] for welds.

To confirm that the PTS analysis results in RT_{PTS} values below the screening criteria in 10 CFR 50.61 at the end of the subsequent period of extended operation, the applicant provides the following:

1. For each beltline material, provide the unirradiated RT_{NDT}, the method of calculating the unirradiated RT_{NDT} (either generic or plant-specific), the margin, chemistry factor, the method of calculating the chemistry factor, the mean value for the shift in transition temperature, and the RT_{PTS} value.

2. If there are two or more data for a surveillance material that is from the same heat of material as the beltline material, provide analyses to determine whether the data are credible in accordance with NRC RG 1.99, Rev 2 (Ref. 12) and whether the margin value used in the analysis is appropriate.

3. If a surveillance program does not include the vessel beltline controlling material but two or more data seta are available from other beltline materials, then provide an analysis of the data in accordance with NRC RG 1.99, Rev 2, Regulatory Position C.2.1, to show that the results either bound or are comparable to the values that would be calculated for the same materials using Regulatory Position C.1.1.

If the PTS screening criteria in 10 CFR 50.61 are projected to be exceeded during the subsequent period of extended operation, an analysis based on NRC RG 1.154 (Ref. 15) or

10 CFR 50.61a may be submitted for review. For applicants with PTS analysis based upon an NRC-approved submittal using 10 CFR 50.61a, the analysis is revised to reflect the subsequent period of extended operation.

4.2.3.1.3.3 10 CFR 54.21(c)(1)(iii)

The NRC staff reviews the applicant's proposal to demonstrate that the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation will be reviewed on a case-by-case basis.

If corrective actions are necessary, the NRC staff ensures that the SLRA provides an assessment of the CLB TLAA for PTS, a discussion of the flux reduction program implemented in accordance with §50.61(b)(3), if necessary, and an identification of the viable options that exist for managing the aging effect in the future. As part of this review, the staff ensures that the applicant addressed the following topics:

A. The applicant explains its core management plans (e.g., operation with a low leakage core design and/or integral burnable neutron absorbers) from now through the end of the subsequent period of extended operation. Based on this core management strategy, the applicant:

(1) Identifies the material in the RPV which has limiting RT_{PTS} value,

(2) Provides the projected neutron fluence value for the limiting material at end of the subsequent period of extended operation,

(3) Provides the projected RT_{PTS} value for the limiting material at end of the subsequent period of extended operation, and

(4) Provides the projected date and neutron fluence values at which the limiting material will exceed the screening criteria in §50.61.

B. The applicant discusses the AMPs or aging management activities that it intends to implement, which actively "manage" the condition of the facility's RPV and hence, the risk associated with PTS. This discussion is expected to address, at least, the facility's reactor pressure vessel material surveillance program.

C. If corrective actions are necessary, the applicant briefly discusses the options that it is considering with respect to "resolving" the PTS issue through end of the subsequent period of extended operation. It is anticipated that this discussion includes some or all of the following:

(1) Plant modifications [e.g., heating of emergency core cooling system (ECCS) injection water] which could limit the risk associated with postulated PTS events [see §50.61(b)(4) and/or (b)(6)],

(2) More detailed safety analyses which may be performed to show that the PTS risk for the facility is acceptably low through end of the subsequent period of extended operation [see §50.61(b)(4)],

(3) More advanced material property evaluation (e.g., use of Master Curve technology) to demonstrate greater fracture resistance for the limiting material [applies to §50.61(b)(4)],

(4) The potential for RPV thermal annealing in accordance with §50.66 [see §50.61(b)(7)], and/or

(5) Use of the alternative PTS Rule (Ref. 8).

4.2.3.1.4 Pressure-Temperature Limits

The regulation in 10 CFR Part 50, Appendix G (Ref. 6) requires that the RPV be maintained within established P-T limits during normal operating conditions of the plant, including heatups and cooldowns of the reactor and anticipated operational transients, and during pressure test and system leak test conditions. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the RPV becomes embrittled and its fracture toughness is reduced, the allowable pressure (given the required minimum temperature) is reduced.

The regulation in 10 CFR 50.36 (Ref. 16) requires that P-T limits be controlled by plant TS; however, the process for performing updates of the P-T limits depends on whether the P-T limit curves for the facility are maintained in the Limiting Conditions of Operation Section of the TS (i.e., in the TS LCOs) or in a PTLR that is controlled and updated in accordance with the Administrative Controls Section of the plant TS (i.e., by an Administrative Controls TS Section). P-T limits are TLAAs for the application if the plant currently has P-T limit curves approved for the expiration of the current period of operation (i.e., 32 EFPY or some other licensed EFPY value defined for the expiration date of the current license). However, as stated in SRP-SLR Section 4.2.2.1.3, the assessment of P-T limit TLAAs for incoming LRAs and basis for accepting the TLAAs under the requirements of 10 CFR 54.21(c)(1)(i), (ii) or (iii) is somewhat dependent on the process that is used for updating the P-T limits.

For P-T limits that are located in the TS LCOs and are controlled by the 10 CFR 50.90 license amendment process, the P-T limits are required to be updated and approved by the NRC prior to expiration of the current P-T limit curves in the TS LCOs, or when a change to the P-T limits is needed for compliance with the requirements in Section IV.C of 10 CFR Part 50, Appendix H (Ref. 4). For those plants that have approved PTLRs, the P-T limits are required to be updated prior to expiration of the current P-T limit curves in the PTLRs, or when a change to the P-T limits is needed for compliance with the requirements in Section IV.C of 10 CFR Part 50, Appendix H, or when required by a specific P-T limits update clause in the Administrative Controls TS Section that governs implementation of the PTLR process.

Specifically, for plants with approved PTLRs, the Administrative Controls TS Section governing the PTLR process requires that the update of the P-T limits be accomplished using prescribed methodologies referenced in the TS requirements. NRC generic letter (GL) 96-03 (Ref. 17) provides the NRC's position on the minimum requirements that need to be included in the Administrative Controls TS Section that governs implementation of the PTLR process and the type of information that need to be included in the NRC-approved methodologies that will be used to update the P-T limits and PTLRs. The GL identifies that 10 CFR 50.90 license amendment requests are not necessary for updates of the P-T limit curves if the required methodologies are used to update the P-T limits in the PTLRs. Since GL 96-03 establishes the NRC's position on what needs be included within the scope of the P-T limit methodologies, applicants with approved PTLRs may want to verify that the P-T limit methodologies referenced in the applicable Administrative Controls TS Section for their PTLR processes are still in conformance with the criteria in GL 96-03 and that a resulting 10 CFR 54.22 (Ref. 18) change of the TS is not needed for their LRAs. If it is determined that a change to the referenced methodologies is needed for the LRA, the applicant should submit the changes to the referenced methodologies as part of a 10 CFR 54.22 implemented license amendment and TS change request for the LRA.

4.2.3.1.4.1 10 CFR 54.21(c)(1)(i)

If the P-T limits are located in the TS LCOs or the PTLRs (whichever is applicable to CLB) and the applicant selects the 10 CFR 54.21(c)(1)(i) option as the basis for accepting the TLAA, the projected neutron fluences for the ¼T and ¾T locations of each of the RPV beltline components at the end of the subsequent period of extended operation are reviewed to confirm that they are bounded by the neutron fluences used to develop the existing P-T limit analysis.

4.2.3.1.4.2 10 CFR 54.21(c)(1)(ii)

The documented results of the revised P-T limit analysis based on the projected reduction in fracture toughness at the end of the subsequent period of extended operation is reviewed for compliance with 10 CFR Part 50, Appendix G. If the P-T limits are controlled by the TS LCOs, the reviewer confirms that the updated P-T limits for the facility are submitted as a 10 CFR 54.22 required license amendment and TS change request for the facility. The reviewer reviews the submitted P-T limit analysis for compliance with requirements in 10 CFR Part 50, Appendix G. If the P-T limits are controlled by an applicable Administrative Control TS Section and a PTLR process, the updated P-T limits are reviewed to confirm that the updated P-T limits have been submitted in an updated PTLR that has been included with the LRA. The P-T limits in the updated PTLR are also reviewed to confirm that the P-T limits have been calculated in accordance with the methodologies referenced in the applicable Administrative Controls TS Section for the PTLR process, or if not, that the updated methodology or methodologies used to generate the updated P-T limits in the PTLR has or have been submitted as part of a 10 CFR 54.22 implemented license amendment and TS change request for the LRA.

The P-T limit evaluations are dependent upon the neutron fluence.

4.2.3.1.4.3 10 CFR 54.21(c)(1)(iii)

Updated P-T limits for the subsequent period of extended operation must be established and implemented prior to entry into the subsequent period of extended operation. The 10 CFR 50.90 (Ref. 10) process for P-T limits located in the TS LCOs or the TS Administrative Controls Process for P-T limits that are administratively amended through a PTLR process can be considered adequate AMPs within the scope of 10 CFR 54.21(c)(1)(iii), such that P-T limits will be maintained through the subsequent period of extended operation.

For plants whose P-T limits are controlled by an applicable Administrative Controls TS Section and a NRC-approved PTLR process, the methodologies referenced in the applicable TS Section are reviewed to verify that they will comply with the requirements in 10 CFR Part 50, Appendix G and conform to the recommended position for minimum methodology contents in GL 96-03. Otherwise, the methodology bases for generating updates of the P-T limits during the subsequent period of extended operation are reviewed to determine whether a

10 CFR 54.22-implemented license amendment and TS change of the methodology requirements is necessary for the LRA.

For BWRs whose applicants are accepting their P-T limits in accordance with the criterion in 10 CFR 54.21(c)(1)(iii), the NRC staff confirms that the applicant addresses the following Renewal Applicant Action Item in the NRC staff's Safety Evaluation Report (SER) for BWRVIP-74 (Ref. 19).

> Action Item 9: Appendix A of BWRVIP-74-A (Ref. 20) indicates that a set of P-T curves should be developed for the heat-up and cool-down operating conditions in the plant at a given EFPY in the subsequent period of extended operation.

This means that, for this action item, the applicant has not provided updated curves, but shall have a procedure for updating P-T limits in accordance with 10 CFR Part 50, Appendix G, that will cover 80 years.

4.2.3.1.5 Elimination of Boiling Water Reactor Circumferential Weld Inspection

Some BWRs have an approved technical alternative, which eliminates the RPV circumferential shell weld inspections from the Section XI program for the current license term. Approved technical alternatives for SLR have yet to be developed. They will be evaluated on a case-by-case basis to ensure that the aging effects will be managed in accordance with 10 CFR 54.21(c)(1) such that the intended function(s) will be maintained during the subsequent period of extended operation.

4.2.3.1.6 Boiling Water Reactor Axial Welds

Those BWRs that have been approved to use the circumferential weld technical alternative also had to justify acceptable conditional probability of failure for their RPV axial shell weld examination coverage from the Section XI program for the current license term. Approved technical alternatives for SLR have yet to be developed. They will be evaluated on a case-by-case basis to ensure that the aging effects will be managed in accordance with 10 CFR 54.21(c)(1) such that the intended function(s) will be maintained during the subsequent period of extended operation.

4.2.3.2 Final Safety Analysis Report Supplement

The reviewer verifies that the applicant has provided information to be included in the FSAR supplement that includes a summary description of the evaluation of the RPV neutron embrittlement TLAA. Table 4.2-1 of this review plan section contains examples of acceptable FSAR supplement information for this TLAA. The reviewer verifies that the applicant has provided an FSAR supplement with information equivalent to that in Table 4.2-1.

The NRC staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR supplement at the next update required pursuant to 10 CFR 50.71(e)(4) (Ref. 21). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR supplement before the license is renewed, no condition will be necessary.

As noted in Table 4.2-1, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments to be completed before the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

4.2.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section and whether the NRC staff's evaluation supports conclusions of the following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be included in the SER:

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that, for the RPV neutron embrittlement TLAA, [choose which is appropriate] (i) the analyses remain valid for the subsequent period of extended operation, (ii) the analyses have been projected to the end of the subsequent period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation. The NRC staff also concludes that the FSAR supplement contains an appropriate summary description of the RPV neutron embrittlement TLAA evaluation for the subsequent period of extended operation as reflected in the license condition.

4.2.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

4.2.6 References

1. NRC. Regulatory Information Summary (RIS) No. 2014-11, "Information on Licensing Applications For Fracture Toughness Requirements For Ferritic Reactor Coolant Pressure Boundary Components." ML14149A165. Washington, DC: U.S. Nuclear Regulatory Commission. October 14, 2014.

2. 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

3. 10 CFR Part 54.21, "Contents of Application–Technical Information." Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

4. 10 CFR Part 50, "Appendix H, Reactor Vessel Material Surveillance Program Requirements." Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

5. NRC. Regulatory Guide 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence." Revision 0. Washington, DC: U.S. Nuclear Regulatory Commission. 2001.

6. 10 CFR Part 50, “Fracture Toughness Requirements.” Appendix G. Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

7. 10 CFR Part 50.61, “Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events.” Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

8. 10 CFR Part 50.61a, “Alternate Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events.” Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

9. L.A. Reyes. Letter (May 27) to the Commission. ML041190564. Washington, DC: U.S. Nuclear Regulatory Commission. 2004.

10. 10 CFR Part 50.90, “Application for Amendment of License, Construction Permit, or Early Site Permit.” Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

11. 10 CFR Part 50.59, “Changes, Tests, and Experiments.” Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

12. NRC. Regulatory Guide 1.99, “Radiation Embrittlement of Reactor Vessel Materials.” Revision 2. May, 1988.

13. ASME. Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components, Nonmandatory Appendix K, “Assessment of Reactor Vessels with Low Upper Shelf Charpy Impact Energy Levels.” New York City, New York. 2010.

14. NRC. NUREG–0800, “U.S. Nuclear Regulatory Commission, Standard Review Plan.” Washington, DC: U.S. Nuclear Regulatory Commission. March 2007.

15. NRC. Regulatory Guide 1.154, “Format and Content of Plant-Specific Pressurized Thermal Shock Safety Analysis Reports for Pressurized Water Reactors.” Washington, DC: U.S. Nuclear Regulatory Commission. January 1987.

16. 10 CFR Part 50.36, “Technical Specifications.” Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

17. NRC. Generic Letter 96-03, “Relocation of the Pressure Temperature Limit Curves and Lower Temperature Overpressure Protection System Limits.” Washington, DC: U.S. Nuclear Regulatory Commission. 1996.

18. 10 CFR Part 54.22, “Contents of Application – Technical Specifications.” Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

19. Christopher Grimes. Letter (October 18) to Carl Terry of Niagara Mohawk Power Company, BWRVIP Chairman, “Acceptance for Referencing of EPRI Proprietary Report TR-113596, BWR Vessel and Internals Project, BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines BWRVIP-74), and Appendix A, Demonstration of Compliance with the Technical Information Requirements of the License Renewal Rule (10CFR54.21).” Washington, DC: U.S. Nuclear Regulatory Commission. 2001.

20. EPRI. TR-1008872, “BWRVIP-74-A, BWR Vessels and Internals Project, BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal.” Palo Aldo, California: Electric Power Research Institute. June 2003.

21. 10 CFR Part 50.71, “Maintenance of Records, Making of Reports.” Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

Table 4.2-1. Examples of FSAR Supplement for Reactor Vessel Neutron Embrittlement Analyses		
TLAA	**Description of Evaluation**	**Implementation Schedule***
Neutron Fluence Example for acceptance per §54.21(c)(1)(iii)	The neutron fluence of each beltline material for the subsequent period of extended operation has been calculated in accordance with the guidance in RG 1.190. The neutron fluence is monitored through the subsequent period of extended operation by using GALL-SLR Report AMP X.M2, "Neutron Fluence Monitoring."	Ongoing through AMP monitoring
Upper-shelf energy Example for acceptance per §54.21(c)(1)(ii)	10 CFR Part 50 Appendix G paragraph IV.A.1 requires that the RPV beltline materials must have Charpy upper-shelf energy of no less than 50 ft-lb (68 J) throughout the life of the RPV unless otherwise approved by the NRC. The upper-shelf energy has been determined to exceed 50 ft-lb (68 J) to the end of the subsequent period of extended operation.	Completed
Pressurized thermal shock (for PWRs) Example for acceptance per §54.21(c)(1)(ii)	For PWRs, 10 CFR 50.61 requires the reference temperature RT_{PTS} for RPV beltline materials to be less than the PTS screening criteria at the expiration date of the operating license unless otherwise approved by the NRC. The reference temperature has been determined to be less than the PTS screening criteria at the end of the subsequent period of extended operation, unless alternate requirements have been invoked in accordance with 10 CFR 50.61(b) and approved by the NRC.	Completed
Pressure-temperature (P-T) limits Example for acceptance per §54.21(c)(1)(iii)	10 CFR Part 50 Appendix G requires that heatup and cooldown of the RPV be accomplished within established P-T limits. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the RPV becomes embrittled and its fracture toughness is reduced, the allowable pressure is reduced. 10 CFR Part 50 Appendix G requires periodic update of P-T limits based on projected embrittlement and data from a material surveillance program. The P-T limits will be updated to consider the subsequent period of extended operation.	For P-T limits controlled by TS LCOs: 10 CFR 50.90 Update should be completed and approved by the NRC before the subsequent period of extended operation For P-T limits controlled by TS PTLR requirements: Update should be completed before the subsequent period of extended operation and updated PTLR containing the

Table 4.2-1. Examples of FSAR Supplement for Reactor Vessel Neutron Embrittlement Analyses		
		updated P-T limits submitted to the NRC in accordance applicable Administrative Control TS reporting requirements
Elimination of BWR circumferential weld inspections and analysis of BWR axial welds	[Not applicable - approved technical alternatives for SLR have yet to be developed]	Not applicable
Other miscellaneous TLAAs on RV neutron embrittlement	Provide sufficient information on how the calculations for plant-specific TLAAs were performed, what the limiting TLAA parameter was calculated to be in accordance with the neutron fluence projected for the subsequent period of extended operation, and why the TLAA is acceptable under either 10 CFR 54.21 (c)(1)(i), (ii), or (iii).	
*An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities to be completed before the subsequent period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities by no later than the committed date.		

4.3 Metal Fatigue

Review Responsibilities

Primary—Branch responsible for the time-limited aging analysis (TLAA) issues

Secondary—None

4.3.1 Area of Review

Fatigue occurs in a metal component when it is subjected to fluctuating loads. If the loading is of sufficient magnitude or frequency, cracks may initiate and propagate in the component at the location of maximum loading. To address fatigue concerns, Section III of the American Society of Mechanical Engineers (ASME) Code requires a fatigue analysis for Class 1 components. The analysis must consider all expected cyclic loads based on the anticipated number of cyclic loadings. In the most rigorous evaluation, the ASME Code provisions include the calculation of the cumulative usage factor (CUF) for selected locations within a component, which is a calculated measure of the expended fatigue initiation life at each location in the component. Under these provisions, the ASME Code limits the CUF to a value of less than or equal to unity for acceptable fatigue design. A CUF below a value of unity provides assurance that no crack has initiated at the analyzed location in the component. Other provisions in Section III of the ASME Code allow less rigorous treatment to address the fatigue design in components that have smaller or less frequent cyclic loadings, (i.e., fatigue waiver evaluation). In some cases, continued adequacy of the fatigue life of a component may be demonstrated through reinspections that continue to demonstrate an absence of fatigue flaws, (i.e., flaw tolerance evaluation). In other cases, the growth of fatigue flaws is assessed to ensure that flaws detected in components remain within allowable limits.

The acceptability of metal components from a fatigue standpoint is demonstrated by one or more relevant fatigue parameters, which include, but are not limited to, the CUF values, the environmentally-adjusted CUF_{en} values, transient cycle limits, and predicted flaw sizes (for fatigue flaw tolerance or component flaw evaluations). The limits of the fatigue parameters are established by the applicable fatigue analyses and may be a design limit, for example from an ASME Code fatigue evaluation, or an analysis-specific value, for example based on the number of cyclic load occurrences assumed in fatigue waiver evaluations or the acceptable flaw sizes postulated in flaw tolerance or component flaw evaluations.

As a result of the assumptions used in the underlying evaluations associated with metal component fatigue parameters (i.e., the magnitude and frequency of the assumed cyclic loadings for the future operating life of the component), the continued validity of metal fatigue analyses is reviewed for the subsequent period of extended operation.

Areas of review to ensure that the metal component fatigue parameter evaluations are valid for the subsequent period of extended operation include:

1. CUF calculations or fatigue waiver evaluations for components designed using the fatigue requirements of Section III of the ASME Code or other Codes that use a I_t calculation [e.g., the 1969 edition of ANSI B31.7 for Class 1 piping, ASME NC-3200 vessels, ASME NE-3200 Class MC components, ASME NG-3200 core support structures, and

metal bellows designed to ASME NC-3649.4(e)(3), ND-3649.4(e)(3), or NE-3366.2(e)(3)] or the Draft ASME Code for Pumps and Valves for I_t analyses).

2. Fatigue-based maximum allowable stress calculations for components evaluated to United States of America Standards (USAS) American National Standards Institute (ANSI) B31.1 or ASME Code Class 2 and 3 requirements.

3. CUF calculations for components that require evaluation of environmental effects (CUF_{en}).

4. Fatigue-based flaw growth, flaw tolerance, or fracture mechanics analyses, including those used to support reinspection intervals for components.

4.3.2 Acceptance Criteria

Acceptance criteria are provided in the following subsections for the areas of review described in Subsection 4.3.1 that delineate acceptable methods for meeting the requirements of the U.S. Nuclear Regulatory Commission (NRC) regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(c)(1).

4.3.2.1 Time-Limited Aging Analysis

Pursuant to 10 CFR 54.21(c)(1)(i) through (iii), an applicant must demonstrate one of the following for each analysis:

i. The analyses remain valid for the period of extended operation:

ii. The analyses have been projected to the end of the period of extended operation; or

iii. The effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

In some instances, the applicant may identify activities to be performed to verify the assumption bases of the fatigue analyses. Evaluations of those activities are provided by the applicant. The reviewer assures that the applicant's activities are sufficient to confirm the calculation assumptions for the subsequent period of extended operation.

Specific acceptance criteria for metal component fatigue evaluations are discussed in the following subsections.

4.3.2.1.1 Components Evaluated for Fatigue Parameters Other than CUF_{en}

For metal components evaluated for fatigue parameters other than CUF_{en}, the acceptance criteria depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), and are as follows:

4.3.2.1.1.1 10 CFR 54.21(c)(1)(i)

The existing fatigue parameter calculations remain valid for the subsequent period of extended operation because the number of accumulated cycles and the assumed severity of each of the cyclic loadings evaluated in the calculations are not projected to exceed the limits evaluated for these loadings. The revised projections are verified to be consistent with historical plant operating characteristics and anticipated future operation.

4.3.2.1.1.2 10 CFR 54.21(c)(1)(ii)

The fatigue parameter calculations are revised and shown to remain acceptable throughout the subsequent period of extended operation based on a revised projection of the cumulative number and assumed severity of each of the cyclic loadings to the end of the subsequent period of extended operation. The revised projections are verified to be consistent with historical plant operating characteristics and anticipated future operation. The resulting fatigue parameter values are verified to remain less than or equal to their respective allowable value for the subsequent period of extended operation.

4.3.2.1.1.3 10 CFR 54.21(c)(1)(iii)

The applicant proposes an aging management program (AMP) as the basis for demonstrating that the effect or effects of aging on the intended function(s) of the structure(s) or component(s) in the fatigue parameter evaluations will be adequately managed during the subsequent period of extended operation. The AMP in Section X.M1, “Cyclic Load Monitoring,” of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) report provides one method that may be used to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii).

An applicant may also propose another AMP to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii). If the basis for aging management is a plant-specific AMP, the AMP is described in terms of the 10 program elements defined in the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR), Appendix A.1, “Branch Technical Position, Aging Management Review—Generic,” Sections A.1.2.3.1 through A–1.2.3.10.

If an inspection program is proposed as the basis for aging management, the applicant should ensure that: (a) inspections will be performed for the specific component(s) or structure(s) in the evaluation and (b) applicant has justified that the inspection methods and frequencies in the proposed inspection program are applicable to the component(s), such that they may be used to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii).

4.3.2.1.2 Components Evaluated for CUF_{en}

For metal components evaluated for CUF_{en}, the acceptance criteria depend on the applicant’s choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii).

Applicants should also include CUF_{en} calculations for additional component locations if they are considered to be more limiting than those previously evaluated. The sample of critical components can be evaluated by applying environmental correction factors to the existing CUF analyses or by performing more refined calculations. Environmental effects on fatigue for these critical components can be evaluated using the positions described in Regulatory Guide (RG) 1.207, Revision 1 (Ref. 5) or an NRC staff-approved alternative.

4.3.2.1.2.1 10 CFR 54.21(c)(1)(i)

The existing CUF_{en} calculations remain valid for the subsequent period of extended operation because the number of accumulated cycles, the assumed severity of the cyclic loadings, and the assumed water chemistry conditions evaluated in the calculations are not projected to exceed the limits evaluated for these loadings. The revised projections for the number of accumulated cycles are verified to be consistent with historical plant operating characteristics and anticipated future operation.

For stainless steel (SS) and nickel alloy materials, or any location where average temperature was used in the calculation, or where a constant F_{en} value of 1.49 was used for nickel alloy materials, the methods are updated under 10 CFR 54.21(c)(1)(ii) to use the positions described in RG 1.207, Revision 1.

4.3.2.1.2.2 10 CFR 54.21(c)(1)(ii)

The CUF_{en} calculations are revised and shown to remain acceptable throughout the subsequent period of extended operation based on a revised projection of the cumulative number of occurrences, the assumed severity of cyclic loadings, and the assumed water chemistry conditions to the end of the subsequent period of extended operation. The revised projections are verified to be consistent with historical plant operating characteristics and anticipated future operation. The resulting CUF_{en} values are verified to remain less than or equal to unity for the subsequent period of extended operation. The positions described in RG 1.207, Revision 1 are used for all component evaluations as a part of revising the calculations.

4.3.2.1.2.3 10 CFR 54.21(c)(1)(iii)

In Section X.M1 of the GALL-SLR Report, the NRC staff evaluated a program for monitoring and tracking the number of occurrences and the severity of critical cyclic loadings for selected components. In Section XI.M2 of the GALL-SLR Report, the NRC staff evaluated a program for monitoring and tracking water chemistry conditions. The NRC staff determined that these programs, when used together, are acceptable AMPs to address the effects of reactor water environment on component fatigue life according to 10 CFR 54.21(c)(1)(iii). The GALL-SLR Report may be referenced in an subsequent license renewal application (SLRA) and should be treated in the same manner as an approved topical report. In referencing the GALL-SLR Report, the applicant should indicate that the material referenced is applicable to the specific plant involved and should provide the information necessary to adopt the finding of program acceptability as described and evaluated in the report. The applicant also should verify that the approvals set forth in the GALL-SLR Report for the generic program apply to the applicant’s program. Alternatively, the components could be replaced and the CUF_{en} values for the replacement components shown to be acceptable for the subsequent period of extended operation.

4.3.2.2 Final Safety Analysis Report Supplement

The specific criterion for meeting 10 CFR 54.21(d) is as follows:

The summary description of the evaluation of TLAAs for the subsequent period of extended operation in the Final Safety Analysis Report (FSAR) supplement is appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the TLAAs regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.3.3 Review Procedures

Review procedures for metal component fatigue parameter evaluations for the areas of review described in Subsection 4.3.1 are discussed in the following subsections.

4.3.3.1 Time-Limited Aging Analysis

The Code of Record should be used for the re-evaluation, or the applicant may update to a later Code edition pursuant to 10 CFR 50.55a using an appropriate Code reconciliation. In the latter case, the reviewer verifies that the requirements in 10 CFR 50.55a are met.

4.3.3.1.1 Components Evaluated for Fatigue Parameters Other Than CUF_{en}

For metal components evaluated for fatigue parameters other than CUF_{en}, the review procedures depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), and are as follows:

4.3.3.1.1.1 10 CFR 54.21(c)(1)(i)

The operating cyclic load experience and a list of the assumed transients used in the existing fatigue parameter calculations is reviewed for the current operating term to ensure that the projected number of transient occurrences during the subsequent period of extended operation will not exceed the assumed number of transient occurrences in the existing fatigue parameter calculations. The projected number of occurrences for each transient is verified to be consistent with historical plant operating characteristics and anticipated future operation. In addition, a comparison of the operating cyclic load severity to the severity for each transient assumed in the existing fatigue parameter calculations is made to demonstrate that the cyclic load severity for each transient used in the fatigue parameter calculations remains bounding. For consistency purposes, the review also includes an assessment of the TLAA information against relevant design basis information and current licensing basis (CLB) information.

4.3.3.1.1.2 10 CFR 54.21(c)(1)(ii)

The operating cyclic load experience is reviewed to ensure that the increased number of cyclic load occurrences and their severity for each transient used for any reanalysis remain within the number of transient occurrences and severity for each transient projected to the end of the subsequent period of extended operation. The revised fatigue parameter calculations are reviewed to ensure that the fatigue parameter remains less than or equal to the allowed value at the end of the subsequent period of extended operation. The revised fatigue parameter calculations are shown to remain acceptable based on revised projections of the cumulative number of occurrences and the assumed severity of each transient to the end of the subsequent period of extended operation. The revised projections are verified to be consistent with historical plant operating characteristics and anticipated future operation. For consistency purposes, the review also includes an assessment of the TLAA information against relevant design basis information and CLB information.

4.3.3.1.1.3 10 CFR 54.21(c)(1)(iii)

Pursuant to 10 CFR 54.21(c)(1)(iii), the applicant proposes an AMP or aging management activities as the basis for demonstrating that the effect or effects of aging on the intended function(s) of the structure(s) or component(s) in the fatigue parameter evaluation will be adequately managed during the subsequent period of extended operation. If Section X.M1, “Cyclic Load Monitoring,” of the GALL-SLR Report is used as the basis for managing cumulative fatigue damage or cracking due to fatigue or cyclical loading in the structure(s) or component(s), the reviewer reviews the applicant’s AMP against the program elements defined in GALL-SLR Report Section X.M1.

An applicant also has the option of proposing another GALL-based AMP, plant-specific AMP, or plant-specific activities, or combination of, to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii). If another GALL-based AMP is proposed as the basis for aging management, the reviewer reviews the applicant’s AMP against the program element criteria defined in the applicable AMP section in Chapter XI of the GALL-SLR Report. If the basis for aging management is a plant-specific AMP or plant-specific aging management activities, the reviewer reviews the program element criteria for the AMP or activities against the program element criteria defined in this SRP-SLR, Appendix A.1, “Branch Technical Position, Aging Management Review—Generic,” Sections A.1.2.3.1 through A.1.2.3.10.

If a sampling based inspection program (a type of condition monitoring program) is proposed as the basis for aging management, the reviewer ensures that the AMP actually performs inspections of the specific component(s) or structure(s) in the evaluation at each unit in a multiunit site and that the applicant has appropriately justified that the inspection methods and associated frequencies are capable of managing cumulative fatigue damage or cracking by fatigue or cyclical loading in the component(s) or structure(s), such that the TLAA may be accepted in accordance with 10 CFR 54.21(c)(1)(iii).

4.3.3.1.2 Components Evaluated for CUF_{en}

For metal components evaluated for CUF_{en}, the review procedures depend on the applicant’s choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii).

Applicants should include CUF_{en} calculations for the limiting component locations exposed to the reactor water environment. A sample of critical components can be evaluated by applying environmental correction factors to the existing CUF analyses or by performing more refined calculations. Environmental effects on fatigue for these critical components can be evaluated using the positions described in RG 1.207, Revision 1, or a NRC staff-approved alternative.

4.3.3.1.2.1 10 CFR 54.21(c)(1)(i)

The operating cyclic load experience and a list of the assumed transients used in the existing fatigue parameter calculations are reviewed for the current operating term to ensure that the number of assumed occurrences of each transient would not be exceeded during the subsequent period of extended operation. A comparison of the operating cyclic load severity to the severity assumed in the existing fatigue parameter calculations for each transient should be made to demonstrate that the cyclic load severities used in the fatigue parameter calculations remain bounding. In addition, a comparison of the water chemistry conditions to those assumed in the existing environmental multiplier (F_{en}) calculations should be made to demonstrate that the water chemistry conditions used in the F_{en} calculations remain appropriate. For consistency purposes, the review also includes an assessment of the TLAA information against relevant design basis information and CLB information. For SS and nickel alloy materials, or any location where average temperature was used in the calculation, or where a constant F_{en} value of 1.49 was used for nickel alloy materials, the review includes verification that the methods have been updated to use the positions described in RG 1.207, Revision 1 under the provisions of 10 CFR 54.21(c)(1)(ii).

4.3.3.1.2.2 10 CFR 54.21(c)(1)(ii)

The operating cyclic load experience and a list of the assumed transients used in the existing fatigue parameter calculations is reviewed for the current operating term to ensure that the number of assumed occurrences for each transient are projected to the end of the subsequent period of extended operation. The reviewer verifies that a comparison of the operating cyclic load severity to the severity assumed in the existing fatigue parameter calculations for each transient has been made to demonstrate that the cyclic load severities used in the fatigue parameter calculations remain bounding. In addition, the reviewer verifies that a comparison of the water chemistry conditions to those assumed in the F_{en} calculations has been made to demonstrate that the water chemistry conditions used in the F_{en} calculations are appropriate. For consistency purposes, the review also includes an assessment of the TLAA information against relevant design basis information and CLB information. The review includes verification that the positions described in RG 1.207, Revision 1 are used for all component evaluations as a part of revising the calculations.

The Code of Record should be used for the reevaluation, or the applicant may update to a later Code edition pursuant to 10 CFR 50.55a using an appropriate Code reconciliation. In the latter case, the reviewer verifies that the requirements in 10 CFR 50.55a are met.

4.3.3.1.2.3 10 CFR 54.21(c)(1)(iii)

The applicant may reference Sections X.M1 and XI.M2 of the GALL-SLR Report in its SLR application and use these GALL-SLR chapters to accept the TLAA in accordance with 10 CFR 54.21(c)(1)(iii), as appropriate. The review should verify that the applicant has stated that the report is applicable to its plant with respect to its program that monitors and tracks the number and severity of critical cyclic loadings and water chemistry conditions for metal components. The reviewer verifies that the applicant has identified the appropriate programs as described and evaluated in the GALL-SLR Report. The reviewer also ensures that the applicant has stated that its program contains the same program elements that the NRC staff evaluated and relied upon in approving the corresponding generic program in the GALL-SLR Report. For consistency purposes, the review also includes an assessment of the TLAA information against relevant design basis and CLB information (including applicable cycle-counting requirements and water chemistry monitoring set forth in the applicable AMPs).

An applicant also has the option of proposing another GALL-based AMP, plant-specific AMP, or plant-specific activities, or combination of, to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii). If another GALL-based AMP is proposed as the basis for aging management, the reviewer reviews the applicant’s AMP against the program element criteria defined in the applicable AMP section in Chapter XI of the GALL-SLR Report. If the basis for aging management is a plant-specific AMP or plant-specific aging management activities, the reviewer reviews the program element criteria for the AMP or activities against the program element criteria defined in this SRP-SLR, Appendix A.1, “Branch Technical Position, Aging Management Review—Generic,” Sections A.1.2.3.1 through A.1.2.3.10.

If a sampling based inspection program (a type of condition monitoring program) is proposed as the basis for aging management, the reviewer ensures that the AMP actually performs inspections of the specific component(s) or structure(s) in the evaluation at each unit in a multiunit site and that the applicant has appropriately justified that the inspection methods and associated frequencies are capable of managing cumulative fatigue damage or cracking by fatigue or cyclical loading in the component(s) or structure(s), such that the TLAA may be accepted in accordance with 10 CFR 54.21(c)(1)(iii).

4.3.3.2 Final Safety Analysis Report Supplement

The reviewer verifies that the applicant has provided information to be included in the FSAR supplement that includes a summary description of the evaluation of the metal fatigue TLAA. Table 4.3-1 contains examples of acceptable FSAR supplement information for metal fatigue TLAAs that are dispositioned in accordance with 10 CFR 54.21(c)(1)(iii). The reviewer verifies that the applicant has provided a FSAR supplement with information equivalent to that in Table 4.3-1.

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

As noted in Table 4.3-1, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities, including enhancements and commitments to be completed before the start of the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

4.3.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section and whether the NRC staff's evaluation supports conclusions of the following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be included in the NRC staff's Safety Evaluation Report:

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that, for the [reviewer to insert applicable type of metal fatigue analysis] TLAA, [choose which is appropriate] (i) the analyses remain valid for the subsequent period of extended operation, (ii) the analyses have been projected to the end of the subsequent period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation. The NRC staff also concludes that the FSAR Supplement contains an appropriate summary description of the [reviewer to insert applicable type of metal fatigue analysis] TLAA, evaluation for the subsequent period of extended operation as reflected in the license condition.

4.3.5 Implementation

Except in those cases where the applicant proposes an acceptable alternative, the methods described herein will be used by the NRC staff in its evaluations of conformance with NRC regulations.

4.3.6 References

1. ASME. "Rules for Construction of Nuclear Power Plant Components." ASME Boiler and Pressure Vessel Code, Section III. New York City, New York: American Society of Mechanical Engineers.

2. ANSI/ASME B31.1, "Power Piping." New York City, New York: American National Standards Institute.

3. ANSI/ASME B31.7-1969, "Nuclear Power Piping." New York City, New York: American National Standards Institute.

4. NRC. Regulatory Guide 1.207, "Guidelines for Evaluating the Effects of Light-Water Reactor Coolant Environments in Fatigue Analyses of Metal Components." Revision 1. Washington, DC: U.S. Nuclear Regulatory Commission. 2014.

5. NRC. NUREG/CR-6909, Revision 1, ANL-12/60, "Effect of LWR Coolant Environments on the Fatigue Life of Reactor Materials." ML14087A068. Washington, DC: U.S. Nuclear Regulatory Commission. March 2014.

6. ASME. Section III, "Rules for Construction of Nuclear Facility Components." New York City, New York: American Society of Mechanical Engineers.

7. ASME. Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components, Nonmandatory, Appendix A, Analysis of Flaws." New York City, New York: American Society of Mechanical Engineers.

8. ASME. Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components, Appendix C, Evaluation of Flaws in Austenitic Piping." New York City, New York: American Society of Mechanical Engineers.

Table 4.3-1. Examples of FSAR Supplement for Metal Fatigue TLAA Evaluation

10 CFR 54.21(c)(1)(i) Examples		
TLAA	**Description of Evaluation**	**Implementation Schedule***
Components Evaluated for Fatigue Parameters Other than CUF_{en}	[Applicant to identify and provide adequate description of the specific metal fatigue parameter evaluation] The number of occurrences and severity of each of the thermal and pressure transients, projected to the end of the subsequent license renewal operating period, demonstrate that the [Applicant to insert Name of the TLAA] remains valid during the subsequent license renewal operating period and therefore, that this TLAA is acceptable in accordance with the criterion in 10 CFR 54.21(c)(1)(i).	Completed (prior to submittal of an application for SLR)
Components Evaluated for CUF_{en}	[Applicant to identify and provide adequate description of the specific metal fatigue evaluation for evaluating environmentally assisted fatigue in ASME Code Class 1 or Safety Class 1 components] The effects of the water environment on component fatigue life have been addressed by assessing the impact of the water environment on the limiting component locations, using the positions described in Regulatory Guide 1.207, Revision 1. The number of occurrences and severity of each of the thermal and pressure transients, projected to the end of the subsequent license renewal operating period, and consideration of the water chemistry parameters demonstrate that the TLAA on environmentally assisted fatigue remains valid during the subsequent license renewal operating period and therefore, that this TLAA is acceptable in accordance with 10 CFR 54.21(c)(1)(i).	Completed (prior to submittal of an application for SLR)
10 CFR 54.21(c)(1)(ii) Examples		
TLAA	**Description of Evaluation**	**Implementation Schedule***
Components Evaluated for Fatigue Parameters Other than CUF_{en}	[Applicant to identify and provide adequate description of the specific metal fatigue parameter evaluation] The analysis has been projected to the end of the subsequent license renewal operating period, considering the number of occurrences and severity of each of the thermal and pressure transients, and demonstrates that the TLAA is acceptable in accordance with 10 CFR 54.21(c)(1)(ii).	Completed (prior to submittal of an application for SLR)
Components Evaluated for CUF_{en}	Applicant to identify and provide adequate description of the specific metal fatigue evaluation for evaluating environmentally assisted fatigue in ASME Code Class 1 or Safety Class 1 components]	Completed (prior to submittal of an application for SLR)

Table 4.3-1. Examples of FSAR Supplement for Metal Fatigue TLAA Evaluation

10 CFR 54.21(c)(1)(i) Examples		
TLAA	**Description of Evaluation**	**Implementation Schedule***
	The effects of the water environment on component fatigue life have been addressed by assessing the impact of the water environment on the limiting component locations, using the positions described in Regulatory Guide 1.207, Revision 1. The analysis for environmentally-assisted fatigue has been projected to the end of the subsequent license renewal operating period, considering the number of occurrences and severity of each of the thermal and pressure transients and the water chemistry parameters, and demonstrates that the TLAA is acceptable in accordance with 10 CFR 54.21(c)(1)(ii).	
10 CFR 54.21(c)(1)(iii) Examples		
TLAA	**Description of Evaluation**	**Implementation Schedule***
Components Evaluated for Fatigue Parameters Other than CUF_{en}	Fatigue evaluations were performed to ensure the continued validity of the metal fatigue analyses for the subsequent license renewal operating period. [Applicant to provide adequate description of the specific metal fatigue parameter evaluation] The AMP monitors and tracks the number of occurrences and severity of thermal and pressure transients, and requires corrective actions to ensure that applicable fatigue analyses remain within their allowable limits. The effects of aging due to fatigue will be managed by the AMP for the subsequent license renewal operating period in accordance with 10 CFR 54.21(c)(1)(iii).	Program should be implemented before the subsequent period of extended operation
Components Evaluated for CUF_{en}	The effects of the water environment on component fatigue life will be addressed by assessing the impact of the water environment on the limiting component locations, using the positions described in Regulatory Guide 1.207, Revision 1. A limiting sample of critical components can be evaluated by applying environmental adjustment factors to the existing CUF analyses or by performing more refined calculations. The AMPs monitor and track the number of occurrences and severity of thermal and pressure transients, monitor water chemistry, and require corrective actions to ensure that the applicable fatigue analyses remain within their allowable limits. The effects of aging due to environmentally assisted fatigue will be managed by the AMPs for the subsequent license renewal operating period in accordance with 10 CFR 54.21(c)(1)(iii).	Program should be implemented before the subsequent period of extended operation

4.4 Environmental Qualification (EQ) of Electric Equipment

Review Responsibilities

Primary—Branch responsible for electrical engineering

Secondary—None

4.4.1 Areas of Review

The U.S. Nuclear Regulatory Commission (NRC) has established environmental qualification requirements in the Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix A, Criterion 4, and 10 CFR 50.49. Section 50.49 specifically requires each nuclear power plant licensee to establish a program to qualify certain electric equipment (not including equipment located in mild environments) so that such equipment, up to its end-of-life condition, will meet its performance specifications during and following design basis accidents under the most severe environmental conditions postulated at the equipment's respective location (qualified life). Such conditions include, among others, conditions resulting from a design basis event such as a loss of coolant accident (LOCA), high-energy line break (HELBs), and post-LOCA environments. Electric equipment is qualified to perform its safety function in those harsh environments after the effects of inservice aging. 10 CFR 50.49 requires that the effects of significant aging mechanisms be addressed as part of environmental qualification. Those components with a qualified life equal to or greater than the duration of the current operating term are covered by time-limited aging analyses (TLAAs).

For equipment located in a harsh environment, the objective of Environmental Qualification (EQ) is to demonstrate with reasonable assurance that electric equipment important to safety, for which a qualified life has been established, can perform its safety function(s) without experiencing common cause failures before, during or after applicable design basis events.

For equipment located in a mild environment (an environment that at no time would be significantly more severe than the environment occurring during normal operation, including anticipated operational occurrences—10 CFR 50.49), the demonstration that the equipment can meet its functional requirements during normal environmental conditions and anticipated operational occurrences in accordance with the plant's design and licensing bases. Equipment important to safety located in a mild environment is not part of an EQ program according to 10 CFR 50.49 [10 CFR 50.49(c)]. Documents that demonstrate that a component is qualified or designed for a mild environment include design/purchase specifications, seismic qualification reports, an evaluation or certificate of conformance as applicable.

Some nuclear power plants have mechanical equipment that was qualified in accordance with the provisions of Criterion 4 of Appendix A to 10 CFR Part 50. If a plant has qualified mechanical equipment, it is typically documented in the plant's master EQ list. If this qualified mechanical equipment requires a performance of a TLAA, it should be performed in accordance with the provisions of SRP-SLR Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses." If a TLAA of qualified mechanical equipment is necessary, usually it will involve assessments of the environmental effects on consumable components such as seals, gaskets, lubricants, fluids for hydraulic systems, or diaphragms.

4.4.1.1 Time-Limited Aging Analysis

All operating plants must meet the requirements of 10 CFR 50.49 for certain important-to-safety electrical components. 10 CFR 50.49 defines the scope of components to be included, requires the preparation and maintenance of a list of in-scope components, and requires the preparation and maintenance of a qualification file that includes component performance specifications, electrical characteristics, and environmental conditions. 10 CFR 50.49(e)(5) contains provisions for aging that require, in part, consideration of all significant types of aging degradation that can affect component functional capability. 10 CFR 50.49(e) also requires component replacement or refurbishment prior to the end of designated life, unless additional life is established through reanalysis or ongoing qualification. 10 CFR 50.49(f) establishes four methods of demonstrating qualification for aging and accident conditions. 10 CFR 50.49(k) and (i) permit different qualification criteria to apply based on plant and component vintage. Supplemental environmental qualification regulatory guidance for compliance with these different qualification criteria is provided in NRC Regulatory Guide (RG) 1.89, Rev. 1, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants" (Ref. 1), and the Division of Operating Reactors (DOR) Guidelines (Ref. 2), and NUREG–0588 (Ref. 3). The principal nuclear industry qualification standards for electric equipment are Institute of Electrical and Electronics Engineers (IEEE) STD 323-1971 (Ref. 4) and IEEE STD 323-1974 (Ref. 5). These standards contain explicit EQ considerations based on TLAAs. Compliance with 10 CFR 50.49 provides reasonable assurance that the component can perform its intended functions during and following accident conditions after experiencing the effects of inservice aging for applicable equipment.

4.4.1.1.1 Division of Operating Reactors Guidelines

The qualification of electric equipment that is subject to significant known degradation due to aging where a qualified life was previously required to be established in accordance with Section 5.2.4 of the DOR Guidelines is reviewed for the period of subsequent period of extended operation according to those requirements. If a qualified life was not previously established, the qualification is reviewed in accordance with Section 7 of the DOR Guidelines.

4.4.1.1.2 NUREG–0588, Category II (IEEE STD 323-1971)

The qualification of certain electric equipment important to safety for which qualification was required in accordance with NUREG–0588, Category II, is reviewed for conformance to those requirements for the subsequent period of extended operation to assess the validity of the extended qualification. These requirements include IEEE STD 382-1972 (Ref. 6) for valve operators and IEEE STD 334-1971 (Ref. 7). In addition, 10 CFR 50.49(L) has to be addressed for replacement equipment.

4.4.1.1.3 NUREG–0588, Category I (IEEE STD 323-1974)

The qualification of certain electric equipment important to safety for which qualification was required in accordance with NUREG–0588, Category I, is reviewed for conformance to those requirements for the subsequent period of extended operation to assess the validity of the extended qualification.

4.4.1.2 Generic Safety Issue

Regulatory Issue Summary (RIS) 2003-09 was issued on May 2, 2003, (Ref. 8) to inform addressees of the results of the technical assessment of generic safety issue (GSI)-168, "Environmental Qualification of Electrical Equipment" (Ref. 9). This RIS requires no action on the part of the addressees.

4.4.1.3 Final Safety Analysis Report Supplement

The detailed information on the evaluation of TLAAs is contained in the subsequent license renewal application (SLRA). A summary description of the evaluation of TLAAs for the period of extended operation is contained in the applicant's Final Safety Analysis Report (FSAR) supplement. The FSAR supplement is an area of review.

4.4.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Subsection 4.4.1 of this review plan section delineate acceptable methods for meeting the requirements of the NRC's regulations in 10 CFR 54.21(c)(1).

4.4.2.1 Time-Limited Aging Analysis

For long-term operation, TLAAs are reviewed to determine continued acceptability of the analyzed component for the subsequent period of extended operation. The time-dependent parameter is reevaluated, analyzed or assumed to determine a value that applies to the subsequent period of extended operation. This new value of the time-dependent parameter is then used to reevaluate the analysis parameter, applicable to the subsequent period of extended operation.

Pursuant to 10 CFR 54.21(c)(1)(i)–(iii), the TLAA is acceptable if it meets one of the following cases:

(i) The analysis remains valid for the subsequent period of extended operation. The time-dependent parameter(s) for the subsequent period of extended operation does not exceed the time-dependent parameter value used in the existing EQ analysis.

(ii) The analysis has been projected to the end of the subsequent period of extended operation and remains acceptable for the subsequent period of extended operation. The time-dependent parameter(s) is projected for the subsequent period of extended operation. The value of the time-dependent analysis parameter(s) remains bounded to the value used in the existing EQ analysis.

(iii) The effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation.

The applicant manages the time-dependent parameter [using an aging management program (AMP) (e.g., GALL-SLR Report AMP X.E1, "SLR AMP X.E1 Environmental Qualification (EQ]" of Electric Components) to assure that the value of the analysis parameter continues to meet the EQ analysis value.

Specific acceptance criteria for EQ of certain electric equipment important to safety analyzed to Section 5.2.4 of the DOR Guidelines; NUREG–0588, Category II (Section 4); or NUREG–0588, Category I, depend on the applicant's choice, that is, 10 CFR 54.21(c)(1)(i), (ii), or (iii), and are:

4.4.2.1.1 10 CFR 54.21(c)(1)(i)

The existing qualification is based on previous testing, analysis, or operating experience, or combinations thereof, that demonstrate that the equipment is qualified for the period of extended operation. For option (i), the aging evaluation existing at the time of the SLRA for the component remains valid for the subsequent period of extended operation, and no further evaluation is necessary.

4.4.2.1.2 10 CFR 54.21(c)(1)(ii)

Qualification of the equipment is extended for the subsequent period of extended operation by testing, analysis, or operating experience, or combinations thereof, in accordance with the CLB. For option (ii), a reanalysis of the aging evaluation is performed in order to project the qualification of the component through the subsequent period of extended operation. Important reanalysis attributes of an aging evaluation include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions if acceptance criteria are not met. These reanalysis attributes are discussed in Table 4.4-1.

4.4.2.1.3 10 CFR 54.21(c)(1)(iii)

In Chapter X of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report (Ref. 10), the NRC staff has evaluated the EQ program (10 CFR 50.49) and determined that it is an acceptable AMP to address EQ according to 10 CFR 54.21(c)(1)(iii). The GALL-SLR Report may be referenced in a SLRA and should be treated in the same manner as an approved topical report. However, the GALL-SLR Report contains one acceptable way and is not the only way to manage aging for SLR.

In referencing the GALL-SLR Report, the applicant should indicate that the material referenced is applicable to the specific plant involved and should provide the information necessary to adopt the finding of program acceptability as described and evaluated in the report. The applicant should also verify that the approvals set forth in the GALL-SLR Report for the generic program apply to the applicant's program.

4.4.2.2 Final Safety Analysis Report Supplement

The specific criterion for meeting 10 CFR 54.21(d) is:

> The summary description of the evaluation of TLAAs for the period of extended operation in the FSAR supplement is appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the TLAA regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.4.3 Review Procedures

For each area of review described in Subsection 4.4.1, the following review procedures should be followed:

4.4.3.1 Time-Limited Aging Analysis

For electric equipment qualified to the requirements of 10 CFR 50.49, the review procedures depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), which are:

4.4.3.1.1 10 CFR 54.21(c)(1)(i)

The documented results, test data, analyses, etc. of the previous qualification, which consisted of an appropriate combination of testing, analysis, and operating experience, are reviewed to confirm that the original qualified life remains valid for the subsequent period of extended operation.

4.4.3.1.2 10 CFR 54.21(c)(1)(ii)

The results of projecting the qualification to the end of the subsequent period of extended operation are reviewed. The qualification methods include testing, inspection, operating experience, reanalysis, ongoing qualification or combinations thereof.

The reanalysis of an aging evaluation is normally performed to extend the qualification by reevaluating original attributes, assumptions and conservatisms for environmental conditions and other factors to identify excess conservatisms incorporated in the prior evaluation. Reanalysis of an aging evaluation to extend the qualification of electrical equipment is performed pursuant to 10 CFR 50.49(e) as part of an EQ program. While an electrical equipment life limiting condition may be due to thermal, radiation, or operational/testing and cyclic aging, the majority of electrical equipment aging limits are based on thermal conditions. Conservatism may exist in aging evaluation parameters, such as the assumed service conditions including temperature and radiation, loading, power, signal conditions, cycles, and application (e.g., de-energized versus energized), or the use of an unrealistically low activation energy.

The reanalysis of an aging evaluation is performed according to the station's quality assurance (QA) program requirements, which requires the verification of assumptions and conclusions including the maintenance of required margins and uncertainties.

For reanalysis, the reviewer verifies that an applicant has completed its reanalysis, addressing attributes of analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions if acceptance criteria are not met (see Table 4.4-1). The reviewer also verifies that the reanalysis has been completed in a timely manner prior to the end of qualified life.

4.4.3.1.3 10 CFR 54.21(c)(1)(iii)

The applicant may reference the GALL-SLR Report in its SLRA, as appropriate. The review should verify that the applicant has stated that the report is applicable to its plant with respect to its EQ program. The reviewer verifies that the applicant has identified the appropriate AMP as described and evaluated in the GALL-SLR Report. The reviewer also ensures that the applicant has stated that its EQ program contains, and is consistent with, the same program elements that the NRC staff evaluated and relied upon in approving the corresponding generic AMP in the GALL-SLR Report. No further NRC staff evaluation is necessary.

If the applicant does not reference the GALL-SLR Report in its renewal application, additional NRC staff evaluation is necessary to determine whether the applicant's TLAA analysis and EQ AMP is acceptable for this area of review.

4.4.3.2 Final Safety Analysis Report Supplement

The reviewer verifies that the applicant has provided information to be included in the FSAR supplement that includes a summary description of the TLAA evaluation of the applicant's EQ AMP including time dependent electric equipment. Table 4.4-2 contains examples of acceptable FSAR supplement information for this TLAA. The reviewer verifies that the applicant has provided a FSAR supplement with information consistent with that in Table 4.4-2 including plant-specific commitments, license conditions, enhancements or exceptions.

As noted in Table 4.4-2, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified in the SLRA any future aging management activities, including commitments, license conditions, enhancements, and exceptions to be implemented prior to or during the subsequent period of extended operation.

4.4.4 Evaluation of Findings

The reviewer determines whether the applicant has provided information sufficient to satisfy the provisions of this section and whether the applicant's evaluation supports conclusions of the applicant's TLLA evaluation. Depending on the applicant's selection, a review of the applicant's 10 CFR 54.21(c)(1)(i), (ii), or (iii) evaluation is to be included in the NRC staff's Safety Evaluation Report.

The NRC staff confirms that the FSAR supplement contains a sufficiently detailed summary description with key AMP attributes identified in the FSAR summary description. The NRC staff also confirms the FSAR summary provides a summary description of any commitments, license conditions, enhancements, or exceptions as appropriate.

> On the basis of its review, the NRC staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.2 (c)(1), that, for the environmental qualification of Electric Equipment TLAA, [choose which is appropriate] (i) the analyses remain valid for the subsequent period of extended operation, (ii) the analyses have been projected to the end of the subsequent period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation.

4.4.5 Implementation

Except in those cases in which the applicant proposes an alternative method for complying with specific portions of the NRC's regulations, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

4.4.6 References

1. NRC. Regulatory Guide 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants." Revision 1. Washington, DC: U.S. Nuclear Regulatory Commission. June 1984.

2. NRC. "Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors." DOR Guidelines. Washington, DC: U.S. Nuclear Regulatory Commission. November 1979.

3. NRC. NUREG–0588, "Interim Staff Position on Environmental Qualification of Safety-Related Equipment." Washington, DC: U.S. Nuclear Regulatory Commission. July 1981.

4. IEEE. Standard 323-1971, "IEEE Trial Use Standard; General Guide for Qualifying Class 1E Equipment for Nuclear Power Generating Stations." New York City, New York: Institute of Electrical and Electronics Engineers.

5. IEEE. Standard 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations." New York City, New York: Institute of Electrical and Electronics Engineers.

6. IEEE. Standard 382-1972, "Standard for Qualification of Actuators for Power Operated Valve Assemblies with Safety Related Functions for Nuclear Power Plants." New York City, New York: Institute of Electrical and Electronics Engineers.

7. IEEE. Standard 334-1971, "IEEE Standard for Type Tests of Continuous Duty Class 1E Motors for Nuclear Power Generating Stations." New York City, New York: Institute of Electrical and Electronics Engineers.

8. NRC. Regulatory Issue Summary 2003-09, "Environmental Qualification of Low-Voltage Instrumentation and Control Cables." Washington, DC: U.S. Nuclear Regulatory Commission. May 2, 2003.

9. NRC. "Environmental Qualification of Low-Voltage Instrumentation and Control Cables." Generic Safety Issue-168. Washington, DC: U.S. Nuclear Regulatory Commission. February 2001.

11. CFR Part 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants*, Washington, DC: U.S. Nuclear Regulatory Commission. 2009.

12. CFR 50.49, "Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. 2014.

13. NRC. Regulatory Guide 1.211, "Qualification of Safety-Related Cables and Field Splices for Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. April 2009.

14. NRC. Regulatory Guide 1.100, “Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants.” Washington, DC: U.S. Nuclear Regulatory Commission. September 2009.

15. NRC. Regulatory Guide 1.218, “Condition-Monitoring Techniques for Electric Cables Used in Nuclear Power Plants.” Washington, DC: U.S. Nuclear Regulatory Commission. April 2012.

16. IEEE, Standard 1205-2014, **“**IEEE Guide for Assessing, Monitoring, and Mitigating Aging Effects on Electrical Equipment Used in Nuclear Power Generating Stations and Other Nuclear Facilities.**”** New York City, New York: Institute of Electrical and Electronics Engineers.

Table 4.4-1. Environmental Qualification Reanalysis Attributes	
Reanalysis Attributes	**Description**
Analytical methods	The analytical models used in the reanalysis of an aging evaluation are the same as those previously applied during the prior evaluation. The Arrhenius methodology is an acceptable thermal model for performing a thermal aging evaluation. The analytical method used for a radiation aging evaluation is to demonstrate qualification for the total integrated dose (i.e., normal radiation dose for the projected installed life plus accident radiation dose). For SLR, one acceptable method of establishing the 80-year normal radiation dose is to multiply the 60-year normal radiation dose by 2.0 (i.e., 80 years/40 years). The result is added to the accident radiation dose to obtain the total integrated dose for the component. For aging effects attributed to cyclic aging, a similar approach may be used. Other models may be justified on a case-by case basis.
Data collection and reduction methods	The identification of excess conservatism in electrical equipment service conditions (for example, temperature, radiation, and cycles) used in the prior aging evaluation is the chief method used for a reanalysis. For example, temperature data and uncertainties used in an equipment EQ evaluation may be based on the anticipated plant design temperatures found to be conservative when compared to actual plant temperature data. When used, plant temperature data can be obtained in several ways, including monitors used for technical specification compliance; other installed monitors, measurements made by plant operators during rounds, or dedicated monitoring equipment for EQ. A representative number of temperature measurements over a sufficient period of time are evaluated to establish the temperatures used in an aging evaluation. Plant temperature data may be used in an aging evaluation in different ways, such as (a) directly applying the plant temperature data in the evaluation or (b) using the plant temperature data to demonstrate conservatism when using plant design temperatures for an evaluation. The methodology for environmental monitoring, data collection and the analysis of localized EQ equipment environmental data (including temperature and radiation) used in the reanalysis is justified in the record of the reanalysis qualification report. Environmental monitoring data used in the analysis that is collected one time, or is of limited duration, is justified with respect to the applicability of such data to the reanalysis. Any changes to material activation energy values included as part of a reanalysis are justified by the applicant on a plant-specific basis. Similar methods of identifying excess conservatism in the equipment service condition evaluation can be used for radiation and cyclic aging.

Table 4.4-1. Environmental Qualification Reanalysis Attributes	
Reanalysis Attributes	**Description**
Underlying assumptions	EQ equipment aging evaluations contain conservatism to account for most environmental changes occurring due to plant modifications and events. A reanalysis demonstrates that adequate margin is maintained consistent with the original analysis in accordance with 10 CFR 50.59 requiring certain margins and accounting for the unquantified uncertainties established in the EQ aging evaluation of the equipment. A reanalysis that utilizes initial qualification conservatisms and/or in-service environmental conditions (e.g., actual temperature and radiation conditions) are part of an EQ program. Adverse localized environments are identified during periodic inspections, or by operational or maintenance activities that affect the operating environment of an environmentally qualified component, the affected component is evaluated and appropriate corrective actions are taken, which may include changes to the qualification bases and conclusions (e.g., changes to qualified life).
Acceptance criteria and corrective actions	The reanalysis of an aging evaluation is used to extend the environmental qualification of a component. If the qualification cannot be extended by reanalysis, the component must be refurbished, replaced, or requalified prior to exceeding the current qualified life. A reanalysis should be performed in a timely manner (such that sufficient time is available to refurbish, replace, or requalify the component if the reanalysis is unfavorable). A modification to qualified life either by reanalysis or ongoing qualification must demonstrate that adequate margin is maintained consistent with the original analysis including unquantified uncertainties established in the original EQ equipment aging valuation.
Ongoing Qualification	As an alternative to reanalysis when assessed margins, conservatisms, or assumptions do not support reanalysis (e.g., extending qualified life) of an EQ component, the use of on-going qualification techniques including condition monitoring or condition based methodologies may be implemented as a means to provide reasonable assurance that an equipment environmental qualification is maintained for the subsequent period of extended operation. On-going qualification of electric equipment important to safety subject to the requirements of 10 CFR 50.49 involves the inspection, observation, measurement, or trending of one or more indicators, which can be correlated to the condition or functional performance of the EQ equipment. On-going Qualification techniques, including condition based monitoring, provide information that may be used in the determination a component’s ability to perform its safety function and the

Table 4.4-1. Environmental Qualification Reanalysis Attributes	
Reanalysis Attributes	**Description**
	components remaining qualified life for the subsequent period of extended operation. On-going qualification techniques for EQ equipment include, as applicable, periodic testing, inspections, mitigation, sampling (e.g., subsequent EQ qualification testing of inservice or representative EQ equipment with established acceptance criteria and corrective actions (e.g., mitigation, replacement or refurbishment) consistent with endorsed standards and regulatory guidance.

Table 4.4-2. Examples of FSAR Supplement for Environmental Qualification Electric Equipment TLAA Evaluation

	10 CFR 54.21(c)(1)(i) Example		
	TLAA	**Description of Evaluation**	**Implementation Schedule***
4.4	Environmental qualification of electric equipment	The original environmental qualification qualified life has been shown to remain valid for the period of extended operation. [Plant specific identification and summary descriptions of commitments, license conditions, enhancements or exceptions are also described as applicable]	
	10 CFR 54.21(c)(1)(ii) Example		
	TLAA	**Description of Evaluation**	**Implementation Schedule***
4.4	Environmental qualification of electric equipment	The environmental qualification has been projected to the end of the period of extended operation. [The summary report addresses the key reanalysis attributes of analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions]. [Plant specific identification and summary descriptions of commitments, license conditions, enhancements or exceptions are also described as applicable]	Completed
	10 CFR 54.21(c)(1)(iii) Example		
	TLAA	**Description of Evaluation**	**Implementation Schedule**
4.4	Environmental qualification of electric equipment	The applicant's environmental qualification process, in accordance with 10 CFR 50.49, will adequately manage aging of environmental qualification equipment for the period of extended operation because equipment will be replaced prior to reaching the end of its qualified life. [The summary report addresses the key reanalysis attributes of methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions.]	Existing program

Table 4.4-2. Examples of FSAR Supplement for Environmental Qualification Electric Equipment TLAA Evaluation

		[The applicant states that its environmental qualification program contains the same elements evaluated in the GALL-SLR Report.] [Plant specific identification and summary descriptions of commitments, license conditions, enhancements or exceptions are also described as applicable]	

4.5 Concrete Containment Unbonded Tendon Prestress Analysis

Review Responsibilities

Primary—Branch responsible for structural engineering

Secondary—Branch responsible for structural engineering

4.5.1 Areas of Review

The prestressing tendons in prestressed concrete containments undergo losses in prestressing forces with time due to creep and shrinkage of concrete and relaxation of the prestressing steel. During the design phase, engineers estimated these losses to the end of the prestressed containment operating life, normally 40 years. Operating experiences with the trend of prestressing forces indicate the prestressing tendons lose their prestressing forces at a rate higher than predicted due to sustained high temperature. In addition, loss of prestress or reduction in tendon force can occur due to breakage of tendon wires or improper anchorages. Stress corrosion cracking (SCC) in individual tendons can also occur and contribute to the loss of tendon prestress if there is a susceptible material and environment combination. Moreover, consideration should be given to an increased tendon relaxation when replacing existing in service tendons with new. Thus, it is necessary to ensure that the applicant addresses existing Time Limited Aging Analyses (TLAAs) for the subsequent period of extended operation. Plant specific TLAAs regarding loss of prestress [e.g., predicted tendon prestress force lower limit–predicted lower limit (PLL), bonded tendons] are addressed and reviewed in Section 4.7, “Other Plant-Specific Time-Limited Aging Analyses.”

The adequacy of the prestressing forces in prestressed concrete containments is reviewed for the subsequent period of extended operation.

4.5.2 Acceptance Criteria

The acceptance criteria for the area of review described in Subsection 4.5.1 delineate acceptable methods for meeting the requirements of the U.S. Nuclear Regulatory Commission (NRC) regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(c)(1).

4.5.2.1 Time-Limited Aging Analysis

Pursuant to 10 CFR 54.21(c)(1)(i) - (iii), an applicant must demonstrate one of the following:

(i) The analyses remain valid for the subsequent period of extended operation;

(ii) The analyses have been projected to the end of the subsequent period of extended operation; or

(iii) The effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation.

4.5.2.1.1 10 CFR 54.21(c)(1)(i)

The existing prestressing force evaluation remains valid because (a) losses of the prestressing force are less than the predicted losses, as evidenced from the trend lines constructed from the recent inspection, (b) the period of evaluation covers the subsequent period of extended operation, and (c) the trend lines of the measured prestressing forces remain above the minimum required prestress force specified at anchorages for each group of tendons for the subsequent period of extended operation.

4.5.2.1.2 10 CFR 54.21(c)(1)(ii)

The prediction line of prestressing forces for each group of tendons initially developed for 40 years of operation should be extended to 80 years. The applicant demonstrates through analysis the unbonded tendon prestressed concrete containment design adequacy remains valid and that the trend lines of the measured prestressing forces will stay above the design Minimum Required Value (MRV) in the current licensing basis (CLB) for each group of tendons during the subsequent period of extended operation.

4.5.2.1.3 10 CFR 54.21(c)(1)(iii)

In Chapter X of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report, the NRC staff evaluated a program that assesses the concrete containment tendon prestressing forces [aging management program (AMP) X.S1, "Concrete Containment Unbonded Tendon Prestress"], and has determined that it is an acceptable AMP to address concrete containment tendon prestress according to 10 CFR 54.21(c)(1)(iii), except for operating experience. Further evaluation is recommended of the applicant's operating experience related to the containment prestress force. However, the GALL-SLR Report contains one acceptable way and not the only way to manage aging. The GALL-SLR report may be referenced in a subsequent license renewal application (SLRA), and is treated in the same manner as an approved topical report.

In referencing the GALL-SLR report, an applicant indicates that the material referenced is applicable to the specific plant involved and should provide the information necessary to adopt the finding of program acceptability as described and evaluated in the report. An applicant also verifies that the approvals set forth in the GALL-SLR report for the generic program apply to the applicant's program.

4.5.2.2 Final Safety Analysis Report Supplement

The specific criterion for meeting 10 CFR 54.21(d) is:

The summary description of the evaluation of TLAAs for the subsequent period of extended operation in the Final Safety Analysis Report (FSAR) supplement is appropriate such that later changes can be controlled by 10 CFR 50.59. The description must contain information associated with the TLAAs regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.5.3 Review Procedures

For each area of review described in Subsection 4.5.1, the following review procedures should be followed:

4.5.3.1 Time-Limited Aging Analysis

For a concrete containment prestressing tendon system, the review procedures, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), are:

4.5.3.1.1 10 CFR 54.21(c)(1)(i)

The results of a recent inspection to measure the amount of prestress loss are reviewed to ensure that the reduction of prestressing force is less than the predicted loss in the existing analysis. The reviewer verifies that the trend line of the measured prestressing force, when plotted on the predicted prestressing force curve, shows that the existing analysis remains valid for the subsequent period of extended operation.

4.5.3.1.2 10 CFR 54.21(c)(1)(ii)

The reviewer reviews the trend lines of the measured prestressing forces to ensure that individual tendon lift-off forces (rather than average lift-off forces of the sampled tendon group) are considered in the regression analysis for the subsequent period of extended operation, as discussed in Information Notice (IN) 99-10, "Degradation of Prestressing Tendon Systems in Prestressed Concrete Containments." The reviewer then verifies that the trend lines will stay above the minimum required prestressing forces for each group of tendons during the subsequent period of extended operation so that the design adequacy is maintained in the subsequent period of extended operation.

4.5.3.1.3 10 CFR 54.21(c)(1)(iii)

An applicant may reference the GALL-SLR Report in its SLRA, as appropriate. The reviewer verifies that the applicant has stated that the report is applicable to its plant with respect to its program that assesses the concrete containment tendon prestressing forces. The reviewer verifies that the applicant has identified the appropriate program (i.e., GALL-SLR Report AMP X.S1) as described and evaluated in the GALL-SLR Report. The reviewer also ensures that the applicant has stated that its program contains the same program elements that the NRC staff evaluated and relied upon in approving the corresponding generic program in the GALL-SLR Report.

Further evaluation is recommended of the applicant's operating experience related to the containment prestress force. The applicant's program should incorporate the relevant operating experience that occurred at the applicant's plant as well as at other plants. The applicant considers applicable portions of the experience with prestressing systems described in IN 99-10. Tendon operating experience could vary among plants with prestressed concrete containments. The difference could be due to the prestressing system design (for example, button-heads, wedge or swaged anchorages), environment, or type of reactor [pressurized water reactor (PWR) or boiling water reactor (BWR)]. The reviewer reviews the applicant's program to verify that the applicant has adequately considered plant-specific operating experience.

If the applicant does not reference the GALL-SLR Report in its SLRA, additional NRC staff evaluation is necessary to determine whether the applicant's program is acceptable for this area of review. The reviewer uses the guidance provided in Branch Technical Position (BTP) RLSB-1 of this Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) to ensure that loss of prestress in the concrete containment prestressing tendons is adequately managed so that trend lines will remain above the minimum required prestressing forces for each group of tendons for the subsequent period of extended operation.

4.5.3.2 Final Safety Analysis Report Supplement

The reviewer verifies that the applicant has provided information, to be included in the FSAR supplement, that includes a summary description of the evaluation of the tendon prestress TLAA. Table 4.5-1 contains examples of acceptable FSAR supplement information for this TLAA. The reviewer verifies that the applicant has provided an FSAR supplement with information equivalent to that in Table 4.5-1.

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

As noted in Table 4.5-1, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments to be completed before the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

4.5.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of Section 4.5 and whether the NRC staff's evaluation supports conclusions of the following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be included in the Safety Evaluation Report:

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that, for the concrete containment tendon prestress TLAA, [choose which is appropriate] (i) the analyses remain valid for the subsequent period of extended operation, (ii) the analyses have been projected to the end of the subsequent period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation. The NRC staff also concludes that the FSAR supplement contains an appropriate description of the concrete containment tendon prestress TLAA evaluation for the subsequent period of extended operation as reflected in the license condition.

4.5.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

4.5.6 References

1. NRC. Regulatory Guide 1.35.1, “Determining Prestressing Forces for Inspection of Prestressed Concrete Containments.” Washington, DC: U.S. Nuclear Regulatory Commission. ML003740040. July 1990.

2. NRC. Information Notice 99-10, “Degradation of Prestressing Tendon Systems in Prestressed Concrete Containments.” ML031500244. Washington, DC: U.S. Nuclear Regulatory Commission. April 1999.

Table 4.5-1. Examples of FSAR Supplement for Concrete Containment Tendon Prestress TLAA Evaluation		
10 CFR 54.21(c)(1)(i) Example		
TLAA	**Description of Evaluation**	**Implementation Schedule***
Concrete Containment Tendon Prestress	The prestressing tendons are used to impart compressive forces in the prestressed concrete containments to resist the internal pressure inside the containment that would be generated in the event of a loss of coolant accident (LOCA). The prestressing forces generated by the tendons diminish over time due to losses in prestressing forces in the tendons and in the surrounding concrete. The prestressing force review and evaluation has been completed and determined to remain valid to the end of the subsequent period of extended operation, and the trend lines of the measured prestressing forces will stay above the minimum required prestressing forces for each group of tendons to the end of this period.	Completed
10 CFR 54.21(c)(1)(ii) Example		
TLAA	**Description of Evaluation**	**Implementation Schedule***
Concrete Containment Tendon Prestress	The prestressing tendons are used to impart compressive forces in the prestressed concrete containments to resist the internal pressure inside the containment that would be generated in the event of a LOCA. The prestressing forces generated by the tendons diminish over time due to losses in prestressing forces in the tendons and in the surrounding concrete. The prestressing force analysis and evaluation has been completed and determined to remain within allowable limits to the end of the subsequent period of extended operation, and the trend lines of the measured pre-stressing forces will stay above the minimum required prestressing forces for each group of tendons to the end of this period.	Completed
10 CFR 54.21(c)(1)(iii) Example		
TLAA	**Description of Evaluation**	**Implementation Schedule***
Concrete Containment Tendon Prestress	The prestressing tendons are used to impart compressive forces in the prestressed concrete containments to resist the internal pressure inside the containment that would be generated in the event of a LOCA. The prestressing forces generated by the tendons diminish over time due to losses of prestressing forces in the tendons and in the surrounding concrete. The [identify the AMP] developed to monitor the prestressing forces will ensure that, during each inspection, the trend lines of the measured prestressing forces show that they meet the requirements of the ASME Code, Section XI, Subsection IWL, as incorporated by reference in 10 CFR 50.55a and	Program should be implemented before the subsequent period of extended operation.

Table 4.5-1.	Examples of FSAR Supplement for Concrete Containment Tendon Prestress TLAA Evaluation	
	supplemented. If the trend lines cross the PLLs, corrective actions should be taken. The program incorporates plant-specific and industry operating experience.	
*An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the subsequent period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.		

4.6 Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analysis

Review Responsibilities

Primary—Branch responsible for structural engineering

Secondary—Branch responsible for mechanical engineering

4.6.1 Areas of Review

This section addresses fatigue analyses for containment metal liner plates, metal containments [including boiling water reactor (BWR) containment suppression chamber and the vent system), and penetrations (including personnel airlocks, equipment hatches, sleeves, dissimilar metal welds, and bellows].

The interior surface of a concrete containment structure is lined with thin metallic plates to provide a leak-tight barrier against the uncontrolled release of radioactivity to the environment, as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix J. The thickness of the liner plates is generally between 1/4-in [6.2 mm] and 3/8-in [9.5 mm]. The liner plates are attached to the concrete containment wall by stud anchors or structural rolled shapes or both. The design process assumes that the liner plates do not carry loads. However, imposed loads or conditions (e.g., dead, seismic, thermal, internal pressure, creep and shrinkage) induce cyclic stresses in the liner plates. Thus, under design-basis conditions, the liner plates could experience cyclic strains. Some plants may have metal containments instead of concrete containments with liner plates. The metal containments are designed to carry dead loads and seismic loads in addition to the internal pressure and temperature loads. For BWR Mark I metal containments, the containment suppression pool torus chamber (wetwell) and the vent system are designed or evaluated for hydrodynamic loads associated with actuation of safety relief valves and the discharge into the suppression pool chamber.

Fatigue of the containment liner plates or metal containments may be considered in the design based on an assumed number of occurrences and severities of cyclic loads for the current operating term. The cyclic loads include reactor building interior temperature variations during heatups and cooldowns of the reactor coolant system, loss of coolant accident (LOCA) as applicable, annual outdoor temperature variations, thermal loads due to the high energy containment penetration piping lines (such as steam and feedwater lines), seismic loads, and pressurization due to periodic Type A integrated leak rate tests. The BWR containment suppression pool chamber and the vent system are designed or evaluated for the hydrodynamic cyclic loads as described in Section 6.2.1.1.C, "Pressure-Suppression Type BWR Containments," of NUREG–0800, "Standard Review Plan."

Electrical penetration assemblies are usually sealed canisters penetrating the containment liner plate or metal containment barrier such that a pressure boundary between the inboard and outboard sides of the penetration exists while maintaining electrical continuity through the device. Mechanical penetrations include piping penetrations, access penetrations, drywell head, and fuel transfer tubes. High energy piping penetrations and the fuel transfer tubes in some plants are equipped with stainless steel (SS) bellow assemblies. These penetrations accommodate loads from relative movements between the containment wall (including the liner) and the adjoining structures, and from Type B, local leak rate tests. The penetrations have sleeves (up to 3 m [10 ft] in length, with a 5- to 8-cm [2- to 3-inch] annulus around the piping) to penetrate the concrete containment wall and allow movement of the piping system. Dissimilar metal welds connect the piping penetrations to the bellows or SS plates to provide essentially leak-tight penetrations. Historical maintenance records, industry operating experience, and aging mechanisms that include degradation due to fatigue and their effects on electrical and mechanical penetrations, are discussed in Electric Power Research Institute (EPRI) Report "Aging Management Guideline for Commercial Nuclear Power Plants Electrical and Mechanical Penetrations."

The containment metal liner plates, metal containments (including BWR containment suppression chamber and the vent system), and penetrations (including personnel airlocks, equipment hatches, sleeves, dissimilar metal welds, and bellows), may be designed in accordance with requirements of Section III of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code[1]. If a plant's code of record requires a fatigue parameter evaluation (fatigue analysis or fatigue waiver), then this analysis may be a time-limited aging analysis (TLAA) and should be evaluated in accordance with 10 CFR 54.21(c)(1) for the subsequent license renewal (SLR) period.

The adequacy of the fatigue parameter evaluations of the containment liner plates, metal containments, and penetrations is reviewed in this section for the subsequent period of extended operation. The number of cyclic load occurrences assumed in the fatigue parameter evaluations should be clearly identified in Section 4.6 of the applicant's subsequent license renewal application (SLRA). The fatigue parameter evaluations of the pressure boundary of process piping are reviewed separately following the guidance in Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Section 4.3, "Metal Fatigue."

4.6.1.1 Time-Limited Aging Analysis (Fatigue Parameter Evaluations)

The ASME Code contains explicit requirements for fatigue parameter evaluations (fatigue analyses or fatigue waivers), which are TLAAs. Specific requirements are contained in the design code of reference for each plant. The severities and the numbers of cycles of actual loadings for each cyclic load assumed in the underlying analyses should be verified against the numbers and severities of the actual loads projected for the subsequent period of extended operation. Monitoring of cyclic loading is accomplished through a TLAA aging management program (AMP) consistent with the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report, X.M1 "Cyclic Load Monitoring," or through a site-specific AMP consistent with the guidance provided in the SRP-SLR, Appendix A.1, "Branch Technical Position, Aging Management Review—Generic."

4.6.1.1.1 Fatigue Analyses (ASME Section III, MC or Class 1)

ASME, Boiler and Pressure Vessel (B&PV) Code, Section III, Division 2, "Code for Concrete Containments, Rules for Construction of Nuclear Facility Components," and ASME B&PV Code, Section III, Division 1, "Subsection NE, Class MC Components, Rules for Construction of

[1]GALL-SLR Report Chapter 1, Table 1, identifies the ASME Code Section XI editions and addenda that are acceptable to use of AMPs.

Nuclear Facility Components," require a fatigue analysis for liner plates, metal containments, and penetrations that considers all cyclic loads based on the anticipated number of cycles. Containment components also may be designed to ASME Section III Class 1 requirements. A Section III, MC or Class 1 fatigue analysis requires the calculation of the cumulative usage factor (CUF) based on the fatigue properties of the materials and the expected fatigue service of the component. The ASME code limits the CUF to a value less than or equal to one for acceptable fatigue design. The fatigue resistance of the liner plates or metal containments, and penetrations during the subsequent period of extended operation is an area of review.

Other evaluations also contain metal fatigue analysis requirements based on a CUF calculation, such as metal bellows designed to ASME NC-3649.4(e)(3) Titles or NE-3366.2(e)(3) standards.

4.6.1.1.2 Fatigue Waiver Evaluations

The current licensing basis (CLB) may include fatigue waiver evaluations that preclude the need for performing CUF analyses of structural components. The American Society of Mechanical Engineers (ASME) Code Section III rules for performing fatigue waiver evaluations for structural components are analogous to those in the Code for performing fatigue waiver evaluations of mechanical components. ASME Code NE-3131(d) Titles (1974 editions or later) rules out consideration for earthquake transients unless they impact designated liner locations recognized in the specifications. ASME Code NE-3222.4(d) "Analysis for Cyclic Operations, Vessels Not Requiring Analysis for Cyclic Operation," provides for a waiver from fatigue analysis when certain cyclic loading criteria are met.

4.6.1.2 Final Safety Analysis Report Supplement

The SLRA contains TLAA information for containment liner plates, metal containments, and penetrations. A summary description of the evaluation of containment liner plates, metal containments, and penetrations TLAAs for the subsequent period of extended operation is also contained in the applicant's proposed final safety analysis report (FSAR) supplement. The FSAR supplement is an area of review.

4.6.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Subsection 4.6.1 delineate acceptable methods for meeting the requirements of the U.S. Nuclear Regulatory Commission (NRC) regulations in 10 CFR 54.21(c)(1).

4.6.2.1 Time-Limited Aging Analysis

In some instances, the applicant may identify activities to be performed to verify the assumption bases of the fatigue parameter evaluations, the fatigue analyses, or the fatigue waiver evaluations. Evaluations of those activities are provided by the applicant. The reviewer assures that the applicant's activities are sufficient to confirm the calculation assumptions for the SLR period.

Pursuant to 10 CFR 54.21(c)(1), an applicant must demonstrate one of the following:

(i) The analyses remain valid for the subsequent period of extended operation;

(ii) The analyses have been projected to the end of the subsequent period of extended operation; or

(iii) The effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation.

Specific acceptance criteria for fatigue of containment liner plates, metal containments, and penetrations are provided in the following subsections.

4.6.2.1.1 Fatigue Parameter Evaluations

For containment liner plates, metal containments, and penetrations that have fatigue parameter evaluations, the acceptance criteria are provided in the following subsections depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii). This section applies to the evaluations identified in Sections 4.6.1.1.1 and 4.6.1.1.2.

4.6.2.1.1.1 10 CFR 54.21(c)(1)(i)

The fatigue parameter evaluations remain valid because the numbers of occurrences and severities of assumed cyclic loads are not projected to be exceeded during the subsequent period of extended operation.

4.6.2.1.1.2 10 CFR 54.21(c)(1)(ii)

The fatigue parameter evaluations have been reevaluated based on revised numbers of occurrences and severities of assumed cyclic loads for the subsequent period of extended operation and have been shown to remain within the allowed limits.

4.6.2.1.1.3 10 CFR 54.21(c)(1)(iii)

The applicant proposes an AMP as the basis for demonstrating that the effect or effects of aging on the intended function(s) of the structure(s) or component(s) in the fatigue parameter evaluations will be adequately managed during the subsequent period of extended operation. GALL-SLR Report AMP X.M1 provides one method that may be used to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii).

An applicant may also propose another AMP to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii). If the basis for aging management is a plant-specific AMP, the AMP should be defined in terms of the 10 program elements defined in the SRP-SLR, Appendix A.1.

If an inspection program is proposed as the basis for aging management, the AMP implements inspections of the component(s) or structure(s) in the evaluation. The AMP justifies the inspection methods and frequencies that are applicable to the component(s) or structure(s), such that the TLAA will meet the requirement of 10 CFR 54.21(c)(1)(iii).

Consistent with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(iii), an AMP is proposed to accept the TLAA in accordance with 10 CFR 54.21(c)(1)(iii) and to manage the effects of cumulative fatigue damage or fatigue-induced cracking on the intended functions of the components during the subsequent period of extended operation. GALL-SLR Report AMP XI.M1 provides one AMP that may be used as the basis for accepting the fatigue parameter evaluation in accordance with 10 CFR 54.21(c)(1)(iii). However, other Generic Aging

Lessons Learned (GALL) AMPs or plant-specific AMPs or activities may be used to accept the TLAA in accordance 10 CFR 54.21(c)(1)(iii) if appropriately justified in the SLRA.

4.6.2.2 Final Safety Analysis Report Supplement

The summary description of the evaluation of TLAAs for the subsequent period of extended operation in the FSAR supplement is appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the TLAAs regarding the basis for determining that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

4.6.3 Review Procedures

For each area of review described in Subsection 4.6.1, the review procedures in the following subsections should be used.

4.6.3.1 Time-Limited Aging Analysis

4.6.3.1.1 Fatigue Parameter Evaluations

For containment liner plates, metal containments, and penetrations with fatigue parameter evaluations, the review procedures are provided in the following subsections depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii).

4.6.3.1.1.1 10 CFR 54.21(c)(1)(i)

The projected number of occurrences and severities of cyclic loadings at the end of the subsequent period of extended operation is compared to the number of occurrences and severities of cyclic loadings used in the existing fatigue parameter evaluations. The comparison confirms that the number of occurrences and severities of cyclic loadings in the existing fatigue parameter evaluations will not be exceeded during the subsequent period of extended operation.

4.6.3.1.1.2 10 CFR 54.21(c)(1)(ii)

The revised number of occurrences and severities of cyclic loadings projected to the end of the subsequent period of extended operation is reevaluated. The revised fatigue parameter evaluations based on the projected number of occurrences and severities of cyclic loads are reviewed to ensure that the calculated fatigue parameters remain less than the allowed values at the end of the subsequent period of extended operation.

If applicable, the code of record is used for the revised fatigue parameter evaluations, or the applicant may update to a later code edition pursuant to 10 CFR 50.55a. In the latter case, the reviewer verifies that the requirements in 10 CFR 50.55a are met.

4.6.3.1.1.3 10 CFR 54.21(c)(1)(iii)

Pursuant to 10 CFR 54.21(c)(1)(iii), the applicant proposes an AMP or aging management activities as the basis for demonstrating that the effect or effects of aging on the intended function(s) of the structure(s) or component(s) in the fatigue parameter evaluation will be adequately managed during the subsequent period of extended operation. If an AMP corresponding to GALL-SLR Report AMP X.M1 is used as the basis for managing cumulative fatigue damage or cracking due to fatigue or cyclical loading in the structure(s) or component(s), the reviewer reviews the applicant's AMP against the program elements defined in GALL-SLR Report AMP X.M1.

An applicant also has the option of proposing another GALL-based AMP, plant-specific AMP, or plant-specific activities, or combination thereof, to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii). If another GALL-based AMP is proposed as the basis for aging management, the reviewer reviews the applicant's AMP against the program element criteria defined in the applicable AMP section in Appendix A of the GALL-SLR Report. If the basis for aging management is a plant-specific AMP or plant-specific aging management activities, the reviewer reviews the program element criteria for the AMP or activities against the criteria defined in the SRP-SLR, Appendix A.1, "Branch Technical Position, Aging Management Review—Generic," Sections A.1.2.3.1 through A.1.2.3.10.

If a sampling based inspection program (a type of condition monitoring program) is proposed as the basis for aging management, the reviewer ensures that the AMP actually performs inspections of the component(s) or structure(s) in the evaluation and that the applicant has appropriately justified that the inspection bases are capable of managing cumulative fatigue damage or cracking by fatigue or cyclical loading in the component(s) or structure(s), such that the TLAA may be accepted in accordance with 10 CFR 54.21(c)(1)(iii).

4.6.3.2 Final Safety Analysis Report Supplement

The reviewer verifies that the applicant has provided information, to be included in the FSAR supplement, that includes a summary description of the fatigue parameter TLAA evaluations for the containment liner plates, metal containments, and penetrations. SRP-SLR Table 4.6-1 contains examples of acceptable FSAR Supplement information for this TLAA. The reviewer verifies that the applicant has provided an FSAR Supplement with information equivalent to that in Table 4.6-1.

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

As noted in Table 4.6-1, the applicant need not incorporate the implementation schedule into its FSAR. However, the review should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments to be completed before the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

4.6.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section and to support the following conclusions, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be included in the Safety Evaluation Report.

On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that the [the reviewer inserts the type of fatigue parameter evaluation] TLAA evaluations, [choose which is appropriate] (i) remains valid for the subsequent period of extended operation, (ii) has been projected to the end of the subsequent period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed during the subsequent period of extended operation. The NRC staff also concludes that the FSAR supplement contains an appropriate summary description of the [the reviewer inserts the type of fatigue parameter evaluation] TLAA evaluations for the subsequent period of extended operation as reflected in the license condition.

4.6.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations.

4.6.6 References

1. NRC. NUREG-0661, "Mark I Containment Long-Term Program Resolution of Generic Technical Activity A-7." Washington, DC: U.S. Nuclear Regulatory Commission. July 1980.

2. American Society of Mechanical Engineers, Boiler and Pressure Vessel (B&PV) Code, Section III, Division 2, "Code for Concrete Containments, Rules for Construction of Nuclear Facility Components," New York City, New York (as endorsed in Regulatory Guide 1.136, "Design Limits, Loading Combinations, Materials, Construction, and Testing of Concrete Containments.").

3. American Society of Mechanical Engineers, Boiler and Pressure Vessel (B&PV) Code, Section III, Division 1, "Subsection NE, Class MC Components, Rules for Construction of Nuclear Facility Components," New York City, New York.

4. American Society of Mechanical Engineers, Boiler and Pressure Vessel (B&PV) Code, Section III, Division 1, "Subsection NC, Class 2 Components, Rules for Construction of Nuclear Facility Components," New York City, New York.

5. Electric Power Research Institute (EPRI) TR-1003456, "Aging Management Guideline for Commercial Nuclear Power Plants Electrical and Mechanical Penetrations," Palo Alto, California, April 2002.

Table 4.6-1. Examples of FSAR Supplement for Containment Liner Plates, Metal Containments, and Penetrations Fatigue TLAA Evaluation		
10 CFR 54.21(c)(1)(i) Example		
TLAA	**Description of Evaluation**	**Implementation Schedule***
Containment Liner Plates, Metal Containments, and Penetrations Fatigue	The containment liner plates, metal containments, and penetrations provide an essentially leak-tight barrier. Current fatigue parameter evaluations remain valid during the subsequent period of extended operation.	Completed
10 CFR 54.21(c)(1)(ii) Example		
TLAA	**Description of Evaluation**	**Implementation Schedule***
Containment Liner Plates, Metal Containments, and Penetrations Fatigue	The containment liner plates, metal containments, and penetrations provide an essentially leak-tight barrier. Fatigue parameter evaluations have been reevaluated based on revised numbers of occurrences and severities of cyclic loads projected for the subsequent period of extended operation. The revised fatigue parameter values remain within allowable limits for the subsequent period of extended operation.	Completed
10 CFR 54.21(c)(1)(iii) Example		
TLAA	**Description of Evaluation**	**Implementation Schedule***
Containment Liner Plates, Metal Containments, and Penetrations Fatigue	The containment liner plates, metal containments, and penetrations provide an essentially leak-tight barrier. The applicant identifies an aging management program (AMP) to manage the effects of fatigue on such components during the subsequent period of extended operation. The program monitors and tracks the number of cycles and occurrences and severities of relevant transients. The program is effective when fatigue evaluations and/or fatigue usage remain within the allowable limits or requires corrective actions (e.g., reanalyses and/or component replacement) when the limits are exceeded. If the component is replaced, the fatigue parameter value for the replacement should be shown to be less than the allowable limit during the subsequent period of extended operation.	Proposed TLAA AMP should be implemented before the subsequent period of extended operation.
*An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the subsequent license renewal application to any future aging management activities to be completed before the subsequent period of extended operation. The NRC staff expects to impose a license condition on any subsequent renewed license to ensure that the applicant will complete these activities no later than the committed date. Note: All containment components need not meet the same requirement. It is likely that the liner plate and the bellows may be evaluated per 10CFR54.21(c)(1)(i), while high energy penetrations may be evaluated per 10CFR54.21(c)(1)(ii).		

4.7 Other Plant-Specific Time-Limited Aging Analyses

Review Responsibilities

Primary—Office of Nuclear Reactor Regulation (NRR) branch responsible for the time-limited aging analysis (TLAA) issues

Secondary—Other branches responsible for systems, as appropriate

4.7.1 Areas of Review

There are certain plant-specific safety analyses that may involve time-limited assumptions defined by the current operating term of the plant (for example, aspects of the reactor vessel design) and may, therefore, be TLAAs. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(c), a subsequent license renewal (SLR) applicant is required to evaluate TLAAs. The definition of TLAAs is provided in 10 CFR 54.3 and in Section 4.1 of this Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR).

As indicated in 10 CFR 54.30, the adequacy of the plant's current licensing basis (CLB) is not an area within the scope of the SLR review. Any questions regarding the adequacy of the CLB must be addressed under the backfit rule (10 CFR 50.109) and are separate from the license renewal process. SLR reviews focus on the subsequent period of extended operation. Pursuant to 10 CFR 54.30, if the reviews required by 10 CFR 54.21(a) or (c) show that there is not reasonable assurance during the current license term that licensed activities will be conducted in accordance with the CLB, the licensee is required to take measures under its current license to ensure that the intended functions of those systems, structures, and components (SSCs) are maintained in accordance with the CLB throughout the term of the current license. The adequacy of the measures for the term of the current license is not within the scope of the SLR review.

Pursuant to 10 CFR 54.21(c), an applicant must provide a listing of TLAAs and plant-specific exemptions that are based on TLAAs. The U.S. Nuclear Regulatory Commission (NRC) staff reviews the applicant's identification of TLAAs and exemptions separately, following the guidance in Section 4.1 of this SRP-SLR.

The NRC staff has developed review procedures for the evaluation of certain TLAAs. If an applicant identifies these TLAAs as applicable to its plant, the NRC staff reviews them separately, following the guidance in Sections 4.2 through 4.6 of this SRP-SLR.

Table 4.7-1 provides examples of potential plant-specific TLAA topics. The reviewer follows the generic guidance in this section of the SRP-SLR for reviewing these and any other plant-specific TLAAs that have been identified by the applicant. For particular systems, the reviewers from branches responsible for those systems may be requested to assist in the review, as appropriate.

The following sub-sections identify the areas of review for plant-specific TLAAs.

4.7.1.1 Time-Limited Aging Analysis

The applicant's evaluation of the TLAA for the subsequent period of extended operation is reviewed.

4.7.1.2 Final Safety Analysis Report Supplement

The FSAR supplement summarizing the applicant's evaluation of the TLAA for the subsequent period of extended operation is reviewed.

4.7.2 Acceptance Criteria

The acceptance criteria for the areas of review described in Section 4.7.1 delineate acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1) and 10 CFR 54.21(d).

4.7.2.1 Time-Limited Aging Analysis

Pursuant to 10 CFR 54.21(c)(1), an applicant must demonstrate one of the following for TLAAs:

(i) The analyses remain valid for the period of extended operation;

(ii) The analyses have been projected to the end of the period of extended operation; or

(iii) The effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Acceptance criteria for each TLAA demonstration are discussed in the following subsections.

4.7.2.1.1 10 CFR 54.21(c)(1)(i)

The applicant must demonstrate that the analysis remains valid for the subsequent period of extended operation. The analysis remains valid because it is shown to be bounding even during the subsequent period of extended operation. No changes to the existing analysis are necessary.

4.7.2.1.2 10 CFR 54.21(c)(1)(ii)

The applicant must demonstrate that the analysis has been projected to the end of the subsequent period of extended operation. The existing analysis is updated or recalculated to show acceptable results for the subsequent period of extended operation.

4.7.2.1.3 10 CFR 54.21(c)(1)(iii)

The applicant must demonstrate that the effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation. Appendix A.1 of this SRP-SLR provides the acceptance criteria for programs and activities used to manage the effects of aging.

4.7.2.2 Final Safety Analysis Report Supplement

The summary description of the applicant's TLAA evaluation should be sufficiently comprehensive such that later changes can be controlled by 10 CFR 50.59. The summary description should identify which demonstration from 10 CFR 54.21(c)(1) was chosen and provide the results of the evaluation used to make that demonstration.

4.7.3 Review Procedures

For certain applicants, plant-specific analyses may meet the definition of a TLAA as given in 10 CFR 54.3. The concern for SLR is that these analyses may not have properly considered the full length of the subsequent period of extended operation, which may change conclusions with regard to safety and the capability of SSCs within the scope of the Rule to perform or one or more safety functions. The review of these TLAAs provides assurance that the effects of aging are properly addressed through the subsequent period of extended operation.

The following sub-sections provide the review procedures for each area of review described in Section 4.7.1.

4.7.3.1 Time-Limited Aging Analysis

For each TLAA, the review procedures depend on the applicant's choice of methods of compliance in 10 CFR 54.21(c)(1)(i), (ii), or (iii).

4.7.3.1.1 10 CFR 54.21(c)(1)(i)

Justification provided by the applicant is reviewed to verify that the existing analysis remains valid for the subsequent period of extended operation. The existing analysis should be shown to be bounding even during the subsequent period of extended operation.

The applicant describes the TLAA with respect to the objectives of the analysis, assumptions used in the analysis, conditions, acceptance criteria, relevant aging effects, and intended function(s). For those analyses that consider cyclic loading, each load or transient type should be identified along with the corresponding number of total cycles assumed in the analysis and the number of cycles that are anticipated to occur through the subsequent period of extended operation. The applicant shows that (a) conditions and assumptions used in the analysis already address the relevant aging effects for the subsequent period of extended operation, and (b) acceptance criteria are maintained to provide reasonable assurance that the intended function(s) is maintained. Thus, no reanalysis is necessary.

In some instances, the applicant may identify activities to be performed to verify the assumption basis for the calculation (e.g., cycle counting). An evaluation of that activity is provided by the applicant. The reviewer assures that the applicant's verification activities are sufficient to confirm the validity of the calculation assumptions for the subsequent period of extended operation.

If the TLAA must be modified or recalculated to extend the period of evaluation to consider the subsequent period of extended operation, then reevaluation should be addressed under 10 CFR 54.21(c)(1)(ii).

4.7.3.1.2 10 CFR 54.21(c)(1)(ii)

The documented results of the revised analyses are reviewed to verify that their period of evaluation is extended such that they are valid for the subsequent period of extended operation. The applicable analysis technique can be the one that is in effect in the plant's CLB at the time that the subsequent license renewal application (SLRA) is filed.

The applicant may recalculate the TLAA using an 80-year period to show that the acceptance criteria continue to be satisfied for the subsequent period of extended operation. The applicant also may revise the TLAA by recognizing and reevaluating any overly conservative conditions and assumptions. Examples include relaxing overly conservative assumptions in the original analysis, using new or refined analytical techniques, and performing the analysis using an 80-year period. The applicant should provide a sufficient description of the analysis and document the results of the reanalysis to show that it is satisfactory for the subsequent period of extended operation.

As applicable, the plant's code of record is used for the reevaluation, or the applicant may update to a later code edition pursuant to 10 CFR 50.55a. In the latter case, the reviewer verifies that the requirements in 10 CFR 50.55a are met.

In some cases, the applicant may identify activities to be performed to verify the assumption basis for the calculation (e.g., cycle counting). An evaluation of that activity is provided by the applicant. The reviewer assures that the applicant's verification activities are sufficient to confirm the validity of the calculation assumptions for the subsequent period of extended operation.

4.7.3.1.3 10 CFR 54.21(c)(1)(iii)

Under this option, the applicant proposes to manage the aging effects associated with the TLAA by an aging management program (AMP) or aging management activities in the same manner as described in the integrated plant assessment (IPA) in 10 CFR 54.21(a)(3). The reviewer reviews the applicant's AMP or aging management activities to verify that the effects of aging on the intended function(s) are adequately managed consistent with the CLB for the subsequent period of extended operation.

The applicant identifies the structures and components (SCs) associated with the TLAA. The TLAA is described with respect to the objectives of the analysis, conditions, assumptions used, acceptance criteria, relevant aging effects, and intended function(s). The reviewer uses the guidance in Section A.1 of this SRP-SLR to ensure that the effects of aging on the SC-intended function(s) are adequately managed for the subsequent period of extended operation.

4.7.3.2 Final Safety Analysis Report Supplement

The reviewer verifies that the applicant has provided information to be included in the Final Safety Analysis Report (FSAR) supplement that includes a summary description of the evaluation of each TLAA. Each such summary description is reviewed to verify that it is sufficiently comprehensive.

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

The applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments to be completed before the subsequent period of extended operation. The NRC staff expects to impose a condition on any subsequently renewed license to require the applicant to complete these activities no later than the committed date.

4.7.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of Section 4.7 and whether the NRC staff's evaluation supports conclusions of the following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be included in the Safety Evaluation Report:

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided an acceptable demonstration, pursuant to 10 CFR 54.21(c)(1), that, for the (name of specific) TLAA, [choose which is appropriate]

(i) The analyses remain valid for the subsequent period of extended operation,

(ii) The analyses have been projected to the end of the period of extended operation, or

(iii) The effects of aging on the intended function(s) will be adequately managed for the subsequent period of extended operation. The NRC staff also concludes that the FSAR supplement contains an appropriate summary description of this TLAA evaluation for the period of extended operation, as required by 10 CFR 54.21(d).

4.7.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method, the method described herein is used by the NRC staff in its evaluation of conformance with NRC regulations.

4.7.6 References

None

Table 4.7-1. Examples of Potential Plant-Specific TLAA Topics
BWRs
Re-flood thermal shock of the reactor pressure vessel
Re-flood thermal shock of the core shroud and other reactor vessel internals
Loss of preload for core plate rim hold-down bolts
Erosion of the main steam line flow restrictors
Susceptibility to irradiation-assisted stress corrosion cracking
PWRs
Reactor pressure vessel underclad cracking
Leak-before-break
Reactor coolant pump flywheel fatigue crack growth
Response to NRC Bulletin 88-11, “Pressurizer Surge Line Thermal Stratification”
Response to NRC Bulletin 88-08, “Thermal Stresses in Piping Connected to Reactor Cooling Systems”
BWRs and PWRs
Fatigue of cranes (crane cycle limits)
Fatigue of the spent fuel pool liner
Corrosion allowance calculations
Flaw growth due to stress corrosion cracking
Predicted lower limit
Grouted tendon prestress systems, structures, and components

5 TECHNICAL SPECIFICATIONS CHANGES

5.1 Review of Technical Specifications Changes and Additions Necessary to Manage the Effects of Aging During the Subsequent Period of Extended Operation

Review Responsibilities

Primary— Division of License Renewal (DLR) technical branch for reviewing applicable technical specifications (TS) requirements for relevance to specific aging management programs (AMPs) or time-limited aging analyses (TLAAs)

Secondary—DLR projects branch responsible for processing of the subsequent license renewal application (SLRA); supporting branches in Office of Nuclear Reactor Regulation, Division of Engineering (NRR/DE); Office of Nuclear Reactor Regulation, Division of Inspection and Regional Support (NRR/DIRS); Office of Nuclear Reactor Regulation, Division of Policy and Rulemaking (NRR/DPR); Office of Nuclear Reactor Regulation, Division of Operating Reactor Licensing (NRR/DORL) or Office of Nuclear Reactor Regulation, Division of Safety Systems (NRR/DSS)

5.1.1 Areas of Review

The requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 54.22 (Ref. 2) require an applicant to identify any new TSs or TS changes (i.e., amendments) that are needed to manage the effects of aging during the period of extended operations. This section of the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) provides guidance for determining whether plant TS changes need to be included in a plant-specific SLRA.

5.1.2 Acceptance Criteria

The TS for a relicensed light-water reactor facility may contain specific TS sections that may have relationships to AMPs or TLAAs that are identified in an SLRA. The following provide examples of (but are not limited to) TS requirements that may relate to AMPs or TLAAs:

- For TS that include administrative controls section provisions that establish preventative maintenance and periodic visual inspection requirements for plant systems located outside of containment [i.e., for applicant's whose SLRAs include periodic surveillance and preventative maintenance AMPs and whose current licensing basis (CLBs) include these types of TS requirements], the AMPs should establish the relationship of the TS requirements to the applicable program element criteria for their AMPs, as applicable.

- For TS that include administrative controls section provisions that establish fuel oil testing requirements for emergency diesel fuel storage tanks (i.e., for applicant's whose SLRAs include diesel fuel oil testing AMPs and with CLBs that include these types of TS requirements), the AMPs should establish the relationship of the TS requirements to the applicable program element criteria for their AMPs, as applicable.

- For TS that include pressure-temperature (P-T) limits for their reactor vessels and reactor coolant pressure boundary components in the limiting conditions of operations (LCOs) and control updates of these P-T limits through their 10 CFR 50.90 license amendment request process, the TS requirements may have direct bearing on how the P-T limit TLAAs for the SLRA are accepted in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii).

- For TS that include P-T limits for their reactor vessels and reactor coolant pressure boundary components in a pressure-temperature limit report (PTLR) and controls updates of the P-T limits and PTLR in accordance with a program and process controlled by the administrative controls section of their TS, the TS requirements may have direct bearing on how the P-T limit TLAAs for the SLRA are accepted in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii).

Acceptance criteria for plant-specific TS are contained in the specific TS provisions or alternatively in referenced documents invoked by the TS requirements. For those SLRAs for plants whose CLBs include TS requirements that relate to an AMP's program element bases for managing specific aging effects, the TS requirements should be reviewed to confirm that they remain adequate for managing the aging effects that are within the scope of the AMPs. Otherwise, the TS requirements should be amended accordingly as part of the SLRA in accordance with 10 CFR 54.22 and the changes in the TS requirement criteria factored into the program element bases for the AMP, as appropriate.

For those TS requirements that relate to TLAAs, the TS requirements and any methodologies or processes invoked by the TS requirements should be reviewed to see if they need to be amended or new TS requirements need to be proposed in order to demonstrate adequate compliance of the TLAAs in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii). Otherwise, TS changes that are determined as being necessary to disposition TLAAs in accordance with the requirements of 10 CFR 54.21(c)(1)(i), (ii), or (iii) should be included in the SLRA as part of TS change requests under 10 CFR 54.22. This may include TS changes that may be needed for P-T limit TLAAs controlled by PTLR processes, if it is determined that the current P-T limit methodologies approved and invoked by the current administrative controls TS requirements cannot generate P-T limits for the subsequent license renewal (SLR) period that will comply with the P-T limit requirements in 10 CFR Part 50, Appendix G (Ref. 1), and Appendix G of the ASME Code Section XI edition of record for the facility.

5.1.3 Review Procedures

The reviewer should review the applicant's operating license, including the TS that are included as part of the operating license, and procedures to ensure that the applicant has identified all appropriate TS changes or additions that may impact AMPs or TLAAs during the subsequent period of extended operation. If it is determined that new TS requirements, or new operating license conditions are needed to manage specific aging effects, or that changes to the existing TS requirements need to be amended in order to manage such aging effects, the reviewer determines that those license amendments are submitted with the SLRA for U.S. Nuclear Regulatory Commission (NRC) approval in accordance with the requirement in 10 CFR 54.22.

Examples of existing TS requirements that may be used to manage the effects of aging include but are not limited to: (a) preventative maintenance and periodic visual inspection requirements for plant systems located outside of containment, (b) diesel fuel oil monitoring requirements or surveillance requirements that are listed in the administrative controls sections of the TS, which may form the bases for fuel oil chemistry programs used to manage loss of material due to general, pitting, crevice, and microbiologically-induced corrosion in emergency diesel fuel oil system components, and (c) requirements in the TS that govern the applicant's updates to the P-T limits of their plants that constitute part of the mandatory bases for managing and analyzing loss of fracture toughness due to neutron irradiation embrittlement in ferritic steel components of the reactor vessel and reactor coolant pressure boundary. This latter example is a TLAA.

5.1.4 Evaluation Findings

The reviewer determines whether the applicant has provided sufficient information to satisfy the provisions of this section, and whether the NRC staff's evaluation supports one of the following three conclusions listed below that is to be included in the NRC staff's safety evaluation report, as applicable for the review of the SLRA:

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided an acceptable basis for concluding that the SLRA does not need to include any new TS requirements or TS amendments to manage the effects of aging during the SLR period.

> On the basis of its review, as discussed above, the NRC staff concludes that the applicant has provided a list of all new TS provisions or TS changes in the SLRA that are needed to manage the effects of aging during the SLR period, as required by 10 CFR 54.22. The NRC staff also concludes that these TS changes will be capable of managing the effects of aging in accordance the requirement in 10 CFR 54.21(a)(3).

> Pursuant to the requirement in 10 CFR 54.22, as discussed above, the NRC staff concludes that the applicant has provided those new TS provisions or TS changes in the SLRA needed to manage [INSERT APPLICABLE AGING EFFECT], as evaluated in [INSERT NAME of TLAA] for the SLR period. The NRC staff also concludes that these TS changes adequately demonstrate that the [INSERT NAME of TLAA and then INSERT one of the Following Statements to finish off this conclusion] . . .will remain valid for the SLR period, as required by 10 CFR 54.21(c)(1)(i)," has been adequately projected to the end of the SLR period, as required by 10 CFR 54.21(c)(1)(ii)," effects of [INSERT APPLICABLE AGING EFFECT AND MECHANISM] on the intended functions of the [INSERT APPLICABLE STRUCTURES OR COMPONENTS EVALUATED IN THE TLAA] during the SLR period, as required by 10 CFR 54.21(c)(1)(iii).

5.1.5 Implementation

The method described herein is used by the NRC staff to evaluate compliance with NRC regulation in 10 CFR 54.22, which requires the applicant to identify any new TS requirements or TS amendments that are necessary to manage the effects of aging during an SLR period.

5.1.6 References

1. 10 CFR Part 50, "Fracture Toughness Requirements." Appendix G. Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

2. 10 CFR 54.22, “Contents of Application–Technical Specifications.” Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

APPENDIX A

GENERAL NRC STAFF POSITIONS AND GUIDANCE

APPENDIX A—GENERAL NRC STAFF POSITIONS AND GUIDANCE

A.1 Aging Management Review—Generic (Branch Technical Position RLSB-1)

A.1.1 Background

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(a)(3), a license renewal application (LRA) is required to demonstrate that the effects of aging on structures and components (SCs) subject to an aging management review (AMR) are adequately managed so their intended functions will be maintained consistent with the current licensing basis (CLB) for the subsequent period of extended operation. The purpose of this Branch Technical Position (BTP) (RLSB-1) is to address the aging management demonstration that has not been addressed specifically in Chapters 3 and 4 of this Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR).

The subsequent license renewal (SLR) process is not intended to demonstrate absolute assurance that SCs will not fail, but rather that there is reasonable assurance that they will perform such that the intended functions are maintained consistent with the CLB during the subsequent period of extended operation.

There are generally four types of aging management programs (AMPs): (i) prevention, (ii) mitigation, (iii) condition monitoring, and (iv) performance monitoring.

Prevention Programs preclude the effects of aging. For example, coating programs prevent external corrosion of a tank.

Mitigation Programs attempt to slow the effects of aging. For example, water chemistry programs mitigate internal corrosion of piping.

Condition Monitoring Programs inspect for the presence and extent of aging effects or perform tests that monitor potential changes in a components or structure’s material condition. Examples of programs that involve inspections are the visual examination of concrete structures for cracking and the ultrasonic examination of pipe wall for flow-accelerated corrosion (FAC)-induced wall thinning. Examples of programs that involve material testing are reactor pressure vessel material surveillance capsule testing programs that monitor for embrittlement in ferritic reactor pressure vessel component’s and material testing programs that monitor for degradation in spent fuel pool neutron absorption materials.

Performance Monitoring Programs test the ability of a structure or component to perform its intended function(s). For example, the ability of the tubes on heat exchangers to transfer heat is tested.

More than one type of AMP may be implemented to ensure that aging effects are managed. For example, in managing internal corrosion of piping, a mitigation program (water chemistry) may be used to minimize susceptibility to corrosion. However, it may also be necessary to have a condition monitoring program (ultrasonic inspection) to verify that corrosion is indeed insignificant. In addition, some AMPs may incorporate more than one of the activities of prevention, mitigation, condition monitoring, or performance monitoring. For example, open cycle cooling water programs may incorporate combinations of inspection (condition monitoring) and flow testing (performance monitoring) activities.

A.1.2 Branch Technical Position

A.1.2.1 Applicable Aging Effects

1. The determination of applicable aging effects is based on degradation mechanisms that have occurred and those that potentially could cause SC degradation. The materials, environment, stresses, service conditions, operating experience, and other relevant information should be considered in identifying applicable aging effects. The effects of aging on the intended function(s) of SCs also should be considered.

2. Relevant aging information may be contained in, but is not limited to, the following documents: (i) plant-specific maintenance and inspection records; (ii) plant-specific site deviation or issue reports; (iii) plant-specific U.S. Nuclear Regulatory Commission (NRC) and Institute of Nuclear Power Operations (INPO) inspection reports; (iv) plant-specific licensee self-assessment reports; (v) plant-specific and other licensee event report (LERs); (vi) NRC, INPO, and vendor generic communications; and (vii) generic safety issues (GSIs)/unresolved safety issues (USIs); NUREG reports; and Electric Power Research Institute (EPRI) reports.

3. If operating experience or other information indicates that a certain aging effect may be applicable and an applicant determines that it is not applicable to its specific plant, the reviewer may question the absence of this aging effect if the applicant has not provided a sufficient basis in its subsequent license renewal application (SLRA). For example, the question could cite a previous application review, NRC generic communications, engineering judgment, relevant research information, or other industry experience as the basis for the question. Simply citing that the aging effect is listed in the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report is not a sufficient basis. For example, it may be that the aging effect is applicable to a pressurized water reactor (PWR) component, but the applicant's plant is a boiling water reactor (BWR) and does not have such a component. In this example, using the GALL-SLR Report merely as a checklist is not appropriate.

4. An aging effect may not have been identified in the GALL-SLR Report, if it arises out of industry experience after the issuance of the GALL-SLR Report. The reviewer should ensure that the applicant has evaluated the latest industry experience to identify all applicable aging effects.

5. An aging effect should be identified as applicable for SLR even if there is a prevention or mitigation program associated with that aging effect. For example, water chemistry, a coating, or use of cathodic protection could prevent or mitigate corrosion, but corrosion should be identified as applicable for SLR, and the AMR should consider the adequacy of the AMP referencing water chemistry, coating, or cathodic protection.

6. Specific identification of aging mechanisms is not a requirement; however, it is an option to identify specific aging mechanisms and the associated aging effects in the integrated plant assessment (IPA).

7. The applicable aging effects to be considered for SLR include those that could result from normal plant operation, including plant or system operating transients and plant shutdown. Specific aging effects from abnormal events need not be postulated for SLR. However, if an abnormal event has occurred at a particular plant, its contribution to the

aging effects on SCs for SLR should be considered for that plant. For example, if a resin intrusion has occurred in the reactor coolant system at a particular plant, the contribution of this resin intrusion event to aging should be considered for that plant.

Design basis events (DBEs) are abnormal events; they include design basis pipe break, loss of coolant accident (LOCA), and safe shutdown earthquake (SSE). Potential aging effects resulting from DBEs are addressed, as appropriate, as part of the plant's CLB. There are other abnormal events which should be considered on a case-by-case basis. For example, abuse due to human activity is an abnormal event; aging effects from such abuse need not be postulated for SLR. When a safety-significant piece of equipment is accidentally damaged by a licensee, the licensee is required to take immediate corrective action under existing procedures (see 10 CFR Part 50 Appendix B) to ensure functionality of the equipment. The equipment degradation is not due to aging; corrective action is not necessary solely for the subsequent period of extended operation. However, leakage from bolted connections should not be considered as abnormal events. Although bolted connections are not supposed to leak, experience shows that leaks do occur, and the leakage could cause corrosion. In addition, condensation frequently occurs during humid periods of normal plant operation and can also occur during plant shutdown when normally hot components might be below the dew point. The aging effects from leakage of bolted connections and condensation occurring during humid periods of normal plant operations should be evaluated for SLR. Condensation during plant shutdowns could result in aging effects such as reduced thermal insulation resistance due to moisture intrusion and should be evaluated for SLR. It is less likely that condensation during plant shutdowns would result in loss of material, unless plant-specific operating experience dictates otherwise (e.g., as a result of extended plant shutdowns).

An aging effect due to an abnormal event does not preclude that aging effect from occurring during normal operation for the subsequent period of extended operation. For example, a certain PWR licensee observed clad cracking in its pressurizer, and attributed that to an abnormal dry out of the pressurizer. Although dry out of a pressurizer is an abnormal event, the potential for clad cracking in the pressurizer during normal operation should be evaluated for SLR. This is because the pressurizer is subject to extensive thermal fluctuations and water level changes during plant operation, which may result in clad cracking given sufficient operating time. The abnormal dry out of the pressurizer at that certain plant may have merely accelerated the rate of the aging effect.

A.1.2.2 Aging Management Program for Subsequent License Renewal

1. An acceptable AMP should consist of the 10 elements described in Table A.1-1, as appropriate. These program elements are discussed further in Position A.1.2.3 below.

2. All programs and activities that are credited for managing a certain aging effect for a specific structure or component should be described. These programs and activities may be evaluated together for the 10 elements described in Table A.1-1, as appropriate.

3. The risk significance of a structure or component could be considered in evaluating the robustness of an AMP. Probabilistic arguments may be used to develop an approach for aging management adequacy. However, use of probabilistic arguments alone is not an acceptable basis for concluding that, for those SCs subject to an AMR, the effects of aging will be adequately managed in the subsequent period of extended operation. Thus, risk significance may be considered in developing the details of an AMP for the

structure or component for SLR, but may not be used to conclude that no AMP is necessary for SLR.

4. For programs that rely on NRC-endorsed technical or topical reports (TRs), the scope of the AMP includes the applicant's bases for resolving or addressing any NRC limitations or applicant/licensee action items that are placed on the activities for implementing a given report's methodology. These limitations or action items are identified in the NRC's safety evaluation on the TR's methodology and recommended activities. If it is determined that the response to a specific applicant action item will result in the need for augmentation of specific programmatic criteria beyond those activities recommended in the applicable TR, the applicant should define the AMP accordingly to identify the AMP program element or elements that are impacted by the basis for responding to the applicable action item and the adjustments that will need to be made to the TR guidance recommendations, as defined in the impacted program elements for the AMP and applicable to the CLB and design basis for the facility. It is also recommended that the applicants provide their bases for resolving the specific limitations or action items in Appendix C of their SLRAs.

A.1.2.3 Aging Management Program Elements

A.1.2.3.1 Scope of Program

The specific program necessary for SLR should be identified. The scope of the program should include the specific SCs, the aging of which the program manages.

A.1.2.3.2 Preventive Actions

1. The activities for prevention and mitigation programs should be described. These actions should mitigate or prevent aging degradation.

2. Some condition or performance monitoring programs do not rely on preventive actions and thus, this information need not be provided.

3. In some cases, condition or performance monitoring programs may also rely on preventive actions. The specific prevention activities should be specified.

A.1.2.3.3 Parameters Monitored or Inspected

1. This program element should identify the aging effects that the program manages and should provide a link between the parameter or parameters that will be monitored and how the monitoring of these parameters will ensure adequate aging management.

2. For a condition monitoring program, the parameter monitored or inspected should be capable of detecting the presence and extent of aging effects. Some examples are measurements of wall thickness and detection and sizing of cracks.

3. For a performance monitoring program, a link should be established between the degradation of the particular structure or component-intended function(s) and the parameter(s) being monitored. An example of linking the degradation of a passive component-intended function with the performance being monitored is linking the fouling of heat exchanger tubes with the heat transfer-intended function as identified by a

change in the differential temperature across the heat exchanger tubes. This could be monitored by periodic heat balances. Since this example deals only with one intended function of the tubes (heat transfer), additional programs may be necessary to manage other intended function(s) of the tubes, such as pressure boundary. Thus, a performance monitoring program must ensure that the SCs are capable of performing their intended functions by using a combination of performance monitoring and evaluation (if outside acceptable limits of acceptance criteria) that demonstrate that a change in performance characteristic is a result of an age-related degradation mechanism.

4. For prevention or mitigation programs, the parameters monitored should be the specific parameters being controlled to achieve prevention or mitigation of aging effects. An example is the coolant oxygen level that is being controlled in a water chemistry program to mitigate pipe cracking.

A.1.2.3.4 Detection of Aging Effects

1. Detection of aging effects should occur before there is a loss of the SC-intended function(s). The parameters to be monitored or inspected should be appropriate to ensure that the SC-intended function(s) will be adequately maintained for SLR under all CLB design conditions. Thus, the discussion for the "detection of aging effects" program element should address (a) how the program element would be capable of detecting or identifying the occurrence of age-related degradation or an aging effect prior to a loss of SC-intended function or (b) for preventive/mitigative programs, how the program would be capable of preventing or mitigating their occurrence prior to a loss of a SC-intended function. The discussion should provide information that links the parameters to be monitored or inspected to the aging effects being managed.

2. Nuclear power plants are licensed based on redundancy, diversity, and defense-in-depth principles. A degraded or failed component reduces the reliability of the system, challenges safety systems, and contributes to plant risk. Thus, the effects of aging on a structure or component should be managed to ensure its availability to perform its intended function(s) as designed when called upon. In this way, all system level-intended function(s), including redundancy, diversity, and defense-in-depth consistent with the plant's CLB, would be maintained for SLR. A program based solely on detecting structure and component failure should not be considered as an effective AMP for SLR.

3. This program element describes "when," "where," and "how" program data are collected (i.e., all aspects of activities to collect data as part of the program).

4. For condition monitoring programs, the method or technique (such as visual, volumetric, or surface inspection), frequency, and timing of new, one-time inspections may be linked to plant-specific or industry-wide operating experience. The discussion provides justification, including codes and standards referenced, that the technique and frequency are adequate to detect the aging effects before a loss of SC-intended function. A program based solely on detecting SC failures is not considered an effective AMP.

   For a condition monitoring program, when sampling is used to represent a larger population of SCs, applicants provide the basis for the inspection population and sample size. The inspection population should be based on such aspects of the SCs as a similarity of materials of construction, fabrication, procurement, design, installation, operating environment, or aging effects. The sample size should be based on such aspects of the SCs as the specific aging effect, location, existing technical information, system and structure design, materials of construction, service environment, or previous failure history. The samples are biased toward locations most susceptible to the specific aging effect of concern in the subsequent period of extended operation. Provisions on expanding the sample size when degradation is detected in the initial sample should also be included. For multiunit sites, samples are conducted at all units. Provisions for expanding the sample size when degradation is detected in the initial sample are included.

5. For a performance monitoring program, the "detection of aging effects" program element should discuss and establish the monitoring methods that will be used for performance monitoring. In addition, the "detection of aging effects" program element should also establish and justify the frequency that will be used to implement these performance monitoring activities.

6. For a prevention or mitigation program, the "detection of aging effects" program element should discuss and establish the monitoring methods that the program will use to monitor for the preventive or mitigative parameters that the program controls and should justify the frequency of performing these monitoring activities.

A.1.2.3.5 Monitoring and Trending

1. Monitoring and trending activities should be described, and they should provide a prediction of the extent of degradation and thus effect timely corrective or mitigative actions. Plant-specific and/or industrywide operating experience may be considered in evaluating the appropriateness of the technique and frequency.

2. This program element describes "how" the data collected are evaluated and may also include trending for a forward look. This includes an evaluation of the results against the acceptance criteria and a prediction regarding the rate of degradation in order to confirm that timing of the next scheduled inspection will occur before a loss of SC-intended function. Although aging indicators may be quantitative or qualitative, aging indicators should be quantified, to the extent possible, to allow trending. The parameter or indicator trended should be described. The methodology for analyzing the inspection or test results against the acceptance criteria should be described. Trending is a comparison of the current monitoring results with previous monitoring results in order to make predictions for the future.

A.1.2.3.6 Acceptance Criteria

1. The quantitative or qualitative acceptance criteria of the program and its basis should be described. The acceptance criteria, against which the need for corrective actions are evaluated, should ensure that the SC-intended function(s) are maintained consistent with all CLB design conditions during the subsequent period of extended operation. The program should include a methodology for analyzing the results against applicable acceptance criteria.

   For example, carbon steel pipe wall thinning may occur under certain conditions due to FAC. An AMP for FAC may consist of periodically measuring the pipe wall thickness and comparing that to a specific minimum wall acceptance criterion. Corrective action is taken, such as piping replacement, before deadweight, seismic, and other loads, and this acceptance criterion must be appropriate to ensure that the thinned piping would be able to carry these CLB design loads. This acceptance criterion should provide for timely corrective action before loss of intended function under these CLB design loads.

2. Acceptance criteria could be specific numerical values, or could consist of a discussion of the process for calculating specific numerical values of conditional acceptance criteria to ensure that the SC-intended function(s) will be maintained under all CLB design conditions. Information from available references may be cited.

3. It is not necessary to justify any acceptance criteria taken directly from the design basis information that is included in the Final Safety Analysis Report (FSAR), plant Technical Specifications (TS), or other codes and standards incorporated by reference into NRC regulations; they are a part of the CLB. Nor is it necessary to justify the acceptance criteria that have been established in either NRC-accepted or NRC-endorsed methodology, such as those that may be given in NRC-approved or NRC-endorsed topical reports or NRC-endorsed codes and standards; the acceptance criteria referenced in these types of documents have been subject to an NRC review process and have been approved or endorsed for their application to an NRC-approved or NRC-endorsed evaluation methodology. Also, it is not necessary to discuss CLB design loads if the acceptance criteria do not permit degradation because a SC without degradation should continue to function as originally designed. Acceptance criteria, which do permit degradation, are based on maintaining the intended function under all CLB design loads.

A.1.2.3.7 Corrective Actions

1. Actions to be taken when the acceptance criteria are not met should be described in appropriate detail or referenced to source documents. Corrective actions, including root cause determination and prevention of recurrence, should be timely.

2. If corrective actions permit analysis without repair or replacement, the analysis should ensure that the SC-intended function(s) are maintained consistent with the CLB.

3. Results that do not meet the acceptance criteria are addressed as conditions adverse to quality or significant conditions adverse to quality under those specific portions of the quality assurance (QA) program that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B. Appendix A.2 describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the corrective actions element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

4. For plant-specific programs that rely on NRC-endorsed Technical or TRs, the corrective actions are implemented in accordance with corrective actions recommended in the applicable TR or TRs, or the applicant's 10 CFR Part 50, Appendix B, QA process, as applicable.

A.1.2.3.8 Confirmation Process

1. The confirmation process should be described. The process ensures that appropriate corrective actions have been completed and are effective.

2. The confirmation process is addressed through those specific portions of the QA program that are used to meet Criterion XVI, “Corrective Action,” of 10 CFR Part 50, Appendix B. Appendix A.2 describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the confirmation process element of this AMP for both safety-related and nonsafety-related systems, structures, and components (SSCs) within the scope of this program.

3. When significant conditions adverse to quality are identified, there should be follow-up activities to confirm that the corrective actions have been completed, a root cause determination was performed, and recurrence will be prevented.

4. For plant-specific condition monitoring programs that rely on the augmented inspection and evaluation methodologies in NRC-endorsed Technical or TRs, the administrative controls for these types of programs, including their implementing procedures and review and approval processes, are implemented in accordance existing site 10 CFR 50 Appendix B, QA Programs, or their equivalent, as applicable. Additional administrative controls criteria may apply as identified in the TRs or in other industry reports or guidelines, such as those developed by (but not limited to) Nuclear Energy Institute (NEI), the EPRI Boiling Water Reactor Vessel and Internals Project (BWRVIP), EPRI Materials Reliability Program (MRP), BWR Owners Group, PWR Owners Group, or industry vendors, such as AREVA, Westinghouse, or General Electric (GE) or GE-Hitachi.

A.1.2.3.9 Administrative Controls

1. The administrative controls of the program should be described. Administrative controls provide a formal review and approval process.

2. Administrative controls are addressed through the QA program that is used to meet the requirements of 10 CFR Part 50, Appendix B, associated with managing the effects of aging (e.g., document control, special processes, and test control). Appendix A.2 describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the administrative controls element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

3. For plant-specific condition monitoring programs that rely on the augmented inspection and evaluation methodologies in NRC-endorsed Technical or TRs, the administrative controls for these types of programs, including their implementing procedures and review and approval processes, are implemented in accordance existing site 10 CFR 50 Appendix B, QA Programs, or their equivalent, as applicable. Additional administrative controls criteria may apply as identified in the TRs or in other industry reports or guidelines, such as those developed by (but not limited to) NEI, the EPRI BWRVIP, EPRI MRP, BWR Owners Group, PWR Owners Group, or industry vendors, such as AREVA, Westinghouse, or GE or GE-Hitachi.

A.1.2.3.10 Operating Experience

1. Consideration of future plant-specific and industry operating experience relating to AMPs should be discussed (See Appendix A.4). Reviews of operating experience by the applicant in the future may identify areas where AMPs should be enhanced or new programs developed. An applicant should commit to a future review of plant-specific

and industry operating experience to confirm the effectiveness of its AMPs or indicate a need to develop new AMPs. This information should provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the SC intended function(s) will be maintained during the subsequent period of extended operation.

2. Currently available operating experience with existing programs should be discussed. The discussion should note any changes to the programs during the first period of extended operation. The operating experience of existing programs, including past corrective actions resulting in program enhancements or additional programs, should be considered. A past failure would not necessarily invalidate an AMP because the feedback from 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 not been fully effective in intercepting aging degradation in a timely manner. This information should provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the SC-intended function(s) will be maintained during the subsequent period of extended operation.

3. Currently available operating experience applicable to new programs should also be discussed. For new AMPs that have yet to be implemented at an applicant's facility, the programs have not yet generated any operating experience. However, there may be other relevant plant-specific or generic industry operating experience that is relevant to the program elements, even though the operating experience was not identified through implementation of the new program. Thus, when developing the elements for new programs, an applicant should consider the impact of relevant operating experience from implementation of its existing AMPs and from generic industry operating experience.

4. For plant-specific condition monitoring programs that rely on the augmented inspection and evaluation methodologies in NRC-endorsed Technical or TRs, the administrative controls for these types of programs, including their implementing procedures and review and approval processes, are implemented in accordance with existing site 10 CFR 50 Appendix B, QA Programs, or their equivalent, as applicable. Additional administrative controls criteria may apply as identified in the TRs or in other industry reports or guidelines, such as those developed by (but not limited to) NEI, the EPRI BWRVIP, EPRI MRP, BWR Owners Group, PWR Owners Group, or industry vendors, such as AREVA, Westinghouse, or GE or GE-Hitachi.

A.1.3 References

NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54–The License Renewal Rule," Nuclear Energy Institute, Revision 6

Table A.1-1. Elements of an Aging Management Program for Subsequent License Renewal	
Element	**Description**
1. Scope of Program	Scope of program includes the specific SCs subject to an AMR for SLR.
2. Preventive Actions	Preventive actions should prevent or mitigate aging degradation.
3. Parameters Monitored or Inspected	Parameters monitored or inspected should be linked to the degradation of the particular SC-intended function(s).
4. Detection of Aging Effects	Detection of aging effects should occur before there is a loss of SC-intended function(s). This includes aspects such as method or technique (i.e., visual, volumetric, surface inspection), frequency, sample size, data collection, and timing of new/one-time inspections to ensure timely detection of aging effects.
5. Monitoring and Trending	Monitoring and trending should provide predictability of the extent of degradation, and timely corrective or mitigative actions.
6. Acceptance Criteria	Acceptance criteria, against which the need for corrective action will be evaluated, should ensure that the SC-intended function(s) are maintained under all CLB design conditions during the subsequent period of extended operation.
7. Corrective Actions	Corrective actions, including root cause determination and prevention of recurrence, should be timely.
8. Confirmation Process	Confirmation process should ensure that corrective actions have been completed and are effective.
9. Administrative Controls	Administrative controls should provide a formal review and approval process.
10. Operating Experience	Operating experience applicable to 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 managed adequately so that the SC-intended function(s) will be maintained during the subsequent period of extended operation. Operating experience with existing programs should be discussed In addition, the ongoing review of both plant-specific and industry operating experience ensures that the AMP is effective in managing the aging effects for which it is credited. The AMP is either enhanced or new AMPs are developed, as appropriate, when it is determined through the evaluation of operating experience that the effects of aging may not be adequately managed.

A.2 Quality Assurance for Aging Management Programs (Branch Technical Position IQMB-1)

A.2.1 Background

The subsequent license renewal application (SLRA) is required to demonstrate that the effects of aging on structures and components (SCs) subject to an aging management review (AMR) will be managed adequately to ensure that their intended functions are maintained consistent with the current licensing basis (CLB) of the facility for the subsequent period of extended operation. Therefore, those aspects of the AMR process that affect quality of safety-related systems, structures, and components (SSCs) are subject to the quality assurance (QA) requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 Appendix B. For nonsafety-related SCs subject to an AMR, the existing 10 CFR Part 50 Appendix B QA program may be used by the applicant to address the elements of corrective actions, the confirmation process, and administrative controls, as described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-SLR). The confirmation process ensures that appropriate corrective actions have been completed and are effective. Administrative controls should provide for a formal review and approval process. Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report describes how a subsequent license renewal (SLR) applicant can rely on the existing requirements in 10 CFR Part 50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to satisfy these program elements/attributes. The purpose of this branch technical position (IQMB-1) is to describe an acceptable process for implementing the corrective actions, the confirmation process, and administrative controls of aging management programs (AMPs) for SLR.

A.2.2 Branch Technical Position

1. Safety-related SCs are subject to 10 CFR Part 50 Appendix B requirements, which are adequate to address all quality-related aspects of an AMP consistent with the CLB of the facility for subsequent period of extended operation.

2. For nonsafety-related SCs that are subject to an AMR for SLR, an applicant has the option to expand the scope of its 10 CFR Part 50 Appendix B program to include these SCs and to address corrective actions, the confirmation process, and administrative controls for aging management during the subsequent period of extended operation. The reviewer verifies that the applicant has documented such a commitment in the Final Safety Analysis Report (FSAR) supplement in accordance with 10 CFR 54.21(d).

3. If an applicant chooses an alternative means to address corrective actions, the confirmation process, and administrative controls for managing aging of nonsafety-related SCs that are subject to an AMR for SLR, the applicant's proposal is reviewed on a case-by-case basis following the guidance in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-SLR).

A.2.3 References

None.

A.3 Generic Safety Issues Related to Aging (Branch Technical Position RLSB-2)

A.3.1 Background

Unresolved safety issues (USIs) and generic safety issues (GSIs) are identified and tracked in the U.S. Nuclear Regulatory Commission (NRC) formal resolution process set forth in NUREG–0933, "Resolution of Generic Safety Issues," which is updated periodically (Ref. 1). Appendix B to NUREG–0933 contains a listing of those issues that are applicable to operating and future plant. NUREG–0933 is a source of information on generic concerns identified by the NRC. Some of these concerns may be related to the effects of aging or time-limited aging analyses (TLAAs) for systems, structures, or components within the scope of the subsequent license renewal (SLR) review. The purpose of this Branch Technical Position (RLSB-2) is to address the SLR treatment of an aging effect or a TLAA which is a subject of an USI or a GSI [60 Federal Register (FR) 22484].

A.3.2 Branch Technical Position

A.3.2.1 Treatment of GSIs

The license renewal rule requires that aging effects be managed to ensure that the structures and components (SC) intended function(s) are maintained and that TLAAs are evaluated for SLR. Thus, all applicable aging effects of SCs subject to an aging management review (AMR) and all TLAAs must be evaluated, regardless of whether they are associated with GSIs or USIs. The agency's Generic Issues Program process for resolving GSIs is described in Management Directive 6.4, "Generic Issues Program," dated November 17, 2009, and SECY-07-0022, "Status Report on Proposed Improvements to the Generic Issues Program."

A.4 Operating Experience for Aging Management Programs

A.4.1 Background

Operating experience is a crucial element of an effective aging management program (AMP). It provides the basis to support all other elements of the AMP and, as a continuous feedback mechanism, drives changes to these elements to ensure the overall effectiveness of the AMP. Operating experience should provide objective evidence to support the conclusion that the effects of aging are managed adequately so that the structures and components (SC)-intended function(s) will be maintained during the subsequent period of extended operation. Under their current operating licenses, subsequent license renewal (SLR) applicants are required to implement programs for the ongoing review of operating experience, such as those established in accordance with Item I.C.5, “Procedures for Feedback of Operating Experience to Plant Staff,” of NUREG–0737, “Clarification of TMI Action Plan Requirements” (Ref. 3).

A.4.2 Position

The systematic review of plant-specific and industry operating experience concerning aging management and age-related degradation ensures that the SLR AMPs are, and will continue to be, effective in managing the aging effects for which they are credited. The AMPs should either be enhanced or new AMPs developed, as appropriate, when it is determined through the evaluation of operating experience that the effects of aging may not be adequately managed. AMPs should be informed by the review of operating experience on an ongoing basis, regardless of the AMP’s implementation schedule.

Acceptable Use of Existing Programs

Programs and procedures relied upon to meet the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix B (Ref. 1) and NUREG–0737 (Ref. 3), Item I.C.5, may be used for the capture, processing, and evaluation of operating experience concerning age-related degradation and aging management during the term of a renewed operating license. As part of meeting the requirements of NUREG–0737, Item I.C.5, the applicant should actively participate in the Institute of Nuclear Power Operations’ operating experience program [formerly the Significant Event Evaluation and Information Network (SEEIN) program endorsed in U.S. Nuclear Regulatory Commission (NRC) Generic Letter (GL) 82-04, “Use of INPO SEEIN Program”] (Ref. 2). These programs and procedures may also be used for the translation of recommendations from the operating experience evaluations into plant actions (e.g., enhancement of AMPs and development of new AMPs). While these programs and procedures establish a majority of the functions necessary for the ongoing review of operating experience, they are also subject to further review as discussed below.

Areas of Further Review

To ensure that the programmatic activities for the ongoing review of operating experience are adequate for SLR, the following points should be addressed:

- The programs and procedures relied upon to meet the requirements of 10 CFR Part 50, Appendix B, and NUREG–0737, Item I.C.5, explicitly apply to and otherwise would not preclude the consideration of operating experience on age-related degradation and aging management. Such operating experience can constitute information on the SCs identified in the integrated plant assessment; their materials, environments, aging effects, and aging mechanisms; the AMPs credited for managing the effects of aging; and the activities, criteria, and evaluations integral to the elements of the AMPs. To satisfy this criterion, the applicant should use the option described in A.2.2.2 of Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Appendix A.2, "Quality Assurance for Aging Management Programs (Branch Technical Position IQMB-1)," to expand the scope of its 10 CFR Part 50, Appendix B, program to include nonsafety-related SCs.

- The license renewal interim staff guidance (LR-ISG) documents and revisions to the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report should be considered as sources of industry operating experience and evaluated accordingly. There should be a process to identify such documents and process them as operating experience.

- All incoming plant-specific and industry operating experience should be screened to determine whether it may involve age-related degradation or impacts to aging management activities.

- A means should be established within the corrective action program to identify, track, and trend operating experience that specifically involves age-related degradation. There should also be a process to identify adverse trends and to enter them into the corrective action program for evaluation.

- Operating experience items identified as potentially involving aging should receive further evaluation. This evaluation should specifically take into account the following: (a) systems, structures, and components (SSCs), (b) materials, (c) environments, (d) aging effects, (e) aging mechanisms, (f) AMPs, and (g) the activities, criteria, and evaluations integral to the elements of the AMPs. The assessment of this information should be recorded with the operating experience evaluation. If it is found through evaluation that any effects of aging may not be adequately managed, then a corrective action should be entered into the 10 CFR Part 50, Appendix B, program to either enhance the AMPs or develop and implement new AMPs.

- Assessments should be conducted on the effectiveness of the AMPs and activities. These assessments should be conducted on a periodic basis that is not to exceed once every five years. They should be conducted regardless of whether the acceptance criteria of the particular AMPs have been met. The assessments should also include evaluation of the AMP or activity against the latest NRC and industry guidance documents and standards that are relevant to the particular program or activity. If there is an indication that the effects of aging are not being adequately managed, then a corrective action is entered into the 10 CFR Part 50, Appendix B, program to either enhance the AMPs or develop and implement new AMPs, as appropriate.

- Training on age-related degradation and aging management should be provided to those personnel responsible for implementing the AMPs and those personnel who may submit, screen, assign, evaluate, or otherwise process plant-specific and industry operating experience. The scope of training should be linked to the responsibilities for processing operating experience. This training should occur on a periodic basis and include provisions to accommodate the turnover of plant personnel.

- Guidelines should be established for reporting plant-specific operating experience on age-related degradation and aging management to the industry. This reporting should be accomplished through participation in the Institute of Nuclear Power Operations' operating experience program.
- Any enhancements necessary to fulfill the above criteria should be put in place no later than the date the renewed operating license is issued and implemented on an ongoing basis throughout the term of the renewed license.

The programmatic activities for the ongoing review of plant-specific and industry experience concerning age-related degradation and aging management should be described in the subsequent license renewal application (SLRA), including the Final Safety Analysis Report (FSAR) supplement. Alternate approaches for the future consideration of operating experience are subject to NRC review on a case-by-case basis.

A.4.3 References

1. 10 CFR Part 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants*, Office of the Federal Register, National Archives and Records Administration, 2015.
2. Generic Letter 82-04, “Use of INPO SEE-IN Program.” March 9, 1982. U.S. Nuclear Regulatory Commission.
3. NUREG–0737, “Clarification of TMI Action Plan Requirements,” U.S. Nuclear Regulatory Commission.
4. NUREG–1801, “Generic Aging Lessons Learned (GALL) Report,” U.S. Nuclear Regulatory Commission.

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10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

The Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) provides guidance to U.S. Nuclear Regulatory Commission staff reviewers in the Office of Nuclear Reactor Regulation. These reviewers will perform safety reviews of applications to renew nuclear power plant licenses for operation from 60 to 80 years in accordance with Title 10 of the Code of Federal Regulations, Part 54. The principal purposes of the SRP-SLR are to ensure the quality and uniformity of staff reviews and to present a well-defined base from which to evaluate applicant programs and activities for the subsequent period of extended operation. The SRP-SLR also is intended to make regulatory information widely available to enhance communication with interested members of the public and the nuclear power industry and to improve public and industry understanding of the staff review process. The safety review is based primarily on the information provided by the applicant in a subsequent license renewal application. Each of the individual SRP-SLR sections addresses (a) who performs the review, (b) the areas that are reviewed, (c) the methods for determining whether the applicant has met the requirements of 10 CFR 54.21, (d) the review procedures, and (e) the conclusions that are drawn.

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